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Rumination in Relation to Suicide Risk, Ideation, and Attempts: Exacerbation by Poor Sleep Quality?

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Abstract

Background—Rumination, particularly brooding rumination, is associated with suicide risk, ideation and attempts; however, findings are inconsistent with respect to reflective rumination. Recent research suggests reflective rumination might be associated with increased suicide risk specifically among vulnerable individuals. Poor sleep quality is related to both suicide risk and rumination, yet no research has examined whether reflective rumination and sleep quality interact in relation to suicidal risk. This study, therefore, examined whether sleep quality moderates the link between ruminative subtypes and (a) suicide risk overall, and (b) suicidal ideation and (c) history of suicide attempts, specifically.

Methods—Participants were 1,696 college students (ages 18–29 years; 65% female) who completed measures assessing rumination, sleep, and suicidal ideation and behavior. Hierarchical linear and logistic regressions were performed regressing overall suicide risk (linear), suicidal ideation (linear) and history of attempts (logistic) on ruminative subtypes controlling for demographics. Sleep quality was examined as a moderator of the rumination-suicide risk/ideation/attempts link.

Results—Brooding rumination was significantly associated with increased suicide risk, ideation, and attempts but these associations were not moderated by sleep quality. Sleep quality exacerbated the association of reflective rumination with overall suicide risk and suicidal ideation specifically. Reflective rumination was not itself, or in interaction with sleep quality, significantly associated with a history of suicide attempts.

Limitations—The study is cross-sectional and utilizes a college student sample.

Conclusions—This study adds to the literature that suggests reflective rumination is associated with suicide risk and ideation in certain cases, such as in individuals with lower sleep quality. In addition, the study adds continued support for an association between brooding rumination and

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suicidal behaviors. More studies that examine the relations between ruminative subtypes and attempts are needed. Interventions that target sleep problems and rumination may be beneficial for suicide prevention and intervention.

Keywords

depression; college; SBQ-R; rumination; sleep; suicide; university students

Introduction

Suicide is the second leading cause of death among young adults in the United States (Centers for Disease Control and Prevention, 2015) with a substantial minority (9% – 25%) of college students reporting suicidal ideation or behavior (i.e., plan, intent, and/or attempts; Becker et al., 2018; Drum et al., 2009; American College Health Association, 2016). Given the tragic consequences of suicide, continued research into potentially modifiable risk factors is imperative. Specifically, college is a time of increased independence for young adults and often entails waning parental support and monitoring that may have helped to identify and ameliorate suicide risk among adolescents. As such, research that helps to elucidate risk factors with college samples is of large importance. Further, much research has been devoted to studying suicide risk as a singular construct that lumps ideation, behavior (e.g., gathering materials in anticipation of a suicide attempt), and attempts. As many more individuals experience suicidal ideation than go on to make suicide attempts, examining factors that may be differentially related to suicidal ideation and attempts is a significant public health priority (Rogers & Joiner, 2017).

One identified risk factor for suicidal ideation and attempts that has garnered recent attention is rumination (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008; Rogers & Joiner, 2017). According to response styles theory (Nolen-Hoeksema, 1991), rumination is repetitively and passively focusing on symptoms of distress and on the possible causes and consequences of these symptoms. Importantly, rumination is not defined by the content of the thought but, rather, the act of perseverative and fixated thought that does not lead to active problem solving (Nolen-Hoeksema et al., 2008). Conceptually, rumination magnifies depressive symptoms, suicidal ideation, and likelihood of attempts by keeping the negative cognitions associated with depressed mood activated for longer, interfering with effective problem solving by encouraging a passive and pessimistic state, and interfering with instrumental behavior and action, leading to an accumulation of unsolved stressors. Law and Tucker (2018) suggest that repetitive negative thinking, such as rumination, increase a sense of entrapment and hopelessness that may enable considering suicide as a prospective outlet and aid the transition from thinking about suicide to suicide attempts through desensitization to violent cognitions experienced during rumination. Rumination has been found to be associated with suicidal ideation concurrently, prospectively and in clinical and community populations (see Rogers & Joiner, 2017 and Morrison & O'Connor, 2008 for reviews). Notably, rumination can be induced in experimental manipulations (Nolen-Hoeksema & Morrow, 1993) and is responsive to both psychosocial and pharmacological treatment for depression (Schmaling et al., 2002), making it an important malleable target for intervention.

