

Can Mindfulness Improve Sleep Quality in Older Adults? a Mediation Model of Rumination and Anxiety

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Abstract: In order to investigate the relationship between mindfulness and sleep quality, 522 elderly people were tested using the five facet mindfulness questionnaire (FFMQ), Pittsburgh Sleep Index Questionnaire (PSIQ), self-rating anxiety scale (SAS) and ruminative responses scale (RRS). SEM and Bootstrap methods were used to investigate the effect of rumination and anxiety. The results indicated that (1) mindfulness would predict sleep quality; (b) both rumination and anxiety mediated the association between mindfulness and sleep quality; (c) rumination and anxiety sequentially mediated the relation between mindfulness and sleep quality. Implications of taking mindfulness as an alternative way to detect and improve elderly sleep quality are discussed.

1. Introduction

Sleep problems are common among the elderly. According to the survey results in China, 45% of the elderly reported that they have sleep problems, among which the rate of sleep disorders in the elderly aged 60 and above was as high as 56.7% [1]. Sleep quality is an important index to measure the quality of life, including 7 components including subjective sleep quality, time to fall asleep, sleep time, sleep efficiency, sleep disorders, hypnotic drugs and daytime dysfunction [2]. Sleep disorders have become an important factor hindering the physical and mental health development of the elderly. Long-term sleep disorders will not only bring about negative emotions such as stress, anxiety and depression [3], but also affect the daytime function of the elderly [4], and even increase the risk of various mental diseases [5]. Therefore, it is of great significance to pay attention to any way that might prevent and intervene with elderly sleep quality.

In recent years, mindfulness has attracted extensive attention from researchers. Mindfulness is a purposeful, non-judgmental method of focusing attention on the present moment [6].” Mindfulness emphasizes the conscious awareness of the physical sensations, emotions, thoughts, and external stimuli in the present moment with an attitude of acceptance, equality, and openness. Some studies have found that there is a significant positive correlation between mindfulness and sleep quality, and the higher the level of mindfulness, the better the sleep quality [7-9]. Although the relationship between mindfulness and sleep quality has been confirmed in a number of studies, little attention has been paid to older adults and the underlying mechanisms are poorly understood. This present study established a theoretical model to investigate the mediating roles of rumination and anxiety in the relationship between mindfulness and sleep quality in older adults.

2. The Mediating Role of Rumination

Ruminant thinking refers to the repeated attention of individuals to the negative emotions, thoughts or behavior states related to themselves, and repeated thinking of this state. According to the IAA (intention; attention & attitude) model, attention is the core of mindfulness emphasizing the awareness of internal and external feelings and experiences. Acting with awareness helps identify and reduce ruminant thinking by diverting attention from harmful ruminant processes through mindfulness [10]. From the perspective of limited cognitive resources, when individuals devote more cognitive resources to the present, the resources used in the ruminant thinking process will

decrease [11]. One study had shown that there is a significant negative correlation between mindfulness and rumination in college students [12]. In addition, mindfulness interventions help reduce rumination [13]. Therefore, this study proposes the first hypothesis:

Hypothesis 1. Mindfulness negatively predicted ruminant thinking in older adults.

In addition, rumination can negatively affect sleep quality through negative emotions such as depression [14-15]. Given the literature reviewed above, although some studies have suggested a direct or indirect relationship between rumination, mindfulness, and sleep quality, there has been no investigation into the mediating role of rumination between meditation and sleep quality in older adults. Therefore, this study aims to examine the role of rumination in this relationship with the elderly as a sample and propose the second hypothesis:

Hypothesis 2. Rumination mediated the relationship between mindfulness and sleep quality.

3. The Mediating Role of Anxiety

Anxiety is one of the common negative emotions in the elderly and chronic anxiety will have a serious threat to their physical and mental health. Mindful emotion regulation model emphasizes that mindfulness can relieve anxiety, fear and other emotional troubles through individuals' conscious awareness of their own emotional experiences and thoughts. In other words, mindfulness can help people detach themselves from automated appraisal and reaction processes [16]. Previous studies have shown that mindfulness is significantly negatively correlated with anxiety [17-19]. A meta-analysis of mindfulness interventions showed that the immediate effect of mindfulness on anxiety was above medium size [19].

