



The Relationship Between Mindfulness and Anxiety in Uyghur High School Students: The Mediating Role of Rumination

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Abstract

Background: Anxiety is an important health issue for many high school students. Studies have demonstrated that the level of mindfulness and rumination are important factors influencing anxiety in high school students. This study explored the relationship between mindfulness and anxiety and the mediating role of rumination in Xinjiang Uyghur High School students.

Methods: The levels of mindfulness, rumination and anxiety were assessed by using the Mindful Attention Awareness Scale (MAAS), State-Trait Anxiety Inventory (STAI) and Ruminative Responses Scale (RRS), respectively, in 650 students from Xinjiang Uyghur Middle school in Yecheng County, Kashi, Xinjiang.

Results: There was a significant negative correlation between mindfulness and anxiety ($r = -0.57$, $P < 0.01$), or rumination ($r = -0.53$, $P < 0.01$), and a significant positive correlation between rumination and anxiety ($r = 0.60$, $P < 0.01$). In addition, rumination mediated between mindfulness and anxiety, with a 39.66% mediation effect.

Conclusion: Our findings suggest that there is a close interrelationship between mindfulness, anxiety and rumination among Uyghur High School students, and that rumination may play a mediating role between mindfulness and anxiety.

Keywords: Anxiety; Mindfulness; Rumination; Intermediary role

Introduction

Anxiety is a subjective emotional experience of tension, uneasiness, and reluctance to give up when an individual is faced with an anticipated event that he or she can freely choose but cannot grasp. According to the persistence and stability characteristics of anxiety [1], state anxiety is a state of temporary fluctuating anxiety, a conscious emotion of apprehension and tension about the situation at the time, which is capable of arousing the autonomic nervous system. It is a complex, individually characterized emotional state or response whose intensity and volatility vary over time. Trait anxiety is a relatively persistent personality trait characterized by a stable tendency to perceive external stimuli as dangerous or threatening [2]. It also shows the intensity of an individual's underlying tendency to respond to certain types of reactions. There are many factors that make high school students anxious [3]. High school students are under tremendous pressure to pass college entrance exams, have unpromising self-identity and interpersonal support issues, and have high parental expectations, making anxiety an important health issue for many high school students [4-6]. High school students with high levels of anxiety usually have difficulty sleeping at night, feel depressed during the day, and are unable to concentrate on their studies, which seriously affects their lives [7]. Previous studies have shown that anxiety is more prominent in adolescents and that there is a significant correlation between mindfulness, rumination and anxiety [8,9]. A survey on the levels of state and trait anxiety among adolescents in a changing society in Kirikkale city in Turkey showed that the state and trait anxiety scores were 40.24 ± 1.73 , and 44.68 ± 9.59 , respectively [10]. A previous study of depression and anxiety found that rumination was indeed a cross-diagnostic factor for mood disorders. Rumination accounted for a large proportion of the overlap between depression and anxiety disorders in adolescents and adults [11]. Duan's study showed that the main

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factor affecting negative emotions such as anxiety in high school students was life events [12]. In addition, Wang et al. also found a significant positive correlation between rumination and anxiety [13]. Therefore, there is a growing concern about how to reduce anxiety and other related problems among high school students. Some studies have demonstrated that the level of mindfulness and rumination are important factors that influence anxiety in high school students [8,14]. Mindfulness refers to purposeful and conscious attention and awareness of the present moment without judgment, analysis, or reaction, but simply being aware of it and paying attention to it [15]. Shapiro proposed a three-axis model of mindfulness [16], which explains mindfulness in terms of attention, attitude, and purpose, and suggests that "re-perception" is a fundamental factor in transforming thought. Mindfulness enables us to put both our dissatisfaction with the past and our confusion about the future in the unimportant place of our own thoughts. It enlivens our thoughts, provides us with a third option for discovering solutions to our problems, and through this option gives us access to internal and external forces of which we are not aware [9]. This power gives us the opportunity to live, learn and grow again. Numerous studies have shown that mindfulness promotes and improves physical and mental health by regulating emotions, thus reducing anxiety in students [17]. Studies have found that mindfulness are positively associated with positive feelings such as life satisfaction [18], self-esteem levels, subjective well-being, and subjective quality of life levels [19,20], and negatively associated with negative feelings such as anxiety levels and difficulties in emotion regulation among high school students. Researchers have also actively conducted studies on mindfulness in Chinese adolescents, and a study by Zhou showed that adolescents' levels of mindfulness were negatively associated with their psychological problems, such as negative feelings like anxiety and depression, but positively associated with levels of psychological well-being [21]. There are also many studies that have explored whether mindfulness is related to rumination [3], and whether the relationship between mindfulness and trait and state anxiety is influenced by rumination [14]. However, no studies have explored this issue among Uyghur High School students and how rumination plays a role in anxiety relief by mindfulness.

