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Shortened sleep fuels inflammatory responses to marital conflict: Emotion regulation matters

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ABSTRACT

Sleep problems can boost inflammation and may jeopardize interpersonal functioning, risks that may be magnified in couples. This observational study examined the effects of self-reported recent sleep duration on couples' inflammation, inflammatory responses to a problem discussion, interpersonal behavior, and use of emotion regulation strategies (emotion expression, cognitive reappraisal) during conflict. People who slept less had higher stimulated interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) production after the marital problem discussion than those who slept more. However, using emotion expression and cognitive reappraisal strategies during conflict protected couples who slept less from inflammatory reactivity. Specifically, people's short sleep did not relate to inflammatory increases when they expressed their own feelings more or when their partner reappraised or expressed their emotions more. When both partners slept less, couples interacted in a more hostile way than when at least one partner slept more. These data point to the combination of short sleep and marital conflict as a novel path to heightened inflammation, a risk that partners' emotion regulation strategies may counteract. The study also highlights the role of short sleep in more negative or punishing marital behavior.

1. Introduction

Sufficient sleep is critical for maintaining health and well-being. Short sleep is implicated in premature mortality as well as cardiovascular disease, cancer, obesity, and diabetes (Cappuccio et al., 2011; Cappuccio et al., 2010). In fact, an expert consensus panel recommended 7–9 h of sleep each night to preserve health in adulthood (Consensus Conference et al., 2015).

Short sleep upregulates inflammatory signaling, a key pathway to many chronic conditions. For example, just one night of 4 h sleep deprivation was sufficient to increase messenger RNA transcription and stimulated monocyte production of interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α, Irwin et al., 2006), as well as nuclear factor-κB (NF-κB) activation (Irwin et al., 2008). Similarly, restricting sleep to 6 h per night for one week resulted in heightened resting plasma IL-6 and TNF-α (Vgontzas et al., 2004), suggesting that the inflammatory effects of minor sleep debt may accumulate rapidly across days. On the other hand, a meta-analysis did not find effects for experimental sleep deprivation or subjective sleep duration on IL-6, indicating that short sleep alone may not increase inflammation (Irwin et al., 2016).

Nevertheless, short sleep duration may independently exacerbate inflammatory responses to stressors. Experimentally sleep-deprived people mount exaggerated sympathetic responses to stressful tasks compared to well-rested people (Liu et al., 2015; O'Leary et al., 2015). Because sympathetic activation heightens inflammation (Pongratz and Straub, 2014), increased inflammatory responsiveness may follow short sleep in daily life as well. Inflam-

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matory sensitization to psychosocial stressors may reflect a novel path from short sleep to chronic illness, as inflammatory responses can contribute to long-term health risks beyond the effects of resting inflammation (Pace et al., 2006).

For couples, sleep problems can provoke hostility (Gordon and Chen, 2014; Hasler and Troxel, 2010). In a diary study, men reported more problematic interactions with their wives after a night of disturbed sleep (Hasler and Troxel, 2010). Likewise, couples who slept poorly over 14 nights reported more daily marital conflict than those who slept better (Gordon and Chen, 2014). Poorer sleep quality also increased negative affect and reduced positive affect during a marital problem discussion (Gordon and Chen, 2014). Moreover, just one partner's poor sleep affected not only his or her own mood and empathic accuracy (i.e. the ability to interpret the other partner's emotions) but also impacted the partner's affect and accuracy (Gordon and Chen, 2014). Consistent with sleep quality's effects on couples, people who were sleep-deprived for 36 h were less sociable in a decision-making game with an anonymous partner, and they were less likely to trust their teammate (Anderson and Dickinson, 2010). Thus, shortened sleep also sets the stage for soured social interactions.

Emotion regulation strategies are the behaviors we use to manage and change our emotions. Common strategies include emotion expression (conveying feelings with words and nonverbal gestures) and cognitive reappraisal, i.e., thinking about an upsetting situation from a different perspective. These regulation strategies play a role in the aftermath of sleep loss, but whether short sleep disturbs emotion regulation is unclear. On the one hand, short sleep may increase both inflammation and interpersonal conflict by disrupting emotion regulation. For instance, total sleep deprivation reduced neural communication between emotion-relevant brain regions, resulting in poorer discrimination of emotion cues (Simon et al., 2015; Yoo et al., 2007). Emotion expression may also suffer with shortened sleep: following sleep deprivation, people were less facially expressive and used more negative emotion words and fewer positive words than after a full night of sleep (McGlinchey et al., 2011; Minkel et al., 2011). On the other hand, some studies suggest that a person's emotion regulation strategies remain unchanged after sleep loss and, therefore, protect against its negative consequences. For example, after sleep restriction, people who frequently used cognitive reappraisal paid less attention to negative-emotion faces than did infrequent reappraisers (Cote et al., 2015). Because regulation strategies directly affect interpersonal communication, conflict, and intimacy between partners (Laurenceau et al., 2005), the question of whether they are reduced by or buffer the effects of short sleep is important; the two hypotheses have not been tested together in a single sample.

