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Yu, X., Langberg, J. M., & Becker, S. P. (2022). Dispositional mindfulness moderates the relation between brooding rumination and sleep quality in adolescents. *Sleep Medicine*, 90, 131-134. doi:10.1016/j.sleep.2022.01.017. PMID: 35152086

**Dispositional mindfulness moderates the relation between brooding rumination and sleep problems in adolescents**

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**Conflict of interests.** The authors declare no potential conflicts of interest with respect to the research, authorship, or publication of this article.

**Acknowledgements.** This research was supported by award number R305A160126 from the Institute of Education Sciences (IES), U.S. Department of Education. The content is solely the responsibility of the authors and does not necessarily represent the official views of the IES.

### Abstract

**Objectives/Background:** This study examined whether dispositional mindfulness moderates the association between brooding rumination and sleep problems in adolescents with and without attention-deficit/hyperactivity disorder (ADHD).

**Participants/Methods:** Participants were 137 adolescents (ages 13-15 years; 64% male). Approximately half (47.4%;  $n=65$ ) were diagnosed with ADHD. Adolescents provided ratings of their dispositional mindfulness and brooding rumination. Both adolescents and parents provided ratings of adolescents' sleep problems.

**Results:** In analyses controlling for sex, race, study site, and group (ADHD vs. comparison), brooding rumination was associated with more adolescent- and parent-reported sleep problems only at low levels of dispositional mindfulness. This effect did not differ for adolescents with or without ADHD and was also unchanged when controlling for internalizing psychopathology symptoms.

**Conclusions:** Our findings showed that dispositional mindfulness might buffer against the negative impact of brooding rumination on adolescent sleep. These findings may have important clinical implications and underscore the potential benefit of including mindfulness and other cognitive-behavioral approaches when treating sleep problems in adolescents.

**Keywords:** ADHD; adolescence; attention-deficit/hyperactivity disorder; mindfulness; brooding rumination; sleep

## **Dispositional mindfulness moderates the relation between brooding rumination and sleep problems in adolescents**

### **1. Introduction**

Adolescents are at high risk of poor sleep (1,2), especially those with attention-deficit/hyperactivity disorder (ADHD) (3). Poor sleep can negatively impact adolescents' school performance and physical and mental health (4). One risk factor for sleep problems is brooding rumination, which involves repetitive thinking about a situation or state of mind and its consequences (5,6). Brooding rumination is associated with poorer sleep quality, longer time taken to fall asleep, and more awakenings (7–9).

Dispositional mindfulness has been identified as a factor that may reduce sleep problems (10). Mindfulness includes paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally (11). The re-perceiving model of mindfulness emphasizes a shift in perspective, suggesting that mindfulness helps individuals re-perceive the moment-by-moment experience, accepting thoughts that occur when trying to fall asleep (e.g., dysfunctional beliefs about sleep) as they are by practicing observing and acknowledging rather than engaging these thoughts by suppressing or changing them, which often leads to arousal and further interferes with sleep (12). In sum, individuals who are engaged in present-moment experience might be less likely to be engaged in repetitive thoughts before sleep.

There is also evidence from intervention studies that mindfulness may be related to rumination and sleep. For example, an eight-week mindfulness-based stress reduction (MBSR) intervention has been found to decrease rumination in adolescents with subthreshold depression (13). Moreover, mindfulness-based interventions have also been shown to help with sleep problems in youth (14,15). In particular, a mindfulness-based in-school group sleep intervention improved sleep,

including shorter objective sleep onset latency (SOL), greater sleep efficiency and total sleep time, earlier bedtime, earlier rise time and smaller day-to-day bedtime variation in adolescent girls (16). Taken together, mindfulness may moderate the relationship between brooding rumination and sleep problems. Specifically, high dispositional mindfulness may dampen the association between brooding rumination and sleep difficulties. To our knowledge, no studies have examined this possibility. As an initial step in addressing this gap, we hypothesized that the association between brooding rumination and sleep problems would be stronger for adolescents low in mindfulness than for adolescents high in mindfulness. Given the high rates of sleep problems in adolescents with ADHD (3), we used a sample of adolescents with and without ADHD and also explored whether effects were different for adolescents with or without ADHD.