In recent years, a growing number of studies have shown that higher levels of mindfulness are associated with lower level of anxiety [8,14,22,23]. For example, higher levels of mindfulness are significantly associated with lower levels of state anxiety [24] and trait anxiety [25]. The beneficial effects of mindfulness in mitigating the negative effects of trait anxiety on the health of medical students are evident at times of high stress and when self-regulation is most needed [26]. These studies suggest that mindfulness may be an important factor influencing state anxiety and trait anxiety in high school students. On the other hand, rumination was positively correlated with anxiety levels, i.e., the more the rumination, the higher the level of anxiety, and the less the rumination, the lower the level of anxiety. These results are consistent with Ripperer's claim [27] that rumination is often accompanied by anxiety and depression as a cognitive function, and also with Sun's claim [28] that rumination can exacerbate or prolong negative mood or anxiety symptoms [19], suggesting that rumination in high school students is significantly associated with social anxiety and has a significant effect on their developmental changes.

In this study, we constructed a relational model of the relationship between mindfulness as the independent variable, anxiety as the

dependent variable, and rumination as the mediating variable. We expected our findings to provide support for the mediating role of rumination in this relational model and to provide a theoretical basis for relieving anxiety among Uyghur High School students. Based on the existing studies, we proposed the following hypotheses. 1) There would be a significant negative correlation between the level of mindfulness and rumination in high school students, leading to lower anxiety levels. 2) Rumination would be a trigger for high school students' anxiety. 3) The level of mindfulness is negatively correlated with anxiety levels, while rumination plays a mediating role between the two.

Methods

Participants

We adopted a random whole-group sampling method to randomly select three high schools in Yecheng County, Kashgar Region, Xinjiang, from which 650 students were randomly selected for questionnaire survey. A total of 561 valid questionnaires were collected, with an effective rate of 86.37%. The ages of the participants ranged from 16 to 19 years old, among which 209 (37.3%) were male students and 352 (62.7%) were female students. 259 (46.2%) were second-year high school students and 302 (53.8%) were third-year students.

Measurement methods

Questionnaires were distributed to the students in the classrooms. Before administering the survey, the research staff explained to the students the purpose of the survey, how to answer the questions, the principle of confidentiality, the free choice of whether to withdraw from the survey, and other administrative principles. Students were asked to complete the survey consecutively, and all questionnaires were collected on the spot.

Mindful attention awareness scale (MAAS): This scale was originally developed by Brown and Warren [29], and is currently considered to be a valid tool for assessing the levels of mindfulness. It addresses the emotional, cognitive and physiological states of individuals in their lives. We used the Chinese version of the MAAS to assess individual differences in the frequency of attention and awareness of present moment experiences. The scale has been tested for reliability and validity in a Chinese population [30]. The scale has one dimension and consists of 15 questions, each rated on a 6-point scale from 1= almost always to 6= almost never, with higher scores reflecting higher levels of positive consciousness. The internal consistency coefficient for this scale was 0.816. The alpha coefficient for this questionnaire was 0.846.

State-trait anxiety inventory (STAI): The Chinese version of the STAI developed by Li and Qian was used in this study. The STAI contains two subscales. One is state anxiety (10 questions testing negative emotions and 10 questions testing positive emotions), and the other is trait anxiety (11 questions testing negative emotions and 9 questions testing positive emotions). Each item is scored using a 4-score scale from 1 (not at all) to 4 (almost always). Positive emotion questions require reverse scoring, with higher scores indicating higher levels of anxiety. The internal consistency coefficients for the STAI total, state anxiety, and trait anxiety scale scores were 0.9, 0.91, and 0.84, respectively.