Two subsets of rumination have been proposed: brooding and reflection (Treynor et al., 2003). Brooding is a tendency to persevere on negative situations or actions (“Why do I always react this way?”), whereas reflection involves considering the causes for the situation or actions (e.g., writing down feelings and attempting to analyze them). Brooding has been consistently found to be associated with suicidal ideation both cross-sectionally (Cheref et al., 2015; Cole et al., 2015; Tucker et al., 2013) and prospectively (Miranda & Nolen-Hoeksema, 2007; O’Connor & Noyce, 2008). These findings have been demonstrated even after controlling for symptoms of depression and previous suicidal ideation (O’Connor & Noyce, 2008). A recent meta-analysis found a significant association between brooding and suicidal ideation (Hedge’s $g = .63$; Rogers & Joiner, 2017).

Results with regard to reflection, however, are more mixed. Some studies found reflection to be associated with greater suicidal ideation cross-sectionally (Miranda & Nolen-Hoeksema, 2007; Tucker et al., 2013), yet others have proposed that reflection may be unassociated with suicidal ideation or even have a protective role (Treynor et al., 2003). Rogers and Joiner (2017) reported a modest positive relationship between reflection and suicidal ideation across 12 studies (Hedge’s $g = .38$), though four of the twelve studies reported a null relationship within the confidence interval and one study (Crane et al., 2007) reported a negative relationship between reflection and SI. Miranda and Nolen-Hoeksema (2007) proposed that inconsistent findings in the possible link between reflection and suicidal ideation may be attributable to the possibility that reflection has a stronger link with suicidal ideation under specific conditions. Specifically, “attempts to understand the reasons for one’s depressed mood may result in suicidal ideation when individuals are not successful in generating solutions during their problem-solving attempts, or when their attempts at reflection turn into brooding” (p. 3093). Therefore, perhaps reflection is associated with suicidal ideation when an individual’s ability to use adaptive problem solving or coping methods is impaired. Three studies lend support to this possibility. In a cross-sectional sample of college students ($N = 298$), Tucker and colleagues (2013) found that lower levels of hope and optimism were associated with a stronger relationship between reflection and SI. This study also controlled for levels of reported depression. An additional study by Tucker and colleagues (2016) did not find evidence that reflection moderated the relation between defeat and entrapment, in a high-risk sample but did not examine whether the relation between entrapment and suicide risk was moderated by reflection. In a second study, Stange and colleagues (2015) reported that reflection and self-criticism interacted to predict SI prospectively after controlling for depression among a population of 72 adults who had been diagnosed with a bipolar spectrum disorder. Finally, in a cross-sectional sample of college students ($N = 96$), Surrence and colleagues (2009) found that reflection was associated with SI among college students who had a history of suicide attempts, but not among those who had no such history. Given this emerging evidence that reflection may be associated with SI specifically among vulnerable individuals, additional studies that examine this link are needed.

One factor that may be associated with increased vulnerability for ruminative thinking and suicide risk is sleep quality. Sleep problems are common among college students who report suicide risk (Becker et al., 2018; Nadorff et al., 2011) and are associated with impaired emotion regulation, impulsivity, and bias toward negative stimuli (Anderson & Platten,

2010; Dinges et al., 1997). Poorer sleep and rumination are thought to be linked in a transactional cycle such that rumination delays the onset of sleep and reduces sleep quality (Pillai et al., 2014; Takano et al., 2012; Zoccola et al., 2009) and, in turn, lack of sleep contributes to executive functioning impairments that make it more difficult to avoid rumination and negative thoughts (Cox et al., 2015; Cox et al., 2018). In addition to rumination, sleep problems have also been linked to suicide risk. Evidence from cross-sectional, longitudinal, case control, and psychological autopsy studies support a link between sleep problems and suicide risk (Bernert et al., 2015; Pigeon et al., 2012; Woznica et al., 2015). Numerous studies have found that sleep problems are associated with increased suicidal ideation and attempts (Goodwin & Marusic, 2008; Nadorff et al., 2013). Though there is (a) evidence that sleep quality and rumination are associated, (b) evidence that sleep quality and suicide risk are associated, and (c) that rumination and suicidal risk are associated, no study to date has examined whether rumination and sleep quality interact to predict suicide risk, ideation, and attempts. Given the evidence that reflective rumination may be associated with suicide ideation among vulnerable individuals and evidence that poorer sleep quality is associated with increased rumination and impaired executive functioning (e.g., effective problem solving), sleep quality is a clear priority for investigation as a factor that may modify the association between reflective rumination and suicide risk, ideation, and attempts.

