



## Mindfulness and sleep quality in adolescents: Analysis of rumination as a mediator and self-control as a moderator



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### ARTICLE INFO

#### Keywords:

Mindfulness  
Sleep quality  
Rumination  
Self-control  
Adolescents

### ABSTRACT

Previous studies have documented that mindfulness was positively correlated with favorable sleep quality, however, the underlying mechanisms are largely unknown. The present study examined the mediating role of rumination and the moderating role of self-control in the association between mindfulness and sleep quality. A sample of 1196 adolescents completed a battery of self-report questionnaires measuring mindfulness, rumination, self-control and sleep quality as well as demographic information. Results showed that, in addition to the negative link between mindfulness and poor sleep quality, mindfulness was negatively associated with rumination, which in turn was positively associated with poor sleep quality. The direct link between mindfulness and poor sleep quality and the indirect link through rumination were both moderated by self-control. These two effects were stronger for adolescents with low self-control than for those with high self-control. These results coincide with the antagonistic interaction hypothesis of the protective-protective model, and indicate that mindfulness and self-control, as two important protective factors of adolescents, may mutually compensate. Limitations and implications are discussed.

### 1. Introduction

Evidence is increasingly indicating that adolescents are at high risk of poor sleep quality (Doane & Thurston, 2014; Royette & Teena, 2014). Poor sleep quality would cause a variety of undesirable consequences such as poor academic performance, negative attitude toward life, stress, anxiety, and depression (Gregory et al., 2011; Perkinson-Gloor, Lemola, & Grob, 2013; Short, Gradisar, Lack, & Wright, 2013). Some individual traits may act as protective factors helping adolescents cope with challenges in particular sleep problems, and one of them is mindfulness (Garland, Campbell, Samuels, & Carlson, 2013). Mindfulness refers to a state of being aware of internal and external experiences without judgment or with openness and acceptance (Brown & Ryan, 2003; Kabat-Zinn, 1994). It is also considered as a dispositional trait reflecting individual tendency to be mindful in everyday life (Brown & Ryan, 2003). Bogusch, Fekete, and Skinta (2016) found that higher levels of mindfulness were associated with more favorable sleep quality through lower levels of anxiety and depressive symptoms. Brand, Holsboertrachsler, Naranjo, and Schmidt (2012) showed that individuals who had long-term mindfulness practice (e.g., Buddhist nuns and monks) reported high favorable subjective sleep,

and individuals who had short-term mindfulness practice (e.g., 8-week course of Mindfulness-Based Stress Reduction) also reported improvement in sleep quality. A longitudinal study by Caldwell, Harrison, Adams, Quin, and Greeson (2010) documented that mindfulness increased through training courses could improve sleep quality even three months later.

Although cross-sectional and longitudinal research both indicate that mindfulness is strongly associated with sleep quality, the underlying mediating mechanism (i.e., how mindfulness is related to sleep quality) and moderating mechanism (i.e., when mindfulness is related to sleep quality) are still unclear. To address the gap, the present study constructed a moderated mediation model to test the mediating role of rumination and the moderating role of self-control in the relation between mindfulness and sleep quality. The findings would promote our understanding of how and when mindfulness is associated with adolescents' sleep quality.

#### 1.1. Rumination as a mediator

Rumination refers to the tendency to repetitively and passively think about one's concerns and distress without making positive

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changes (Nolen-Hoeksema, 1991; Watkins, 2008). The response style theory documents that rumination enhances negative thinking, deteriorates coping behaviors, and prolongs and exacerbates negative effects (Nolen-Hoeksema, 1991). Studies revealed that rumination was one of the risk factors which could explain anxiety and depression during adolescence (Michl, McLaughlin, Shepherd, & Nolen-Hoeksema, 2013). Rumination was also considered to be one of the causes of poor sleep quality. The cognitive-behavioral model of insomnia suggests that negative cognitive factors such as rumination and brooding are vital predictors of poor sleep quality (Hage, Jalloul, Sabbah, & Adib, 2008). Cross-sectional studies showed that rumination was positively associated with poor sleep quality in adolescents and young adults (Liu et al., 2017; Thomsen, Mehlsen, Christensen, & Zachariae, 2003). A longitudinal study further indicated that, even after controlling for anxiety and depression, baseline rumination could predict reduction in sleep quality three weeks later (Takano, Iijima, & Tanno, 2012).

Mindfulness has a strong association with rumination. People who have high awareness of what is taking place in a non-judgmental or accepting way are less likely to indulge in repetitive and passive thoughts. The re-perceiving model of mindfulness also suggests that mindfulness helps individuals re-perceive the moment-by-moment experience, and reduce automatic and habitual responses to negative stimulation (Shapiro, Carlson, Astin, & Freedman, 2006). Cross-sectional and longitudinal studies have documented that mindfulness is an effective factor to counteract rumination (Borders, Earleywine, & Jajodia, 2010; Petrocchi & Ottaviani, 2015). Studies on Mindfulness-Based Stress Reduction also revealed that as mindfulness increased, rumination significantly decreased (Gu, Strauss, Bond, & Cavanagh, 2015; Sharma & Rush, 2014). Considering that mindfulness is negatively correlated with rumination, and rumination in turn is positively correlated with poor sleep quality, rumination may mediate the relationship between mindfulness and sleep quality.