## **2. Methods**

### **2.1. Participants**

Parents reported on participants' biological sex (male, female). Participants were 137 adolescents (87 male, 50 female) in eighth grade (ages 13-15 years;  $M \pm SD = 14.10 \pm 0.36$  years). Approximately half (47.4%;  $n=65$ ) met diagnostic criteria for ADHD. Most participants were White (87.6%), with remaining participants Asian, (3.6%), Black (2.9%), or Biracial/Multiracial (5.8%); 4.4% of participants identified as Hispanic/Latino. All participants had an estimated IQ  $\geq 80$  based on the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II).

### **2.2. Procedures**

All procedures were approved by an Institutional Review Board. Participants were recruited during the fall semester of their eighth-grade year at two sites in the United States. Parents who contacted the investigators in response to recruitment activities through local schools completed an eligibility screening. Those meeting the screening criteria were scheduled for an evaluation to determine eligibility. We aimed to recruit an approximately equal number of adolescents with and without

ADHD. To be eligible for the ADHD group, participants had to meet full DSM-5 diagnostic criteria for either ADHD predominantly inattentive presentation or ADHD combined presentation based on the Parent Children's Interview for Psychiatric Syndromes (P-ChIPS) (17) conducted at the study evaluation visit<sup>1</sup>. To be eligible for the comparison group, participants were required to have fewer than four symptoms of ADHD in each domain (i.e., inattention and hyperactivity/impulsivity) on the P-ChIPS. To be eligible for either group, participants had to have an estimated IQ  $\geq 80$ , take core classes in a regular education setting, and could not have a diagnosis of autism, bipolar disorder, a dissociative disorder, a psychotic disorder, or an organic sleep disorder per parent report on a phone screen. For additional details, see (18). The broader study from which data in the present study were drawn included 302 participants, though only one of the two cohorts completed the mindfulness measure at the second timepoint used in this study, resulting in the sample size of 137 adolescents.

### **2.3. Measures**

#### **2.3.1. Mindfulness**

Mindful Attention Awareness Scale for Adolescents-Short (MAAS-A-Short). The MAAS-A is an adolescent self-report measure of trait mindfulness, and a 6-item short version was used (19). Each item is rated on a 6-point scale (1=*almost always*, 6=*almost never*). The MAAS-A is a valid and frequently used measure to assess mindfulness in adolescence (20). In the present study,  $\alpha=.91$ .

#### **2.3.2. Rumination**

Ruminative Response Scale (RRS). The RRS is a self-report measure of rumination that has been adapted for use with adolescents (21). The RRS includes a five-item brooding subscale with items rated on a 4-point scale (1=*almost never*, 4=*almost always*). In the present study,  $\alpha=.77$ .

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<sup>1</sup> Participants meeting criteria for ADHD predominantly hyperactive-impulsive presentation were not included given the low prevalence of this presentation in adolescence and ongoing concerns about its validity after early elementary school (25). Only two potential participants were excluded on the basis of this exclusionary criterion.

### **2.3.3. Sleep problems**

Sleep Habits Survey (SHS). The SHS is an adolescent-report measure of sleep (22). In the present study, the 10-item sleep/wake problems subscale was used which assesses the frequency of several sleep-related difficulties experienced over two weeks (1=*never*; 5=*every day/night*) with higher scores indicating more sleep problems ( $\alpha=.75$ ).

Sleep Disturbances Scale for Children (SDSC). The SDSC is a 26-item parent-report measure of youths' sleep functioning (23). In this study, the seven-item Difficulties Initiating and Maintaining Sleep (DIMS) subscale was used. The DIMS subscale includes items about going to bed reluctantly, difficulty in falling asleep, sleep anxiety, night awakenings, difficulty in falling asleep after awakenings, sleep duration, and sleep latency over six months ( $\alpha=.68$ ).

### **2.4. Statistical analyses**

First, descriptive statistics and correlation analyses were conducted with SPSS 26.0 (IBM Corporation, Armonk NY, USA). Next, moderation analyses controlling for sex, race, study site, and group (ADHD vs. comparison) were conducted to examine whether dispositional mindfulness moderated the association between brooding rumination and sleep using the SPSS PROCESS macro (24). Separate models were conducted for adolescent- and parent-reported sleep problems. Finally, we re-ran the regression analyses to explore whether any effects were further moderated by ADHD status.