The current study adds to the evidence examining the link between rumination, sleep quality, and suicide risk, ideation, and attempts. Using validated measures of rumination, sleep quality, and suicide risk in a large sample, we examined (1) whether brooding and reflective rumination, sleep quality, and suicide risk, ideation, and history of attempts were correlated. Next, we evaluated associations between (2.1) subtypes of rumination and suicide risk (2.2) suicidal ideation, and (2.3) and history of suicide attempts and whether these associations were moderated by sleep quality after controlling for demographic variables. We hypothesized that brooding rumination, reflective rumination, and poor sleep would be correlated with suicide risk, ideation, and attempts, consistent with previous research (Rogers & Joiner, 2017; Pigeon et al., 2012). Further, since previous research has found reflective rumination to be associated with suicidal ideation, but not attempts, among vulnerable individuals (Rogers & Joiner, 2017; Surrence et al., 2009; Tucker et al., 2013), we hypothesized that reflective rumination and sleep quality would interact to predict suicidal risk and ideation, but not attempts. Finally, because previous research has found brooding rumination to predict suicidal ideation and attempts (Rogers & Joiner, 2017), we hypothesized that there would be a main effect of brooding on suicide risk, ideation and attempts.

Methods

Participants

Participants were 1,696 college students enrolled in two public universities in the Midwest United States. Participants ranged in age from 18 to 29 years ($M=18.97$, $SD=1.26$). There were 1,092 women (64.5%), 596 men (35.2%), and 6 participants who indicated their sex as Other (0.4%). The majority (81.8%, $n=1,383$) of participants self-identified as White; the

remaining participants self-identified as Asian/Asian American (7.8%, $n=131$), Black/African American (5.9%, $n=100$), Biracial/Multiracial (4.0%, $n=68$), American Indian/Alaska Native (0.4%, $n=6$), or Native Hawaiian/Other Pacific Islander (0.1%, $n=2$). Seventy-three participants (4.3%) self-identified as Hispanic/Latino. The sex, race, and ethnicity items were not completed by 2, 6, and 2 participants, respectively. Most participants (63.5%) were in their first year of college; the remaining participants were in their second (23.6%), third (8.7%), fourth (4.0%), or other (0.2%) year of college. Samples did not differ with regard to sex, race, ethnicity, sleep status, or depression status between universities. Small differences emerged where students from University 2 were slightly older ($d = .21$) than University 1, and students from University 2 had slightly higher depression ($d = .26$) and suicide risk total scores ($d = .24$) than those from University 1. Additional details regarding this sample can be found elsewhere (Becker, Holdaway, & Luebke, 2018). As detailed by Becker, Luebke, and Holdaway (2018), 69 participants (4% of the sample) reported a history of suicide attempts, 296 participants (17% of the sample) reported ideation “sometimes”, “often”, or “very often”.

Procedures

This study was approved by the local Institutional Review Board (IRB) at each institution and was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments. Participants were students in introductory psychology courses in the 2016–2017 academic year who were provided with the opportunity to participate in research or to complete an alternative activity for course credit. Participants could review available studies through an online portal and read a brief description of available studies prior to opting to participate. Participants at each institution were provided with information regarding the study and informed that participation was optional. If participants chose to participate in the current study, they then completed the survey in Qualtrics anonymously in a single session. All participants received the contact information of the local investigator, IRB, and student counseling center.