Ruminative responses scale (RRS): This scale was originally developed by Nolen-Hoeksema in 1991 [31] and describes concerns about individuals' depressive symptoms. A Chinese version of the

RRS, developed by Han and Yang [32] was used in this study. The scale has 22 items divided into three dimensions: Symptom rumination, brooding, and reflection. Each item is rated on a 4-point scale from 1 (not at all) to 4 (almost always), with higher scores reflecting higher levels of rumination. The internal consistency coefficient of the scale was 0.91, and the internal consistency reliability of the three dimensions was 0.88, 0.78, and 0.76, respectively.

Statistical analysis

The SPSS 22.0 program was used to analyze the data. Descriptive statistics were used to perform descriptive analyses of mindfulness, rumination, and anxiety. Differences in mindfulness, anxiety, and rumination among high school students in different grades were investigated using t-tests and ANOVA.

We used AMOS22.0 to test the mediating effect of rumination between mindfulness and anxiety. According to the mediation effect test procedure proposed by Wen et al. [33], we conducted a mediation effect test with mindfulness as the independent variable, anxiety as the dependent variable, and rumination as the mediating variable. Rumination was defined as the observed variable, and mindfulness and anxiety were defined as indicator variables, and the model fit index tests and standardized path coefficients were measured.

Results

Descriptive statistics of mindfulness, anxiety, and sleep quality

Descriptive statistical analysis was performed for each variable, and the results are shown in Table 1. The mean score for mindfulness was 62.98 ± 18.07 . The mean score for rumination was 43.75 ± 12.94 . The mean score for anxiety was 89.43 ± 16.17 . The mean score for state anxiety was 44.4 ± 8.85 . The mean score for trait anxiety was 45.03 ± 7.94 .

In terms of skewness, the skewness of mindfulness, rumination, anxiety, state and trait anxiety were all between -0.5 and 0.5, indicating that the data were relatively normally distributed. In terms of kurtosis, the data for each variable exhibited relatively flat kurtosis.

Correlations between mindfulness and anxiety and rumination

As shown in Table 2, correlation analysis revealed a significant negative correlation between mindfulness and anxiety ($r = -0.57$,

$p < 0.01$) or state ($r = -0.56$, $p < 0.01$) and trait anxiety ($r = -0.53$, $p < 0.01$). Moreover, there was a significant negative correlation between mindfulness and rumination ($r = -0.53$, $p < 0.01$). Rumination was significantly and positively correlated with anxiety ($r = -0.53$, $p < 0.01$), or state ($r = 0.97$, $p < 0.01$) and trait anxiety ($r = 0.96$, $p < 0.01$).

Path analysis of mindfulness and rumination on anxiety

The above correlation analysis provided the necessary statistical basis for further research on the predictive effects of mindfulness and rumination on anxiety. A Structural Equation Model (SEM) was used for path analysis to examine the predictive effect of mindfulness on anxiety and its plausibility. We used mindfulness as the independent variable, anxiety as the dependent variable, and rumination as the mediating variable. The anxiety entries were divided into two dimensions, namely state anxiety and trait anxiety. In this way, a model was constructed as shown in Figure 1.

The results of the mediation model fitting indicators (Table 3) showed that the Estimated Root Mean Square (RMSEA value) of error was 0.05, which was less than 0.08, indicating a reasonable fitness. The Goodness of Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Comparative Fit Index (CFI), and Bentler-Bonett canonical Fit Index (NFI) were all greater than 0.90, indicating that the constructed model was acceptable and that the model fitness was good for mediating effects analysis.

From the results of the standardized path coefficients (Table 4), there was a significant negative correlation between mindfulness and anxiety, a significant negative correlation between mindfulness and rumination, and a significant positive correlation between rumination and anxiety (all $P < 0.001$). Intermediate model analysis revealed a total effect $c = -0.58$, a direct effect $c' = -0.35$, and an indirect effect $a*b = -0.23$. The signs of $a*b$ and c' were the same, indicating a partial mediating effect. Thus, the indirect effect accounted for $a*b/c' * 100\%$ of the total effect = 39.66%. These results suggested that rumination partially mediated the mindfulness-to-anxiety pathway, with a mediating effect of 39.66%.

Discussion

This study analyzed mindfulness based on the three-axis model of mindfulness (IAA model) proposed by Shapiro. The IAA model consists of three components: Attitude, attention, and purpose. Of these three components, attention is central to achieve a change in the

Table 1: Descriptive statistics of the variables (N=561).