## **3. Results**

Descriptive statistics and intercorrelations among study variables are provided in Table 1.

Specifically, brooding was positively associated with both adolescent and parent ratings of sleep problems. In addition, mindfulness was negatively correlated with brooding rumination and both adolescent- and parent-report of sleep problems.

Interaction effects were found in analyses examining mindfulness as a moderator of brooding in relation to both adolescent-reported ( $t = -2.46, p = .02$ ) and parent-reported ( $t = -1.89, p = .06$ ) sleep problems<sup>2</sup>. Although the interaction examining parent-report model did not reach conventional levels of statistical significance, we chose to probe this interaction given that moderation models are often underpowered in observational research. As shown in Figure 1, conditional effect analyses indicated that brooding was associated with significantly higher sleep problems at low levels of mindfulness ( $t = 2.60, p = .01$  for adolescent-reported sleep problems;  $t = 2.24, p = .03$  for parent-reported sleep problems), but not at mean or high levels of mindfulness ( $ps > .10$ ). It should be noted that the obtained statistical significance at high levels of mindfulness in the model for parent-reported sleep problems only deviated slightly from conventional levels ( $p = .03$ ). Neither of these interactions was further qualified by ADHD status.

#### 4. Discussion

The study examined whether mindfulness moderated the relation between brooding rumination and adolescent sleep problems. We found brooding to be associated with more sleep problems only at low levels of dispositional mindfulness, and this effect did not differ for adolescents with or without ADHD. Importantly, findings were consistent across both parent and adolescent reports of sleep. Consistent with previous research, our findings showed that brooding rumination was positively correlated with more sleep problems, whereas dispositional mindfulness was negatively correlated with sleep problems and brooding rumination. What is unique about this study is further demonstrating that brooding rumination and dispositional mindfulness interact in their relation to

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<sup>2</sup> Given that internalizing psychopathology symptoms are strongly associated with rumination and mindfulness, we conducted sensitivity analyses to evaluate whether moderated effects remained when internalizing symptoms were also included as a covariate. Specifically, a composite of anxiety and depression symptoms (total score on the adolescent-reported Revised Child Anxiety and Depression Scales) was included as a covariate, with three items involving sleep removed to remove overlap between the covariate and dependent variables. When regression models were re-run and included internalizing symptoms, the interaction effect remained almost identical to the models not including internalizing symptoms (adolescent-reported sleep problems:  $t = -2.28, p = .024$ ; parent-reported sleep problems:  $t = -1.79, p = .076$ ).

adolescent sleep problems. These findings suggest that mindfulness may help reduce the negative impact of brooding rumination on sleep, and clinicians might consider including mindfulness and other cognitive-behavioral approaches when treating sleep problems in adolescents.

Several limitations should be noted. The cross-sectional design precludes causal conclusions. Future experimental studies are needed to evaluate temporal and causal links. Recruitment from specific schools, as well as the largely White sample, may restrict the generalizability of our findings which will need to be replicated. In addition, the rumination and mindfulness measures used in this study are trait measures, and it would be useful for future research to examine state measure particularly in examining day-to-day sleep problems. Nevertheless, our findings indicate that, independent of ADHD symptomatology, mindfulness may buffer the effect of rumination on sleep problems in adolescents.



Table 1

Intercorrelations and descriptive statistics of study variables

Variable	1	2	3	4	5	6	7	8
1. ADHD status	--							
2. Site	-.124	--						
3. Sex	-.204*	.020	--					
4. Race	.047	-.201*	-.129	--				
5. Brooding rumination	.190*	.104	.100	-.141	--			
6. Trait mindfulness	-.287**	.058	.095	.111	-.473**	--		
7. SR sleep problems	.362**	.154	-.045	-.083	.356**	-.389**	--	
8. PR sleep problems	.371**	.013	.006	-.010	.300**	-.308**	.436**	--
<i>Mean</i>	--	--	--	--	8.04	3.97	17.18	13.43
<i>Standard Deviation</i>	--	--	--	--	2.71	1.16	5.34	3.67

*Note.*  $N=137$ . For ADHD status, 0=comparison, 1=ADHD. For race, 0=non-White, 1=White. For sex, 0=male, 1=female. For site, 0=site 1, 1=site 2. ADHD=attention-deficit/hyperactivity disorder. PR=parent-report. SR=adolescent self-report.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