Measures

Depression—The depression subscale of the *Depression Anxiety Stress Scales-21* (DASS-21; Antony et al., 1998; Lovibond and Lovibond, 1995) was used to assess depressive symptoms. The depression subscale (e.g., “I felt down-hearted and blue”) consists of seven items, none of which focus on suicide or sleep. Each item is rated using a four-point scale (0 = *did not apply to me at all*, 3 = *applied to me very much or most of the time*). In the present study, Cronbach’s $\alpha = .90$.

Rumination—The *Ruminative Responses Scale* (RRS; Nolen-Hoeksema & Morrow, 1991) was used to assess rumination. The 5-item brooding and 5-item reflection subscales were used in the current study, as recommended by Treynor and colleagues (2003). Items are rated on a four-point scale, ranging from 1 (*Almost never*) to 4 (*Almost always*). The brooding and reflective subscales of the RRS have demonstrated good psychometric properties (Treynor et al., 2003). In the present study, Cronbach’s α s for brooding and reflection were .86 and .83, respectively.

Sleep—The *Pittsburgh Sleep Quality Index* (PSQI; Buysse et al., 1989) was used to assess sleep during the previous month. The PSQI assesses seven well-validated components of sleep: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. A global PSQI score is calculated that reflects total sleep problems with higher scores indicating poorer sleep quality. The PSQI is internally consistent (Buysse et al., 1989; Dietrich et al., 2016), is reliable across four weeks (Lund et al., 2010), correlates with other measures of sleep disturbance and daily diaries of sleep activity (Dietrich et al., 2016), and has been frequently used with college students (Lund et al., 2010; Orzech et al., 2011). In the present study, $\alpha = 0.69$.

Suicide Risk—The *Suicidal Behaviors Questionnaire-Revised* (SBQ-R; Osman et al., 2001) is a four-item self-report measure assessing aspects of suicide risk. The SBQ-R is a validated and reliable measure that can be used to identify suicide risk and behaviors (Osman et al., 2001). The four items assess lifetime ideation/attempt, frequency of ideation over the past 12 months, telling someone else about ideation, and likelihood of attempting suicide in the future. In the current study, a total score of suicide risk (Cronbach's $\alpha = .82$), a continuous variable (SBQ Item 2) that reflects frequency of suicidal ideation from 1 (*Never*) to 5 (*Very Often [5 or more times]*), and a dichotomous variable (SBQ Item 1) reflecting a history of suicide attempts (1) or no history of suicide attempts (0) were used. SBQ Item 1 was dichotomized according to guidelines by the developers (Osman et al., 2001) into attempt and non-attempt subgroups which lumps respondents who indicate the presence of a previous attempt without a desire to die ($n = 38$ in the current sample) and those who indicate a previous attempt with a desire to die ($n = 31$ in the current sample).

Analytic Approach

Survey validity checks—In order to improve the quality of participant responses, we utilized an instructional manipulation check (IMC; Oppenheimer et al., 2009), “trap questions” (e.g., “If you are paying attention, please click on the response ‘sometimes’”), and a question at the end of the full survey that asked participants the following: “How much effort did you put into this study from 0 to 10 (0=*not much effort at all*, 5=*moderate effort*, 10=*my best effort*)?”. The IMC consists of a set of instructions and a question similar to other survey questions, but the instructions indicate that the respondent should ignore the question and click on a specific answer. Respondents were required to answer the question correctly to proceed with the survey. To ensure the validity of responding, we set a threshold of 50% accuracy or higher for the “trap questions” and a self-reported effort rating of 5 or higher to ensure that participants were putting forth sufficient effort while also not excluding participants who might have responded inaccurately due to attention lapses or impulsive responding. This threshold was met by 1,708 of the 1,812 participants (94%) who completed the survey, and 1,696 of these 1,708 participants (99.3%) had complete data for measures included in the current study; these 1,696 participants were used in analyses.