In addition, a number of studies have shown that anxiety can cause sleep disorders. The study of Stewart et al. [20] showed that negative emotions such as anxiety and depression will affect the secretion of central 5-hydroxytryptamine, which will lead to difficulty in falling asleep and difficulty in entering deep sleep. This means that individuals in an anxious mood may have difficulty falling asleep due to their higher wakefulness [21]. Therefore, Individuals with lower levels of mindfulness were more likely to experience more anxiety and poorer sleep quality in their daily lives. The third hypothesis is proposed in this study:

Hypothesis 3: Anxiety mediates the relationship between mindfulness and sleep quality.

4. A Multiple Mediation Model

The purpose of this study was to investigate the mediating role of rumination and anxiety in the relationship between mindfulness and sleep quality. Although studies have shown that mindfulness can predict sleep quality, proximal psychological factors, such as rumination and emotional experiences, are needed to help us understand the psychological mechanisms between mindfulness and sleep quality in elderly. According to the mindful coping model, mindfulness as a metacognition of consciousness, can help individuals adopt decentralized adaptive responses [22]. Mindfulness helps to increase the cognitive flexibility of individuals and reduce the rumination of negative events. When individuals produce negative emotions brought about by rumination, they can reduce automatic evaluation through awareness and positive evaluation, thus reducing anxiety and improving sleep quality. Therefore, the multiple mediation model in this study can better explain the psychological factors that mindfulness influences sleep quality.

5. The Present Study

In conclusion, this study aims to reveal three research questions :(1) the mediating role of rumination in the relationship between mindfulness and sleep quality in the elderly; (2) the mediating role of anxiety in the relationship between mindfulness and sleep quality in the elderly; (3) to confirm how do rumination and anxiety work together in the above pathway.

5.1 Method

5.1.1 Participants

The participants were recruited from China. A total of 522 elderly (33% were male elderly) completed our survey including the measurement of demographic variables, mindfulness, sleep quality, anxiety and ruminative responses. The mean age was 66.23years (SD = 1.88, range =60-75years).

5.1.2 Measures

1) Mindfulness

Mindfulness was measured by the Chinese Five Facet Mindfulness Questionnaire [23] (FFMQ), which consists of 39 items. It measures five dimensions including observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience. Items are rated on five-point Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true), with higher scores indicating greater mindfulness. In this study, Cronbach's α was 0.83.

2) Sleep quality

Sleep quality was measured by the Pittsburgh Sleep Index Questionnaire [24] (PISQ). The scale is composed of 19 self-rated items. These 19 items are grouped into seven component scores, each weighted equally on a 0-3 scale. The seven component scores are then summed to yield a global PSQI score, which has a range of 0-21; higher scores indicate worse sleep quality. In this study, Cronbach's α was 0.88.

3) Anxiety

Anxiety was measured by the Self-rating Anxiety Scale [25] (SAS), which consists of 20 items. Items are rated on a 1-4 likert type scale and the total SAS score may vary from 20 (no anxiety at all) to 80 (severe anxiety); higher scores indicate the higher anxiety level. In this study, Cronbach's α was 0.86.

4) Ruminative response

Ruminative response was measured by the Ruminative Responses Scale [26] (RRS). This scale includes 22 items, each rated on a 4-point rating scale anchored by 1: Almost never and 4: Almost always. It measures three dimensions including brooding, reflection and depression. Higher scores indicate the higher rumination. In this study, Cronbach's α was 0.92.

5.1.3 Procedure

The survey was conducted online for all participants using a convenient sampling method and a survey software. Informed consent was obtained from the participants prior to the survey and they were informed that their participation was voluntary and could be terminated at any time.

5.1.4 Statistical Analyses

Data analysis was conducted with SPSS 26.0. First, descriptive information and zero order correlation of the variables were analyzed. Second, the mediating effect of ruminative response and anxiety were tested separately using the PROCESS macro for SPSS (Model 4). Third, Hayes's PROCESS macro for SPSS (Model 6) was used to test the multiple mediation model of ruminative response and anxiety in the association between mindfulness and sleep quality. Age and sex were controlled as covariables. Bootstrap confidence interval (CIS) was used to determine whether the effects of Model 4 and Model 6 were significant. If Ci does not contain 0, the effect will be significant.

