Journal of Psychosomatic Research 77 (2014) 70–75

Contents lists available at ScienceDirect

Journal of Psychosomatic Research

A seven day actigraphy-based study of rumination and sleep disturbance among young adults with depressive symptoms

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ARTICLE INFO

Article history:
Received 24 February 2014
received in revised form 9 May 2014
accepted 11 May 2014

Keywords:
Rumination
Sleep
Actigraphy
Daily sampling
Depression

ABSTRACT

Objectives: Trait ruminators exhibit significantly higher levels of sleep disturbance than those without this cognitive vulnerability. However, support for the sleep disruptive effects of state rumination, especially in the pre-sleep period, is rare, and hindered by methodological drawbacks such as self-report and single night assays of sleep. Finally, despite the pervasiveness of the ruminative response style among individuals with depression, the association between rumination and sleep disturbance has not been explored in this population. The present study employed a week-long daily sampling approach to examine the effects of naturally occurring pre-sleep rumination on self-reported and actigraphy-based sleep among individuals with high depressive symptomatology.
Methods: Forty-two university students (19.6 ± 3.2 yo;73.8% female), all of whom reported at least moderate levels of depressive symptoms, completed a short questionnaire after waking each morning for seven days. On this questionnaire, they self-reported sleep indices from the previous night and levels of engagement in pre-sleep rumination. Sleep was also monitored throughout this period via wrist actigraphy. Hierarchical-linear-modeling was used to examine the association between nightly rumination and sleep.
Results: Nightly variations in pre-sleep rumination were predictive of significantly longer actigraphy- and diary-based sleep onset latency (SOL). Notably, a 1 SD increase on the pre-sleep rumination scale was associated with an approximately 7 minute increase in actigraphy-based SOL, even after controlling for baseline sleep disturbance and depressive symptoms.
Conclusions: These data offer compelling evidence for the impact of pre-sleep rumination on sleep onset, providing insight into one potential mechanism that triggers sleep disturbance among individuals with depressive symptoms.

Introduction

Originally conceptualized as an explanation for the gender disparity in the prevalence of depression and as a cognitive catalyst that amplifies and prolongs depressive episodes, rumination involves passively and repetitively focusing on the self or on dysphoric affect states [1–3]. Empirical data show variously that individuals with depression report significantly higher levels of rumination than do healthy controls [4], that rumination is a risk factor for both incident [5] and recurrent [6] depressive episodes, and that it is significantly associated with depressive severity and duration [7]. A small yet growing literature also implicates rumination in the etiology of sleep disturbance [8], one of the most prevalent symptoms in depression.

Thomsen et al. found significant bivariate correlations between trait rumination and self-reported sleep disturbance, including increased sleep onset latency (SOL) and reduced sleep quality in a non-clinical sample of Danish university students [9]. Notably, rumination was significantly associated with overall sleep quality even after controlling for depressive symptoms. Nearly identical findings emerged in another study of university students in which baseline levels of trait rumination were significantly predictive of poor subjective sleep quality at a three-week follow-up assessment, covarying for baseline depression and anxiety symptoms [10]. Similarly, in a sample of insomnia patients [11], a small proportion (17%) of whom also met diagnostic criteria for depression, participants who scored above the median on a trait measure of rumination reported significantly worse sleep quality, reduced sleep efficiency, and increased wakefulness after sleep onset (WASO). Finally, in a comparison of self-reported good and poor sleepers, poor sleepers reported significantly higher levels of trait rumination [12]. Together, these studies offer converging evidence that individuals with high trait levels of rumination are significantly more likely to experience sleep disturbance than are individuals without this cognitive vulnerability. However, owing to cross-sectional designs, none of these studies were able to assess the association between state rumination and sleep disturbance. Data from experience sampling studies suggest that levels of state rumination vary significantly from day to day as a

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http://dx.doi.org/10.1016/j.jpsychores.2014.05.004
0022-3999/

function of life events or stressors even among trait ruminators, and more importantly that the severity of negative affect following a stressor is commensurate with levels of actual engagement in ruminative perseveration [13,14]. The assessment of state rumination may therefore offer important insight into any within-person variance in the association between rumination and sleep disturbance. This distinction between state and trait rumination is especially critical as individuals with sleep disturbance do not exhibit disturbed sleep every night; even the DSM-V criteria for insomnia disorder stipulate only three nights of sleep disturbance per week [15]. An important clinical question therefore arises: what causes trait ruminators to experience sleep disturbance on a given night?