Statistical analyses—Linear and logistic regressions were used to test if sleep quality moderated the relation between rumination and suicide risk (linear), rumination and suicidal ideation (linear), or history of a suicide attempt (logistic). Suicide risk, ideation, and history

of suicide attempt were regressed on brooding, reflection, and sleep quality, as well as the brooding $\times$ sleep quality and reflection $\times$ sleep quality interactions. Age, sex, and race were included as covariates. Covariates were selected based on available demographic information. Worth noting is that recent research (Rogers et al., 2018) proposes that suicide ideation after controlling for depression may be characterized by the “will” for suicide (self-sacrifice, fearlessness, externalizing behavior) because the “desire for death” (passive ideation and depressive cognitions) has been covaried out by the removal of depression symptoms that overlap with this aspect of suicidal ideation. As we believe that this aspect of suicide risk, ideation, and behavior is important to be able to predict, we chose to not include depression as a covariate in our analyses. Following model-testing recommendation (Cohen et al., 2003), models that included the interaction terms were examined first. If either interaction term was nonsignificant, the model was repeated with the nonsignificant interaction term(s) removed. Significant interactions were plotted using procedures outlined by Holmbeck (2002). Specifically, regression equations were calculated separately for participants with average sleep quality, poorer sleep quality (one standard deviation below the mean), and higher sleep quality (one standard deviation above the mean), and substituted values of one standard deviation below and above the mean (± 1 SD) for predictor variable(s) (i.e., brooding and/or reflection rumination) were used in each equation in order to produce graphs of the moderated effect (note, however, that continuous rumination variables were used in all regression analyses). For all regressions, VIF values were below 3 (values >10 are typically considered problematic), and all tolerance values were above 0.20 (values $<.10$ are typically considered problematic) (Cohen et al., 2003), indicating that the regression models did not suffer from problems with multicollinearity.

Results

Correlation Analyses

Table 1 provides the intercorrelations and descriptive statistics of the study variables. As expected, reflection and brooding were significantly associated with each other, but were not redundant ($r = 0.71$, $p < .001$). Both reflection rumination and brooding rumination were significantly associated with sleep quality, with small-to-medium effect sizes ($r_s = 0.27$ and 0.34 , respectively, both $p_s < .001$). Reflection and brooding were moderately correlated with SBQ total score ($r_s = 0.43$ and 0.46 , respectively, $p_s < .001$) and suicidal ideation ($r_s = 0.40$ and 0.42 , respectively, $p_s < .001$) and exhibited small, though significant, associations with a history of attempts ($r_s = 0.14$ and 0.15 , $p_s < .001$). Sleep quality was also significantly correlated with suicide risk ($r = .33$, $p < .001$), ideation ($r = .28$, $p < .001$), and history of attempts ($r = .15$, $p < .001$), with small effect sizes. Given the correlation of demographic variables with constructs of interest, we elected to retain age, sex, and race in regression analyses.

Regression Analyses

Results of the regression analyses are summarized in Table 2, Table 3, and Table 4. In the total suicide risk analyses (Table 2), the original regression model contained a significant reflection $\times$ sleep quality interaction, though the brooding $\times$ sleep quality interaction was not significant. As such, the brooding $\times$ sleep quality interaction was removed and the model re-

run. Above and beyond demographic characteristics (i.e., age, sex, race), there was a main effect of brooding rumination in relation to increased suicidal risk ($\beta = 0.24, p < .001$). In addition, there was a significant reflection $\times$ sleep quality interaction ($\beta = 0.44, p < .001$). As shown in Figure 1, reflection rumination was more strongly significantly positively associated with suicidal risk for college students with worse sleep quality ($\beta = 0.24, p < .001$) than for college students with those with average ($\beta = 0.16, p < .001$) or better sleep quality ($\beta = 0.08, p = .004$).

In the suicidal ideation analyses (Table 3), the original regression model contained a significant reflection $\times$ sleep quality interaction, though the brooding $\times$ sleep quality interaction was not significant. As such, the brooding $\times$ sleep quality interaction was removed and the model re-run. Above and beyond demographic characteristics (i.e., age, sex, race), there was a main effect of brooding rumination in relation to increased suicidal risk ($\beta = 0.22, p < .001$). In addition, there was a significant reflection $\times$ sleep quality interaction ($\beta = 0.43, p < .001$). As shown in Figure 2, reflection rumination was more strongly significantly positively associated with suicidal ideation for college students with worse sleep quality ($\beta = 0.09, p < .001$) than for college students with those with average ($\beta = 0.06, p < .001$) or better sleep quality ($\beta = 0.03, p = .003$).