Dimension	Minimum	Maximum	Mean	SD	Skewness	Kurtosis
Mindfulness	15	90.00	62.98	18.07	-0.33	-0.50
Anxiety	44	139.00	89.43	16.17	-0.41	-0.10
Rumination	22	88.00	43.75	12.94	0.32	0.00
State anxiety	21	71.00	44.4	8.85	-0.37	-0.17
Trait anxiety	23	71.00	45.03	7.94	-0.37	0.19

Table 2: Correlation analysis of each variable.

Variable	Mean \pm SD	Mindfulness	Anxiety	Rumination	State anxiety	Trait anxiety
Mindfulness	62.98 \pm 18.07	1				
Anxiety	89.43 \pm 16.17	-0.57**	1			
Rumination	43.75 \pm 12.94	-0.53**	0.60**	1		
State anxiety	44.40 \pm 8.85	-0.56**	0.97**	0.61**	1	
Trait anxiety	45.03 \pm 7.94	-0.53**	0.96**	0.55**	0.85**	1

Notes: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

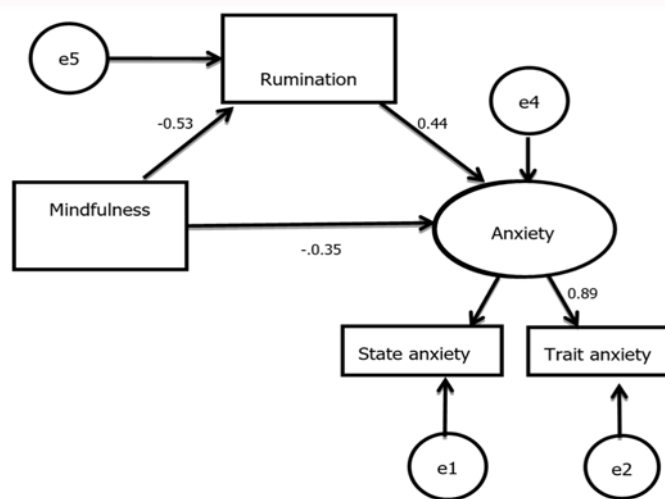


Figure 1: A model of the mediating effect of rumination in mindfulness and anxiety.

Table 3: Model fitting index.

Statistical volume	X ² degrees of freedom ratio	P-value	RMSEA	GFI	AGFI	CFI	NFI	TLI	IFI
Threshold value	<3.00	>0.05	<0.08	>0.90	>0.90	>0.90	>0.90	>0.90	>0.90
Value	1.75	0.19	0.03	1.00	0.98	1.00	1.00	1.00	1.00

Table 4: Standardized path coefficients.

Path	Estimate	Standardized Estimate	S.E.	C.R.	P-value
Rumination <---Mindfulness	-0.38	-0.53	0.03	-14.8	***
Anxiety <---Rumination	0.24	0.44	0.02	11.12	***
Anxiety <---Mindfulness	-0.01	-0.35	0.02	-9.02	***

direction of thinking through mindfulness training, and providing criteria for evaluating the effectiveness of mindfulness through an open and inclusive attitude, without making any value judgments. This process produces "re-perception", which is fundamental to the shift in thinking and emphasizes the ability to reduce the control of immediate emotions over the individual and reduce the automatic response patterns of negative emotions [34]. The mediating effects between mindfulness and anxiety was examined through a mediating effect testing process [41], focusing on the mediating role of rumination.

In this study, we used a larger sample size to explore the relationship between mindfulness, rumination, and anxiety. We found that up to 89.34% of high school students had anxiety problems that affected their learning and life. Previous studies have found anxiety detection rates among adolescents ranging from 34.1% to 63.4%, while the anxiety detection rate in our study was somewhat higher than that in previous studies. This difference may be mainly due to the different measurement instruments used, the different national contexts of the two countries, and the different academic and social pressures faced at the high school level. Previous studies have demonstrated a significant correlation between depression and anxiety in a gender-specific context [35], whereas our study demonstrated a significant relationship between rumination and anxiety in a gender-neutral context. Cognitive distortions associated with anxiety can lead to psychological disorders and problems [36], while anxiety-induced discomfort in biological functioning [21] can lead to more persistent health problems, such as chronic illnesses and even early death

[37]. Nearly three-quarters of the students in this study had varying degrees of state or trait anxiety problems, indicating that anxiety problems among the Uyghur High School students in Kashgar region of Xinjiang are already worthy of concern. Our findings provide some preliminary evidence for decreasing anxiety by increasing the level of mindfulness and reducing rumination, which has important implications for high school students facing high levels of pressure to advance to higher education.