5.2 Results

5.2.1 Preliminary Analyses

Descriptive statistics and the correlation matrix of the variables are shown in Table 1. Results of the correlation analysis showed that mindfulness was positively associated with sleep quality ($r = -.0402$, $p < .05$). Ruminative response was positively associated with sleep quality ($r = .0531$, $p < .05$). Anxiety were negatively associated with sleep quality ($r = .1768$, $p < .05$). Besides, mindfulness was negatively related to ruminative response ($r = -0.3283$, $p < .005$) and negatively

related to anxiety ($r = -.2238, p < .05$). Moreover, ruminative response was positively associated with anxiety ($r = .4788, p < .05$).

Table 1 Descriptive Statistics And Correlations for All Variables

	M	SD	1	2	3	4
1.Mindfulness	124.73	14.274	1			
2.Sleep quality	12.562	3.9071	-.0402*	1		
3.Ruminative response	45.04	13.282	-.3283*	.0531*	1	
4.Anxiety	47.1983	12.12410	-.2238*	.1768*	.4788	1

5.2.2 The Mediating Role of Rumination

Model 4 of the PROCESS macro was adopted to test the mediating role of rumination in the relationship between mindfulness and sleep quality. The results indicated that mindfulness was negatively associated with rumination ($b = -.33, p < .05$), which in turn was associated with sleep quality ($b = .05, p < .05$). Meanwhile, the direct effect of mindfulness on sleep quality remained significant ($b = -.04, p < .05$), indicating that rumination partially mediated the relation between mindfulness and sleep quality (indirect effect = $-.02, 95\% CI = -.10$ to $-.07$). Therefore, Hypothesis 1 was supported.

5.2.3 The Mediating Role of Anxiety

For the mediating role of anxiety, the results showed that mindfulness was negatively associated with anxiety ($b = -.22, p < .05$), which was in turn negatively related to sleep quality ($b = .18, p < .05$). Meanwhile, the residual direct effect was significant ($b = -.24, p < .05$), which means that anxiety partially mediated the relation between mindfulness and sleep quality (indirect effect = $-.04, 95\% CI = -.05$ to $-.03$). Therefore, Hypothesis 2 was supported.

5.2.4 The Multiple Mediation Model

Model 6 of the PROCESS macro was used to test the multiple mediation model. As shown in Table 2, the multiple mediation model accounted for a significant variation of sleep quality in elderly ($R^2 = .59$). The results showed that mindfulness significantly predicted rumination ($b = -.33, p < .05$) and anxiety ($b = -.22, p < .05$). rumination significantly predicted anxiety ($b = .49, p < .05$), as well as sleep quality ($b = .05, p < .05$). Anxiety also had a significant impact on sleep quality ($b = .18, p < .001$).

For each mediation pathways, the pathway of “mindfulness \rightarrow rumination \rightarrow sleep quality” was significant (indirect effect = $-.02, 95\% CI = -.03$ to $-.01$); the pathway of “mindfulness \rightarrow anxiety \rightarrow sleep quality” was also significant (indirect effect = $-.04, 95\% CI = -.05$ to $-.03$); moreover, the pathway of “mindfulness \rightarrow rumination \rightarrow anxiety \rightarrow sleep quality” was significant (indirect effect = $-.03, 95\% CI = -.04$ to $-.02$). Besides, the total indirect effect was significant (indirect effect = $-.08, 95\% CI = -.10$ to $-.07$). Therefore, rumination and anxiety partially mediated the relation between mindfulness and sleep quality, thus Hypothesis 3 was supported.

Table 2 Testing the Pathways of the Multiple Mediation Model

Effect	<i>b</i>	95% CI	
		Lower	Upper
Direct effects			
mindfulness \rightarrow rumination	-.33**	-.40	-.26
mindfulness \rightarrow anxiety	-.22**	-.27	-.17
rumination \rightarrow anxiety	.48**	.42	.54
mindfulness \rightarrow sleep quality	-.04**	-.06	-.02
rumination \rightarrow sleep quality	.05**	.02	.07
anxiety \rightarrow sleep quality	.18**	.15	.21
Indirect effects			
	-.02	-.03	-.01

mindfulness →rumination →sleep quality			
mindfulness →anxiety →sleep quality	-.04	-.05	-.03
mindfulness →rumination →anxiety →sleep quality	-.03	-.04	-.02

$N = 522$. The beta values are standardized coefficients. $**p < .05$.