In the analysis examining history of suicide attempts (Table 4), interactions between reflection $\times$ sleep quality and brooding $\times$ sleep quality were not significant. As such, both were removed and the model re-run¹. After re-running, main effects of brooding ($OR = 1.12, p = .006$) and sleep quality ($OR = 1.16, p < .001$) were detected.

Discussion

This study adds to a growing body of literature documenting an association between rumination and suicide risk, ideation, and attempts (Rogers & Joiner, 2017; Surrence et al., 2009; Tucker et al., 2013). Using a large sample of students from two universities, brooding rumination was found to be associated with suicide risk, ideation, and attempts and reflective rumination was found to be associated with suicide risk and ideation among students with poorer sleep quality. Reflective rumination was not associated with a history of suicide attempts.

To our knowledge, this is the first study to examine sleep quality as a moderator of the relationship between ruminative subtypes and suicide risk, ideation, and attempts. Previous studies by Surrence and colleagues (2009) and Tucker and colleagues (2013) have suggested that reflective rumination may be associated with increased suicidal ideation among some individuals but not others. Consistent with speculation by Miranda and Nolen-Hoeksema (2007) tendency to reflectively ruminate may have less effect on suicide risk and ideation among nonvulnerable individuals. However, when reflective rumination is compromised or tainted by factors such as executive functioning impairment (such as is found among individuals with worse sleep quality), negative cognitive style (e.g., lack of hope, optimism,

¹History of attempts included participants who indicated a history of attempts with or without a desire to die. No changes in the pattern of findings were found in exploratory analyses selecting each of these groups separately (i.e., only those who indicated a history of attempts with a desire to die or only those without).

Tucker et al., 2013), or an existing tendency to consider suicide when faced with difficult situations (e.g., history of suicide attempts; Surrence et al., 2009) it may function as a risk factor for suicidal ideation and risk. The fact that these effects were detected in a college sample that was not selected for high-risk status bolsters the case for further exploring these analyses among vulnerable populations, as reflection may be clinically most relevant among those who are at high-risk for suicidality. In the future, longitudinal designs that can examine the order of effects and causality will be important. Further, experimental designs that examine the effects of sleep restriction or extension on rumination and vice versa over the course of days or weeks would help to disentangle the effects and help to inform priorities for intervention that may help lessen future suicidal ideation and attempts.

Our finding that greater brooding was associated with greater suicide risk, ideation, and attempts in a college sample is consistent with previous findings (Cole et al., 2015; Tucker et al., 2013) and with response styles theory (Nolen-Hoeksema, 1991). Specifically, passively fixating on negative situations and actions appears to be cognitive response style that has a particularly negative relationship with suicide risk, ideation, and attempts. In future longitudinal and cross-lagged research, it will be important to continue to establish the directionality of the association between brooding and suicide risk, ideation, and attempts, as well as mechanisms of these associations. For example, Rogers and colleagues (2017) found agitation and nightmares mediated the relationship between brooding and suicidal ideation; however, Weis and colleagues (2015) reported that rumination and depression mediated the relationship between sleep problems and suicide risk. Clearly more research examining the directionality of effects is warranted.

Few previous studies have focused on the relationship between ruminative subtypes and history of suicide attempts and the current study adds to this small body of literature. Specifically, Rogers and Joiner (2017) only found two previous studies that had examined the relationship between suicide attempts and ruminative subtypes in a college sample (Polanco-Roman et al., 2015; Surrence et al., 2009) making this a clear priority area for continued research. Notably, our sample is the largest of any that has examined the relationship between ruminative subtypes and suicide attempts to date. Our findings are partially aligned with the findings of Surrence and colleagues (2009) that indicated no main effects of ruminative subtypes on suicidal attempts and findings are aligned with Polanco-Roman and colleagues (2015) who found that reflective rumination was not associated with suicide attempts but found a positive association with brooding. Further, even when including those studies in the Rogers and Joiner (2017) review that included clinical samples, the associations between ruminative subtypes and suicide attempts were clearly smaller than those between ruminative subtypes and suicidal ideation (Rogers & Joiner, 2017). Given these potentially differential relationships, more research that specifically examines those factors that differentiate individuals who exhibit only suicidal ideation from those who may actually make an attempt should be a significant public health priority. There is a lack of current research that aids in prediction of the progression from suicidal ideation to suicide attempts and utilizing a conceptual and empirically testable model that differentiates possible risk factors of suicidal ideation from suicide attempts is an important step in developing effective intervention and prevention programming.