Characteristics of mindfulness, anxiety and rumination among Uyghur High School students

We found that the mean score of mindfulness level of Uyghur High School students was 62.98 ± 18.07 , which was moderate and consistent with a previous study [21]. Such findings suggest that Uyghur High School students have a high level of concern and perception of the present moment. The mean score for overall anxiety was 89.43 ± 16.17 , and the mean scores for state anxiety and trait anxiety were 44.40 ± 8.85 and 45.03 ± 7.94 separately, which is consistent with Xu's study [5]. Moreover, their mean score for rumination was 43.75 ± 12.94 , which was slightly lower compared to Sun's study. The reason for this discrepancy may be that Uyghur High School students are influenced by their ethnic character of being able to sing and dance, and therefore have a lower overall level of rumination. The difference in mindfulness levels between Uyghur sophomore and senior was not significant, which is consistent with the study of Ji et al. [38], but not with that Ai's study [4]. The reason for this discrepancy may be that Ai studied the difference between freshmen and sophomores, while the present study was the difference between sophomores and

seniors, probably because freshman students have just entered high school and are in the transition stage between junior and senior high school, and are unfamiliar with everything in high school, including new knowledge, new learning style, new environment, new teachers and new friends. However, in the vast majority of our high schools, sophomores have already received what seniors are learning, and senior year is a pure review year. Therefore, for sophomores, it is like a change of scenery and the pressure of the entrance exams increases steeply, and the sense of urgency grows with each passing day. In China, sophomores and seniors face similar pressure to study and take exams. As a result, there is a difference in the level of mindfulness between sophomores and freshmen, but not much difference between sophomores and seniors. Similarly, the difference in anxiety levels between sophomores and seniors was not significant, which is consistent with Liu et al. findings on adolescents [39]. In addition, the difference in rumination between sophomores and seniors was also not significant ($t=0.41$, $p>0.05$), which is consistent with the findings of Shen et al. on high school students [40].

The relationship between mindfulness and anxiety

Mindfulness is an awareness that arises through concentration, without evaluation or criticism in the present moment, which is a constant state of objective alertness to our thoughts, emotions and circumstances [41]. The most important characteristic of mindfulness is to accept and observe our thoughts and feelings without judging them as right or wrong. Previous studies have demonstrated a significant negative correlation between mindfulness and anxiety [42]. The present study also found differences in anxiety levels among students with different levels of mindfulness and a significant negative correlation between mindfulness and both state and trait anxiety, i.e., the higher the mindfulness level, the lower the state and trait anxiety, and the lower the overall anxiety level. This is consistent with the findings of several studies [5,22], but previous studies have examined only trait anxiety. There are few domestic studies on the regulation of state and trait anxiety by mindfulness in high school students. Zhang et al. found that mindfulness training significantly increased the level of mindfulness and decreased the level of state and trait anxiety in junior high school students [17]. A study of sophomore students at the University of Bologna Medical School suggest that mindfulness plays a beneficial role in reducing the negative effects of trait anxiety, by acting as an important self-regulatory resource in times of high stress, by providing awareness and non-judgmental acceptance of their internal experiences [26]. Liu's study also demonstrated a negative correlation between mindfulness and anxiety, showing that the seniors' mindfulness level significantly and negatively predicted their math and English learning anxiety [6]. In other words, the higher the level of students' mindfulness, the lower the level of math and English learning anxiety.

The mediating role of rumination

A path analysis of the mediating role of rumination between mindfulness and anxiety showed a significant negative correlation between mindfulness and anxiety, a significant negative correlation between mindfulness and rumination, and a significant positive correlation between rumination and anxiety. This suggests a partial mediating effect of rumination between mindfulness and anxiety (indirect effect $a*b = -0.23$, so the indirect effect accounted for $a*b/c*100%$ of the total effect = 39.66%). The Bootstrap method was used to test the significance of the total, mediated, and direct effects between mindfulness, rumination, and anxiety, further confirming

the partial mediating effect of rumination between mindfulness and anxiety. The amount of the mediating effect accounted for 34% of the total effect.