6. Discussion

As predicted, the results of this study support the mediating role of rumination and anxiety in the relationship between mindfulness and sleep quality. While some empirical evidence supports the effect of mindfulness on sleep quality, the explanation of how it affects sleep quality is unclear. This study investigated the effects of mindfulness on sleep quality in older adults and the multiple mediating roles of rumination and anxiety. These findings contribute to the further understanding of the psychological mechanism of the impact of mindfulness on sleep quality in the elderly, and provide ideas for the intervention of sleep quality.

6.1 The Mediating Role of Rumination

Consistent with hypothesis 1, the results showed that rumination partially mediated the relationship between mindfulness and sleep quality. The results of this study suggest that sleep quality, as an important indicator of physical and mental health, can be improved by levels of mindfulness. Mindfulness improves sleep by allowing people to focus more on the present moment and ruminate less. Therefore, we should not only focus on the role of mindfulness in promoting sleep quality, but also focus on reducing the level of rumination in older adults.

6.2 The Mediating Role of Anxiety

The results showed that anxiety was a partial mediator between mindfulness and sleep quality. From the perspective of Socioemotional Selectivity Theory, the priority of different goals will change with the shortening of the time range of human life course. Older people tend to devote more resources to emotionally meaningful goals and activities, which in turn makes them more prone to anxiety and emotional distress. Mindfulness helps older adults become aware of their current emotional experiences, free themselves from past experiences and judgments, and reduce negative emotions such as anxiety. Therefore, alleviating anxiety by strengthening mindfulness is an effective way to improve sleep quality in the elderly.

6.3 The Sequential Mediation

In addition, rumination and anxiety partially mediated the relation between mindfulness and sleep quality. Ruminant is related to the loss of inhibition function [27]. When individuals tend to ruminate, their ability to suppress negative information is poor, and they lack the cognitive processing ability from negative information to new positive information, so they are more prone to anxiety. Resource Depletion Theory holds that that cognitive resources are limited, and individuals will consume cognitive resources when rumination, which will affect the executive control function of individuals and lead to anxiety. This theory also provides support for the multiple mediation model between rumination and anxiety. In real life, older people who have severe sleep problems can be adjusted by reducing ruminations and anxiety.

6.4 Implications

Our findings have important implications for improving sleep quality in older adults. First, this study found that mindfulness is an important factor in promoting sleep quality, which is supported by previous research [28]. Second, rumination mediated the relationship between mindfulness and sleep quality in the elderly. The importance of reduced ruminant thinking in the elderly should be emphasized, which can be intervened through mindfulness training. Third, anxiety also plays a mediating role between mindfulness and sleep quality, suggesting that reducing anxiety in older adults can also help improve sleep quality. Emotional regulation training has been found to reduce anxiety [29], and how to apply these interventions in the elderly population is worth exploring by

related departments. Finally, our findings suggest that the assessment of the level of mindfulness in the elderly should be strengthened, and timely intervention for rumination and anxiety should be carried out to improve sleep quality. At the same time, interventions targeting these two mediators are more effective than interventions targeting a single mediator.

6.5 Limitations and Future Directions

Although this study shows that rumination and anxiety can be used to explain the relationship between mindfulness and sleep quality in older adults, there are some limitations in this study. First of all, the convenience sampling method was adopted in this study, which only included the elderly in China. It is not clear whether the results can be generalized to other age and cultural groups. Therefore, different participants need to be selected for future studies to verify the results of this study. Secondly, this is a cross-sectional study, future research could supplement the evidence with longitudinal and laboratory studies. Thirdly, this study only used questionnaires, and future studies can consider combining questionnaires with physiological indicators to more objectively evaluate sleep quality and other variables. Finally, other moderators of the relationship between mindfulness and sleep quality need to be explored in future studies.

7. Conclusion

In summary, the present study tested the mediating mechanisms in the relation between mindfulness and sleep quality in elderly, which revealed that rumination and anxiety sequentially mediated these two variables. This study confirmed that the level of mindfulness can predict the sleep quality of the elderly by establishing a multiple mediation model.

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