### 1.2. Self-control as a moderator

Self-control refers to individuals' capacity to resist inner desires and external temptations which hinder long-term goal pursuit (Tangney, Baumeister, & Boone, 2004). It is an important dispositional trait that has a strong association with good physical and mental outcomes. Individuals with higher levels of self-control generally have better health, better psychosocial adjustment and more wealth (Boals, Vandellen, & Banks, 2011; Moffitt et al., 2011; Tangney et al., 2004). Self-control is also considered as a dimension of mental toughness, and research have found that high mental toughness scores are associated with favorable subjective and objective sleep (Brand et al., 2014a, 2014b). Self-control not only exerts positive effects on physical and mental health, but also acts as a protective moderator in the relation between negative factors and their outcomes. For instance, Gardner, Dishion, and Connell (2008) found that self-control buffered the association between deviant peer affiliation and adolescents' externalizing behaviors. Cooper, Seibert, May, Fitzgerald, and Fincham (2017) found that the effects of school burnout on emotional dysregulation and victimization were moderated by self-control, with these effects being stronger for low self-control adults than for high self-control adults.

Mindfulness is positively correlated with self-control (Bowlin & Baer, 2012; Wittmann et al., 2014). On one hand, it is necessary for individuals to regulate and control attention, attitude, feelings and behaviors so as to focus on the ongoing physical and psychological experience in a non-judgmental way (Brown & Ryan, 2003; Kabat-Zinn, 1994; Shapiro et al., 2006). Thus, individuals with high self-control may be more likely to engage in mindfulness. On the other hand, individuals with high levels of mindfulness are inclined to objectively observe their thoughts and feelings without maladaptive responses even when unpleasant thoughts and feelings are present (Bowlin & Baer, 2012). Thus, mindfulness may also help enhance self-control (Canby, Cameron, Calhoun, & Buchanan, 2015). Yet it is still unclear how

mindfulness and self-control interact to influence physical and mental health, in particular sleep quality. The protective-protective model proposes two hypotheses to explain how two protective factors work together: enhancing interaction hypothesis and antagonistic interaction hypothesis (Cohen, Cohen, West, & Aiken, 2003; Wang, Zhang, Peng, Mo, & Xiong, 2009). The enhancing interaction hypothesis suggests that the effect of one protective factor (e.g., mindfulness) on its outcomes (e.g., rumination and sleep quality) may be increased by another protective factor (e.g., self-control). Namely, mindfulness may be more closely associated with rumination and sleep quality for individuals with high self-control than for those with low self-control. On the contrary, the antagonistic interaction hypothesis argues that the effect of one protective factor (e.g., mindfulness) on its outcomes (e.g., rumination and sleep quality) may be reduced by another protective factor (e.g., self-control). Namely, mindfulness may be more closely associated with rumination and sleep quality for individuals with low self-control than for those with high self-control. To our knowledge, no research to date has examined how mindfulness and self-control interact to correlate with sleep quality and rumination. In the present study, we would test the moderating role of self-control in the relation between mindfulness and sleep quality, and in the link between mindfulness and rumination. Given that self-control may also play a moderating role in the association between rumination and sleep quality because of its protective effect, the present study would also test whether the link between rumination and sleep quality would be different at different values of self-control.

According to prior research on mediation and moderation models (e.g., Hayes, 2013; Liu et al., 2017), if rumination acts as a mediator in the relation between mindfulness and sleep quality, and self-control moderates the relation between mindfulness and rumination or the relation between rumination and sleep quality, then the mediating effect of rumination would be moderated by self-control. Therefore, we would examine the moderating role of self-control in the direct link between mindfulness and sleep quality and the indirect link through rumination.

### 1.3. The present study

This study explored the mechanisms underlying the association between mindfulness and sleep quality in adolescents. Specifically, we examined a moderated mediation model (see Fig. 1) to test three hypotheses:

**Hypothesis 1.** Rumination would mediate the relation between mindfulness and sleep quality in adolescents. Mindfulness would be negatively related to rumination, which in turn would be positively related to poor sleep quality.

**Hypothesis 2.** Self-control would moderate the relation between mindfulness and sleep quality in adolescents. The association between mindfulness and sleep quality would be stronger for individuals with

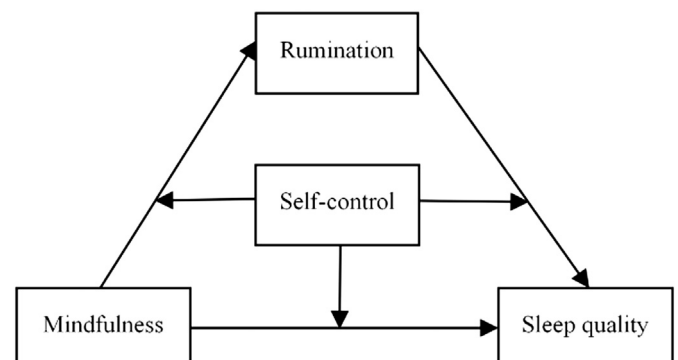


Fig. 1. Conceptual model.

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