The effect of mindfulness on anxiety could be partially explained by rumination, a result that is consistent with the findings of previous studies [8,14,43]. That is, mindfulness negatively predicted rumination, while high rumination predicted severe anxiety. The significant negative correlation between mindfulness and rumination is consistent with the findings of Zhou et al., showing that the levels of mindfulness of high school students were significant negative predictors of all dimensions of rumination [21]. Studies have shown that mindfulness is associated not only with changes in perception, improved attention and memory, but also with mood states and emotion regulation [44]. Bogusch et al. found that higher levels of mindfulness were associated with better sleep quality by reducing levels of anxiety and depressive symptoms [45]. Another study found that a reduction in rumination after mindfulness training promoted a reduction in depressive and anxiety symptoms [46]. High school students with high levels of positive thinking are able to refrain their judgments and reactions to stimuli, which enable them to address the negative effects of previously inherited emotional response patterns, reduce anxiety, and improve emotional state. This helps the students to improve their academic performance, as well as their sense of well-being and satisfaction with life. It is possible that this may be the mechanism of action for positive thinking in our study.

Rumination was positively correlated with anxiety levels, i.e., the more rumination, the high the anxiety level, which is consistent with previous study [28]. Individuals who fall into rumination often use negative cognitive styles, often face difficulties and stress with one-sided, negative emotions, and constantly amplify negative emotions, when they tend to be unconfident at this time, resulting in social anxiety. Our findings are consistent with previous studies that rumination has a significant positive correlation with anxiety. There are few national and international studies on rumination and state anxiety and trait anxiety, and only a few similar studies suggest that rumination is an important cause of state anxiety and trait anxiety. A study from the University of Turin explored the association between negative emotions and state and trait anxiety and found that negative emotions had a positive and significant effect on state and trait anxiety, albeit mediated by alexithymia [47], with rumination being a typical factor contributing to negative emotions.

The relationship between mindfulness and anxiety was partially mediated by rumination, which is consistent with a previous study. In a study of 1,151 adults with hospital anxiety and depression, mindfulness had both direct and indirect effects on anxiety, while rumination was second only to worry in mediating the effects. Another study examined the mediating role of rumination and acceptance between mindfulness and internalizing symptoms (generalized anxiety and depression) in Chinese adolescents, with a random selection of 1,554 middle and high school students in two cities in southern China, 71.8% of whom were high school students. The results demonstrated that mindfulness was significantly and negatively associated with internalizing symptoms and rumination in adolescents, and overall, the mediating role of rumination was significantly greater than that of acceptance in this process [8]. The findings of Yu and McKim's study were also similar to our study [14,43]. Previous studies have found a significant negative association between mindfulness and adolescents' rumination, and a mediating

pathway between mindfulness awareness and reduced rumination in a heterogeneous community sample. The present study contributes to a deeper understanding of how mindfulness interacts with anxiety through rumination - the mediating role of rumination.

Limitations

This study was conducted with as much research rigor as possible, but there are several shortcomings that we hope to improve in subsequent studies. Second, only high school sophomores and juniors in Yecheng County, Kashgar region, Xinjiang were selected, which may not be universally representative. Future studies can expand the selection of the sample. Third, this is a cross-sectional study, while collecting data on the main study variables simultaneously. Although the results of the data analysis were able to confirm the study hypothesis, they could not prove the existence of a causal relationship between the variables. In the future, a combination of cross-sectional and longitudinal studies, as well as a simultaneous pre- and post-test design of mindfulness training could be used to further explore the mechanisms underlying the effects of mindfulness on anxiety. Fourth, the questionnaire was too homogeneous and used a subjective survey, which may cause deviations from some students who were not willing to expose their inner reality too much.

Conclusion

The above findings illustrate the inter-relationship between mindfulness, rumination and anxiety, and reflect the mediating role of rumination in the relationship between mindfulness and anxiety in high school students. Overall, we conducted an empirical study on the role of rumination and clarified that rumination could partially mediate the relationship between mindfulness and anxiety in high school students. This study may provide some ideas for addressing anxiety problems in high school students. Through mindfulness training, high school students' rumination can be reduced, leading to an ultimate reduction in anxiety.