Two recent studies sought to address this issue. Guastella and Moulds [16] assigned a sample of college students to either a rumination induction task or a distraction exercise of comparable length just prior to sleep on the night following a mid-term examination, a presumed stressor. Analyses revealed that high trait ruminators assigned to the rumination induction reported significantly worse sleep quality than those in the distraction condition and in comparison to low ruminators in either condition. Zoccola et al. [17] employed a similar paradigm in which they assessed the association between state rumination following a stressor and actigraphy-based sleep in a sample of college students. In addition to completing a trait measure of rumination, participants in this study also reported levels of state rumination immediately after delivering a speech that was negatively evaluated by a panel of judges. While trait rumination was significantly associated with longer actigraphy-based SOLs, state-levels of rumination did not independently predict any sleep outcomes. However, there was a significant interaction between state and trait rumination such that high trait ruminators who reported more state rumination experienced the longest SOLs. Though these studies offer partial support for an association between state rumination and sleep, a number of questions remain unanswered. While the Gaustella and Moulds study did not include a manipulation check, the Zoccola study measured state rumination in the afternoon following the induction phase. Thus, neither study was able to establish reliably that participants actually experienced ruminative cognitions during the period right before sleep or while trying to fall asleep. Further, with one exception [17], all prior research on rumination and sleep has relied on self-report measures of sleep. A substantial body of evidence suggests that participants often report sleep disturbance in the absence of any demonstrable disruption in objectively measured sleep [18]. In a recent report, a panel of 25 sleep assessment experts specifically recommended the use of both self-report measures as well as objective assessment techniques such as actigraphy for future research [19]. Another limitation in these studies is the use of data from a single night of sleep assessment. Sleep researchers have long warned against a "first-night" effect on the reliability of sleep measures owing to inadvertent participant reactivity to study protocols [20]. Further, as levels of repetitive thought show considerable within-person variability over time even in short assessment intervals, more state-sensitive measures are warranted to adequately capture these constructs [13].

All extant research on sleep and rumination falls into one of two methodological categories: studies which compare trait ruminators with controls on various sleep indices; and studies which examine the effects of experimentally induced rumination on sleep. While the former fail to account for within-person fluctuations in state levels of rumination, the latter may not be generalizable to the association between sleep and natural variations in rumination. Finally, despite the evidence that individuals with depression experience high levels of rumination [4] and that rumination is predictive of sleep disturbance, we are unaware of any studies that have investigated the rumination–sleep relationship among individuals with depressive symptoms. To address these questions, the present study adopted an actigraphy-based daily sampling approach to examine the association between state rumination and nightly sleep in a sample of young adults with high levels of depressive symptomatology. Participants were assessed for a period of seven consecutive days during which they reported daily levels of pre-sleep rumination, as well as nightly sleep parameters such as SOL, sleep quality, and TST. Using a multi-method approach to sleep assessment, sleep parameters were not only self-reported by participants using a web-based sleep diary, but were also measured objectively via actigraphy. We hypothesized that the effects of pre-sleep rumination will mirror extant findings on trait rumination and sleep. Specifically, pre-sleep rumination will be predictive of longer diary- and actigraphy-based SOLs and poor sleep quality.

Method

Participants

Recruitment strategy and demographic characteristics

Our data derive from a clinical trial on the efficacy of mindfulness-based techniques on sleep among high trait ruminators. Here, we present data from the baseline/control week of the clinical trial when no interventions occurred. Participants were recruited from a large survey study involving undergraduate college students enrolled in psychology courses at a midwestern U.S. university. As there are no clinical cut-offs for current rumination scales, participants in this survey study who scored 1.5 standard deviations above the mean on the Response Style Questionnaire-Rumination (RRS) Scale [3] received electronic invitations ($n = 112$) to participate in the present study. Other inclusion criteria were reliable internet access, adult age, and willingness to wear an actigraph. The first 42 students to respond to invitations and meet above criteria constituted our sample. Similar to the population of high trait ruminators and depressed individuals, female students were overrepresented (74%) in the study sample [2,21]. Other demographic characteristics of this sample reflected the student profile at the university (see Table 1).

Baseline clinical characteristics

Levels of depressive symptoms and sleep disturbance were assessed using the *Beck Depression Inventory—Second Edition (BDI-II)* and the *Pittsburgh Sleep Quality Index (PSQI)* respectively. All participants scored above 21 on the BDI-II with a median score of 35. Given that BDI-II scores above 20 suggest moderate depression and scores greater than 28 indicate severe depression, levels of depressive symptoms were

Table 1
Sample descriptive statistics

	Sample ($N = 39$)			Overall student body ($N = 28{,}602$)
	%			%
Gender (% women)	73.8			59
Ethnicity (% Hispanic)	2.4			3.0
Race (% White)	85.7			86.7
	M (SD)	Median	Min	Max
Age	19.55 (3.20)	19	18	38
RRS	59. 17 (15.46)	57	26	94
BDI-II	37.03 (9.94)	35	22	72
PSQI: total sleep time (hours)	6.41 (1.12)	6	4	9
PSQI: sleep onset latency (minutes)	38 (24)	30	5	90
PSQI: overall score	8.02 (3.45)	2	2	16
PSQI: medication use	%			
Not during the past month	66.7			
Less than once a week	7.7			
Once or twice a week	17.9			
Three or more times a week	7.7			

Note. M = mean; SD = standard deviation; Min = minimum; Max = maximum; PSQI = Pittsburgh Sleep Quality Index; RRS = Response style questionnaire—rumination scale; BDI-II = Beck Depression Inventory—2nd Edition.