Study findings should be considered in light of several limitations. Perhaps most importantly, the cross-sectional design of our study precludes making causal inferences. Given the hypothesized transactional nature of sleep quality, rumination, and suicidal risk, ideation, and attempts, future longitudinal and cross-lagged methods will be key in disentangling causal paths and identifying optimal points of intervention. In addition, our study only included self-report rating scale measures, which may have contributed to mono-informant biases. Also, the PSQI had only moderate internal consistency in our study, and it would be informative for future studies to use multiple sleep measures including objective measures (e.g., actigraphy). Our methods have ecological validity in that screening and intervention initiatives are likely to rely on self-report measures given their efficiency and low cost. Still, including objective sleep measures is an important direction for future work, particularly given recent interest in intraindividual variability of sleep as a predictor of functional outcomes (Becker et al., 2017; Bei et al., 2016), and a recent study found actigraphy-measured sleep variability to outperform depression in a short-term longitudinal study of suicidal ideation in college students (Bernert et al., 2017). In addition, there is recent concern in the literature regarding overestimation of suicide attempt history when measured via single-items, as on the SBQ-R (Hom, Joiner, & Bernert, 2016). Future studies using multi-item or interview formats are needed. Relatedly, though our sample was large, the small proportion of participants who reported a history of suicide attempts in the current sample limits our ability to conduct in-depth exploration of factors associated with a history of attempts, factors that differentiate those with ideation from those with a history of attempts, or difference between those who reported a history of attempts with a desire to die and those who reported a history of attempts without a desire to die. This is an important area for future studies with larger samples and in samples selected for high-risk status. For example, Pompili and colleagues (2013) examined differences in insomnia and suicide history among a high-risk group of adults who presented to an emergency department, finding insomnia was associated with more violent, high-lethality, attempts, which has implications for considering the role that sleep problems may play in the progression from ideation to attempts. Nevertheless, our findings are an important contribution to the extant literature and are of clinical relevance to colleges who may be considering screening for suicide risk. Finally, although our study included college students from two universities, the sample was disproportionately female and White; future studies would benefit from greater diversity. Despite these limitations, findings from the study are the first empirical indication that reflective rumination may be associated with increased suicide risk and ideation among individuals with poorer sleep quality, and help to continue to clarify the role reflective rumination plays in suicide risk, ideation, and attempts.

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Figure 1.
Sleep Quality Moderates the Relation between Reflection Rumination and Suicide Risk.

Figure 2.
Sleep Quality Moderates the Relation between Reflection Rumination and Suicidal Ideation.

Table 1

Intercorrelations and Descriptive Statistics of Study Variables

Variable	1	2	3	4	5	6	7	8	9
1. Sex	--								
2. Race	.01	--							
3. Age	-.17***	-.06*	--						
4. Reflection	.04	-.10**	.07**	--					
5. Brooding	.06*	-.08**	-.001	.71***	--				
6. Sleep Quality	.07*	.02	-.02	.27***	.34***	--			
7. SBQ Total	.05*	-.04	-.01	.43***	.46***	.33***	--		
8. SBQ Item 1	.05*	.00	-.02	.14***	.15***	.15***	.47***	--	
9. SBQ Item 2	.04	-.04	-.01	.40***	.42***	.28***	.88***	.31***	--
<i>Mean</i>	--	--	18.97	9.74	10.65	6.95	5.17	--	1.61
<i>SD</i>	--	--	1.26	3.63	3.89	3.20	2.81	--	1.04

Note. $N = 1,696$. For sex, 0 = male, 1 = female. For race, 0 = non-White, 1 = White. For SBQ Item 1, 0 = no history of suicide attempts, 1 = history of suicide attempts. SBQ = Suicidal Behavior Questionnaire-Revised.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Hierarchical Regression Models Examining Sleep Quality as a Moderator of the Associations between Rumination and Suicidal Risk in College Students