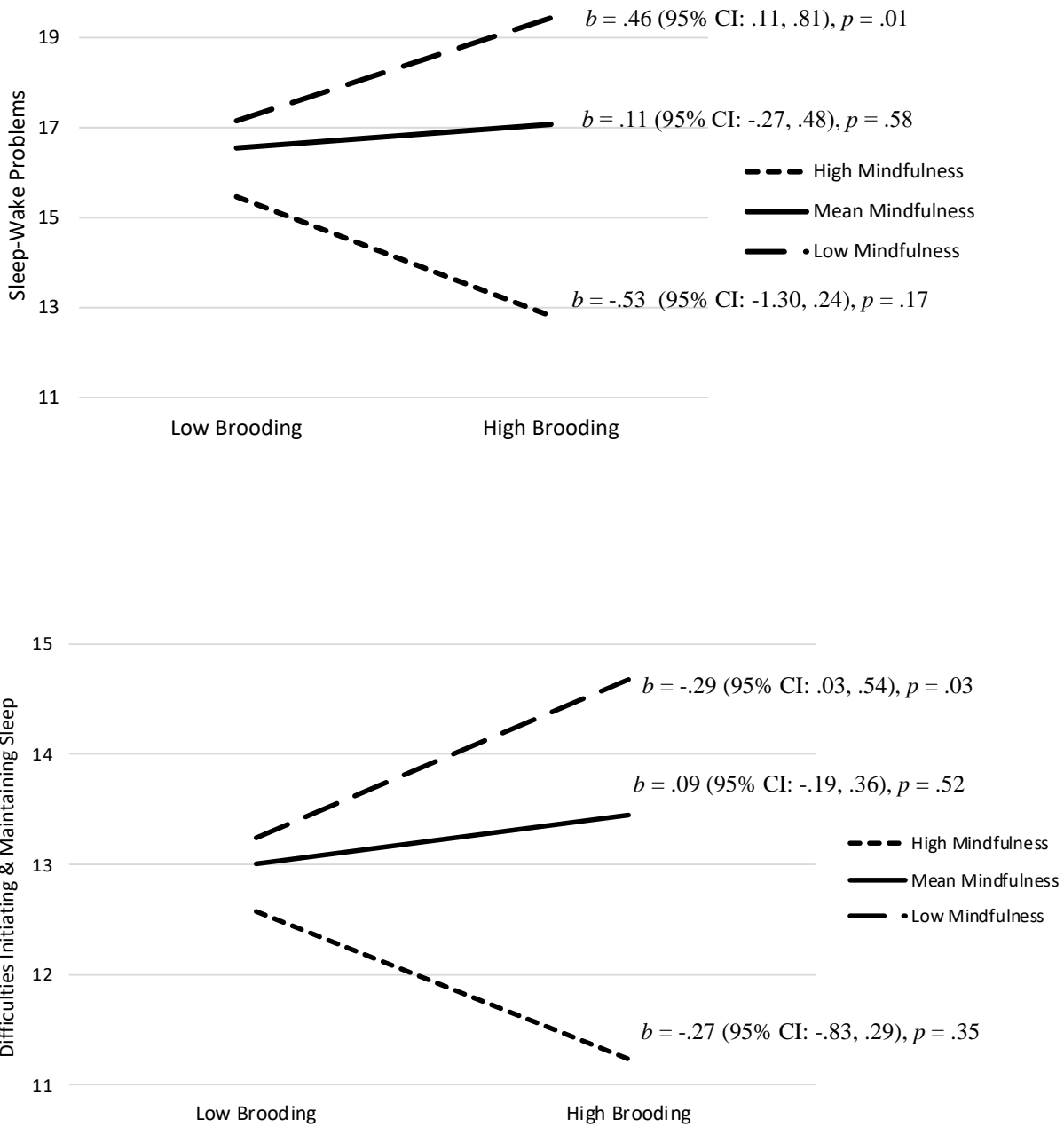


Fig.1. Models of brooding rumination  $\times$  mindfulness in relation to sleep-wake problems (top panel: adolescent-report measure) or difficulties initiating & maintaining sleep (bottom panel: parent-report measure).

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