Sleep is dyadic for many adults: 70% share a bed with their significant other (National Sleep Foundation, 2013). Nevertheless, there is a surprising dearth of studies on short sleep and inflammation in couples. Having a bed partner impacts sleep quantity and quality (Troxel et al., 2007), and beyond the effects of their own sleep problems, people whose partners slept poorly reported poorer health and well-being (Strawbridge et al., 2004). Inflammatory changes may account for this trend: partners' short sleep may serve to boost one another's next-day inflammation and heighten inflammatory responses to conflict, a novel mechanism of short sleep's health effects. Given that partners' poor sleep has also led to increases in negative mood and lower empathic accuracy (Gordon and Chen, 2014), it is important to examine whether short sleep translates to more hostile, less warm behavior during conflict. Furthermore, both partners' emotion regulation use during conflict may modulate the effects of sleep on inflammation.

The first objective of our study was to examine the effects of husbands' and wives' self-reported recent sleep duration on both partners' inflammation and inflammatory reactivity to marital conflict, a potent stressor. We hypothesized that those with shorter recent sleep would have higher morning inflammation and inflammatory reactivity to conflict than people who had slept more, assessed via stimulated IL-6 and TNF-α. We also predicted that people whose partners had slept less would have higher next-morning and post-conflict inflammation, above and beyond the effects of their own sleep duration. Our second objective was to test the effects of both partners' short sleep on their behavior and emotion regulation during conflict. We hypothesized that both partners' short sleep would relate to more negative and less positive behavior during conflict. Finally, we tested emotion expression and cognitive reappraisal strategies both as outcomes of sleep and buffers of the sleep-inflammation tie, expecting that more expression and reappraisal would relate to lower post-conflict inflammation or would attenuate short sleep's effects on post-conflict inflammation.

Table 1
Sample description.

	N(%) or Mean(SD)	Range
Age	38 (8.2)	24–61
BMI	32.1 (5.8)	19.5–46
College educated	58 (67.4%)	
Employed full-time	60 (70%)	
Marital satisfaction (CSI)	124 (33)	7–160
Years married	11.5 (6.6)	3–27
Chronic sleep problems (PSQI)	4.9 (2.5)	1–14
Hours of prior two nights' sleep	6.7 (1.0)	3.5–9

Note: Higher CSI scores indicate greater marital happiness. Higher PSQI scores indicate more past-month sleep problems. CSI = Couples Satisfaction Index; PSQI = Pittsburgh Sleep Quality Index.

2. Method

2.1. Participants

Couples were recruited for a parent study of immune responses to high-fat meals (Kiecolt-Glaser et al., 2015b). An initial online screen and follow-up in-person screen determined eligibility. Couples married fewer than 3 years and those who had sensory impairments that would interfere with study completion were excluded. Couples were not considered if either partner had a chronic health problem including anemia or diabetes (HbA1c > 6.5), smoked, abused substances, or used prescription medication other than birth control (n = 5) or levothyroxine (n = 3). Participants fit our exercise criteria if they engaged in a minimum of 2 h of vigorous activity per week for those with a BMI of <24.99 (normal weight) and 5 h per week for BMI > 25 (overweight or obese).

In the online screen, potential participants completed the 16-item version of the Couples Satisfaction Index; the full version was given at the end of the first visit (Funk and Rogge, 2007). Happier couples were overrepresented among applicants, consistent with evidence that recruiting unhappy couples is a challenge for marital research in general (Bradbury and Karney, 1993). Accordingly, in terms of both inclusion and scheduling, we prioritized dissatisfied couples to represent the full range of marital discord. We also spent considerable time and effort to recruit people who were healthy but overweight to address aims relevant to the parent study's meal component. A total of 350 interested individuals were excluded because either they or their spouse did not meet our stringent health criteria.

The sample consisted of 86 participants (43 couples). Participants were 38.2 years old on average (SD = 8.2, range = 24–61) and primarily White (81%). None of the participants took sleep medication. All couples were married, and the average length of marriage was 11.5 years (SD = 6.6, range = 3–27). Table 1 provides additional sample characteristics.