Table 2

	Original Model				Final Model			
	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>B</i>	<i>SE</i>	β	<i>t</i>
	$H(8,1673) = 79.31^{***}, R^2 = .28$				$H(7,1674) = 90.68^{***}, R^2 = .28$			
Sex	.07	.12	.01	.57	.07	.12	.01	.57
Race	-.04	.15	-.01	-.25	-.04	.15	-.01	-.26
Age	-.03	.05	-.02	-.72	-.03	.05	-.02	-.72
Reflection	.00	.06	-.01	-.08	-.02	.04	-.02	-.38
Brooding	.16	.05	.22	2.97**	.17	.02	.24	7.84***
Sleep Quality	-.10	.06	-.12	-1.74	-.09	.05	-.11	-1.75
Reflection $\times$ Sleep	.02	.01	.41	3.27**	.03	.00	.44	5.17***
Brooding $\times$ Sleep	.00	.01	.04	.30	--	--	--	--

Note. For sex, 0 = male, 1 = female. For race, 0 = non-White, 1 = White. SBQ = Suicidal Behavior Questionnaire-Revised.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Hierarchical Regression Models Examining Sleep Quality as a Moderator of the Associations between Rumination and Suicidal Ideation in College Students

Table 3

	Original Model				Final Model			
	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>B</i>	<i>SE</i>	β	<i>t</i>
	$F(8,1673) = 62.81^{***}, R^2 = .23$				$F(7,1674) = 58.86^{***}, R^2 = .23$			
Sex	.02	.05	.01	.48	.02	.05	.01	.48
Race	.00	.06	.00	-.07	.00	.06	.00	-.07
Age	-.02	.02	-.02	-.88	-.02	.02	-.02	-.88
Reflection	.00	.02	-.01	-.13	.00	.02	-.01	-.25
Brooding	.06	.02	.21	2.79**	.06	.01	.22	6.95***
Sleep Quality	-.05	.02	-.15	-2.15*	-.05	.02	-.14	-2.28*
Reflection $\times$ Sleep	.01	.00	.42	3.25**	.01	.00	.43	4.92***
Brooding $\times$ Sleep	.00	.00	.01	.09	--	--	--	--

Note. For sex, 0 = male, 1 = female. For race, 0 = non-White, 1 = White. SBQ = Suicidal Behavior Questionnaire-Revised.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 4
Hierarchical Logistic Regression Models Examining Sleep Quality as a Moderator of the Associations between Rumination and Previous Suicide Attempt in College Students

	Original Model				Final Model			
	B	SE	Wald	OR (95% CI)	B	SE	Wald	OR (95% CI)
	$\chi^2(8) = 62.12, p < .001, \text{Nagel. } R^2 = .13$				$\chi^2(6) = 58.50, p < .001, \text{Nagel. } R^2 = .12$			
Sex	-.37	.30	1.49	.69 (.38, 1.25)	-.36	.30	1.39	.70 (.39, 1.27)
Race	-.13	.34	.15	.88 (.45, 1.71)	-.16	.34	.22	.85 (.44, 1.66)
Age	-.04	.11	.14	.96 (.77, 1.19)	-.05	.11	.19	.95 (.77, 1.18)
Reflection	.28	.12	5.34*	1.32 (1.04, 1.67)	.06	.05	1.73	1.06 (.97, 1.17)
Brooding	.00	.11	.00	1.00 (.80, 1.25)	.11	.05	5.98**	1.12 (1.02, 1.22)
Sleep Quality	.28	.14	3.77	1.32 (1.00, 1.74)	.15	.04	15.54***	1.16 (1.08, 1.25)
Reflection $\times$ Sleep	-.03	.01	3.64	.98 (.95, 1.00)	--	--	--	--
Brooding $\times$ Sleep	.01	.01	1.08	1.01 (.99, 1.04)	--	--	--	--

Note. For sex, 0 = male, 1 = female. For race, 0 = non-White, 1 = White. SBQ = Suicidal Behavior Questionnaire-Revised. Nagel. = Nagelkerke. OR = odds ratio.

* $p < .05$.

** $p < .01$.

*** $p < .001$.