References

1. Spielberger CD, Gorsuch RL, Lushene R, Vagg PR, Jacobs GA. Manual for the state-trait anxiety inventory. Palo Alto, CA: Consulting Psychologists Press. Spielberger, C. D. 1983.
2. Spielberger CD. Theory and research on anxiety. *Anxiety and behavior*. 1966;3-22.
3. Chambers R, Eleonora G, Craig H, Wendy K, Tracy G, Nicholas A. Mindful emotion regulation predicts recovery in depressed youth. *Mindfulness*. 2014;6(3):523-34.
4. Jun-Mei A. Relationship between mindfulness level and social anxiety in high school students: mediating effect of self-control. 2019.
5. Ying X. The influence factors of high school students' examination anxiety and study on the intervention effect of mindfulness training. 2018.
6. Hao-Yu L. Research on mindfulness intervention in senior three students learning anxiety. 2020.
7. Zhang X, Dimitriou D, Halstead EJ. Sleep, anxiety, and academic performance: A study of adolescents from public high schools in China. *Front Psychol*. 2021;12:678839.
8. Parmentier FBR, García-Toro M, García-Campayo J, Yañez AM, Andrés P, Gili M, et al. Mindfulness and symptoms of depression and anxiety in the general population: The mediating roles of worry, rumination, reappraisal and suppression. *Front Psychol*. 2019;10:506.
9. Desrosiers A, Vine V, Klemanski DH, Nolen-Hoeksema S. Mindfulness and emotion regulation in depression and anxiety: Common and distinct mechanisms of action. *Depress Anxiety*. 2013;30(7):654-61.
10. Oğuztürk O, Bülbül SH, Özen NE, Ekici M, Örnek K, Ünlü E, et al. State and trait anxiety levels of adolescents in a changing society, Kirikkale City, Turkey. *J Clin Psychol Med Settings*. 2012;19(2):235-41.
11. McLaughlin KA, Nolen-Hoeksema SN. Rumination as a transdiagnostic factor in depression and anxiety. *Behav Res Ther*. 2011;49(3):186-93.
12. Xue-Wei D. The effect of short-range mindfulness-based cognitive therapy on the negative cognition of depression disorder. 2018.
13. Rong-Shan W, Xia-Xia M. Exploring the predictors of college students' anxiety: Rumination and A-type personality. 2014.
14. Yu M. Chinese adolescents' mindfulness and internalizing symptoms: The mediating role of rumination and acceptance. *J Affect Disord*. 2021;280(Pt A):97-104.
15. Shapiro SL, et al. Mechanisms of mindfulness. *J Clin Psychol*. 2006. 62(3): p. 373-86.
16. Shapiro SL, Carlson LE, Astin JA, Freedman B. Mechanisms of mindfulness. *J Clin Psychol*. 2006;62(3):373-86.
17. Jieting Z, Cuimei Y, Shuying W, Jingfeng Z, Wu K, Xinli C. The effectiveness of 4-week mindfulness-based stress reduction improving anxiety among junior school students. *Studies of Psychology and Behavior*. 2021;19(1):104-10.
18. Xi L. The relationship between senior high school students' Mindfulness and Life Satisfaction: The rule of Self-acceptance and Gratitude. 2019.
19. Ge J, Wu J, Li K, Zheng Y. Self-compassion and subjective well-being mediate the impact of mindfulness-based stress reduction in Chinese college students. *Front Psychol*. 2019;10:367.
20. Liya Yan G, Xinghua L. Mindfulness and subjective well - being among junior school students: Mediating role of self-esteem. *China J Health Psychol*. 2014;22(11):1749-51.
21. Yi-lun Z. The relationship between mindfulness ruminant thinking and depression in senior high school students and its educational countermeasures. 2020.
22. Bradshaw G. The Importance of Mindfulness for Anxious Students. ERIC. 2019.
23. Schmertz SK. Rumination as a mediator of the relation between mindfulness and social anxiety in a clinical sample. Georgia State University. 2008.
24. Ilies IA, Egan H, Mantzios M. Comparing state anxiety and mindfulness between mindfulness and loving-kindness meditation whilst controlling for the effect of altruism and boredom. *Curr Issues Pers Psychol*. 2019;7(2):109-19.
25. Singh D, Suhas AV, Naveen VK, Nagendra HR. Measures of mindfulness and anxiety in OM meditators and non-meditators: A cross-sectional study. *Int J Med Public Health*. 2014;4(1):110-14.
26. Fino E, Martoni M, Russo PM. Specific mindfulness traits protect against negative effects of trait anxiety on medical student wellbeing during high-pressure periods. *Adv Health Sci Educ Theory Pract*. 2021;26:1095-1111.
27. Rippere V. Commonsense beliefs about depression and antidepressive behavior: A study of social consensus. *Behav Res Ther*. 1977;15(6):465-73.
28. Yue-ming S. High school students ruminant thinking influence on social anxiety. 2017.
29. Brown KW, Ryan RM. The benefits of being present: mindfulness and its role in psychological well-being. *J Pers Soc Psychol*. 2003;84(4):822-48.
30. Siyi C, Hong C, Renlai Z, Yan-Yan Z. Revision of Mindful Attention Awareness Scale (MAAS). *Chin J Clin Psychol*. 2012;20(2).
31. Hoeksema S, Stanford JM, Nolen-Hoeksema 1991. *J Pers Soc Psychol*. 1991;61(1):115-21.

32. Xiu H, Hongfei Y. Chinese version of Nolen-Hoeksema Ruminative Responses Scale (RRS) used in 912 college students: Reliability and validity. *Chin J Clin Psychol.* 2009;17(5).
33. Zhonglin W, Lei C, Kit-Tai H, Hongyun L. Testing and application of the mediating effects. *Acta Psychologica Sinica.* 2004;36(5):614-20.
34. Kaitlyn M. Mindfulness and its ability to alleviate state and trait anxiety. 2014.
35. Alharbi R, Alsuhaibani K, Almarshad A, Alyahya A. Depression and anxiety among high school student at Qassim Region. *J Family Med Prim Care.* 2019;8(2):504-10.
36. Goldin P, Ramel W, Gross J. Mindfulness meditation training and self-referential processing in social anxiety disorder: Behavioral and neural effects. *J Cogn Psychother.* 2009;23(3):242-57.
37. Liu H, Shi Y, Auden E, Rozelle S. Anxiety in rural Chinese children and adolescents: Comparisons across provinces and among subgroups. *Int J Environ Res Public Health.* 2018;15:2087.
38. Guantao J. The relationship among meta worry, mindfulness and test anxiety in high school students. 2016.
39. Shanshan L. Relationship between test anxiety and sleep quality in middle school students. *J Psychiatry.* 2011;24(1).
40. Yan S. Relationship between ruminant thinking, self-esteem, resilience and social anxiety in high school students: An analysis of mediating effects with regulation-Shen Yan. 2020.
41. Fino E, Martoni M, Russo PM. Specific mindfulness traits protect against negative effects of trait anxiety on medical student wellbeing during high-pressure periods. *Adv Health Sci Educ Theory Pract.* 2021;26(3):1095-1111.
42. Bergen-Cico D, Cheon S. The mediating effects of mindfulness and self-compassion on trait anxiety. *Mindfulness.* 2013;5(5):505-19.
43. McKim RD. Rumination as a mediator of the effects of mindfulness: Mindfulness-Based Stress Reduction (MBSR) with a heterogeneous community sample experiencing anxiety, depression, and/or chronic pain. 2008, ProQuest Information & Learning.
44. Fen W, Yu-Xia H. Psychological and neural mechanisms of mindfulness. *Adv Psychol Sci.* 2011;19(11):1635-44.
45. Bogusch LM, Fekete EM, Skinta MD. Anxiety and depressive symptoms as mediators of trait mindfulness and sleep quality in emerging adults. *Mindfulness.* 2016;7(4):962-70.
46. Ramel W, Goldin PR, Carmona PE, McQuaid JR. The effects of mindfulness meditation on cognitive processes and affect in patients with past depression. *Cognit Ther Res.* 2004;28(4):433-55.
47. Franzoi IG, Sauta MD, Granieri A. State and trait anxiety among university students: A moderated mediation model of negative affectivity, alexithymia, and housing conditions. *Front Psychol.* 2020;11:1255.