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Romantic Relationship Satisfaction Is Associated With Sleep in Undergraduate Students

Joshua W. Madsen[1], Laura Hernández[1], Ivan Sedov[1], and Lianne M. Tomfohr-Madsen[1, 2, 3]

[1] Department of Psychology, University of Calgary
[2] Alberta Children's Hospital Research Institute (ACHRI), Calgary, Alberta, Canada
[3] Department of Pediatrics, University of Calgary

Poor sleep is a widespread concern among undergraduate students. Romantic relationships have special prominence in emerging adulthood and have been shown to influence sleep in other adult populations. This study investigated the association between relationship satisfaction and sleep in 60 undergraduate students currently involved in a romantic relationship. Subjective sleep was assessed with the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). Actigraphy was used to assess objective sleep duration, sleep efficiency, wake after sleep onset, and sleep onset latency. Hierarchical regression analyses were conducted. After adjusting for age, body mass index, ethnicity and symptoms of depression, greater relationship satisfaction was positively associated with actigraphy assessed total sleep time and sleep efficiency and negatively associated with wake after sleep onset. No associations were observed with subjectively assessed sleep. Future research should explore mechanisms linking relationship functioning to sleep among undergraduate students. Advocacy efforts should focus on ensuring availability of relational interventions for undergraduate students to optimize their well-being.

Keywords: actigraphy, college students, emerging adults, relationship satisfaction, sleep

University students contend with many stressors associated with academic obligations and unique demands of emerging adulthood—the developmental stage to which many belong—that have implications for sleep. For example, college students implicate emotional and academic stress in their sleep problems (Lund et al., 2010). This is particularly troubling as stress, mental health problems, and pressure to achieve are on the rise among college students (e.g., Brunner et al., 2014). College students also often live in communal and potentially noisy environments (Forquer et al., 2008), which along with a host of other factors could impact sleep patterns. It is not surprising that the transition from high school to college has been found to be associated with less regular sleep-wake cycles, including delayed sleep at night, particularly on weekends (Wolfson, 2010).

Unsurprisingly, poor sleep quality is prevalent among university students (Forquer et al., 2008). Over half of university students are classified as having poor sleep quality (Lund et al., 2010) and report difficulties initiating and maintaining sleep (Amaral et al., 2018). Currently, the National Sleep Foundation recommends between 7 and 9 hr of sleep per night for "young adults" (18–25 years), the age group in which most university students fall (Hirshkowitz et al., 2015). However, research shows that many

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Joshua W. Madsen https://orcid.org/0000-0003-3112-7592
Laura Hernández https://orcid.org/0000-0002-7204-9706
Correspondence concerning this article should be addressed to Joshua W. Madsen, Department of Psychology, University of Calgary, 2500 University Drive NW, Calgary, AB T2N 1N4, Canada. Email: jmadsen@ucalgary.ca

students sleep less than expert recommendations (Doane et al., 2015; Gaultney, 2010; Lund et al., 2010) as well as their own self-reported ideal amount of sleep (Taylor & Bramoweth, 2010). For example, Lund et al. found a mean total sleep time of 7.02 hr in a large online survey of university students, with 25% reporting fewer than 6.5 hr of sleep per night. Students recognize these difficulties and are interested in help from their universities. In a large national survey of undergraduate students, two thirds of respondents rated "Sleep difficulties" as a health-related topic that they would like to receive information about from their institutions (Hartmann & Prichard, 2018). However, only about a quarter of students report receiving such information.

Consequences of Poor Sleep Quality

Short and fragmented sleep is far from innocuous. In college students, later bedtimes, shorter sleep duration, longer time to fall asleep, and inconsistent sleeping patterns have each been associated with lower academic attainment (Baert et al., 2015; Eliasson et al., 2010; Gaultney, 2010; Taylor et al., 2013). In a study of the relationship between sleep and academic functioning among 55,322 undergraduate students, Hartmann and Prichard (2018) found that for each additional day per week that a student reported a sleep problem, their cumulative GPA decreased by .02 and their likelihood of dropping a course increased by 10%. This was the case even after controlling for factors associated with academic success, such as other academic variables, use of alcohol and other drugs, and perceived stress. This is not surprising as sleep deprivation is related to a host of factors relevant to academic functioning, including various higher cognitive processes (Killgore, 2010), greater school absenteeism (Bauducco et al., 2015), emotional dysregulation (Goldstein & Walker, 2014), and poorer decision-making (Harrison & Horne, 2000), and that daytime sleepiness is associated with lower academic motivation (Edens, 2006).

Sleep disturbances are also associated with a range of physical (Irwin, 2015; Irwin & Opp, 2017) and mental health (Alfano & McGlinchey, 2020) problems. Although sleep disturbances are a symptom of multiple psychiatric disorders, they are increasingly recognized as significant problems unto themselves. Furthermore, they contribute to the onset and maintenance of a host of behavioral and mental health problems via a number of proposed mechanisms, such as stressful live events and stress reactivity (Vargas & Perlis, 2020), impulsivity (Hasler & Pedersen, 2020), dysregulation of the hypothalamic-pituitary-adrenal axis (Asarnow, 2020), and inflammation (Tubbs et al., 2020). For example, young adults with lower sleep quality report higher levels of depression (Dinis & Bragança, 2018; Regestein et al., 2010), anxiety (Taylor et al., 2011), and substance abuse (Roane & Taylor, 2008). In addition to predicting negative consequences of alcohol use, global sleep quality also moderates the relationship between alcohol use and consequences among college students. That is, heavier drinkers experience more negative consequences from their use of alcohol (e.g., not able to do homework) when they also report poorer sleep (Kenney et al., 2012). Even among undergraduate students that report generally healthy sleep habits, lower self-rated nighttime sleep duration has been negatively related to greater mental health problems, and nighttime sleep disruptions have been positively associated with anxiety and somatic complaints (Milojevich & Lukowski, 2016).

Romantic Relationships in Emerging Adulthood

In light of the significant and negative consequences of poor sleep health among undergraduate students, identifying modifiable factors that contribute to sleep problems in this population is important. One such factor that may be especially relevant among undergraduate students is romantic relationship quality. Intimate relationships occupy a particularly prominent place among emerging adults. According to Arnett (2007), expectations for love in emerging adulthood "tend to be extremely high—not just a reliable marriage partner but a 'soul mate'" (p. 72). Emerging adulthood has been conceptualized as representing a key transitional stage with respect to relationship functioning, as young adults attempt to effectively integrate romantic relationships with other life goals, like career development (Shulman & Connolly, 2013). Norona et al. (2017) substantiated this perspective by demonstrating that emerging adults "consider both their need to be close with others and their need to follow their own paths for their

careers and desires for family formation" (p. 116). It is not surprising that qualities of romantic relationships have been found to disproportionately affect identity development—relative to friendships—among emerging adults (Barry et al., 2009) and that being in a committed relationship is associated with better well-being among this age group (Braithwaite et al., 2010; Salvatore et al., 2014; Simon & Barrett, 2010; Whitton et al., 2013). Given the salience of romantic relationships in this developmental period, examining relationship functioning to better understand sleep among undergraduate students is a promising area of inquiry.

Sleep and Relationship Satisfaction

A large literature suggests that sleep and social processes mutually influence each other (Gordon et al., 2017), including in the context of romantic bonds (e.g., Troxel, 2010). Healthy relationships promote good sleep quality (e.g., Troxel, 2010) while sufficient sleep fosters higher relationship satisfaction (e.g., Maranges & McNulty, 2017). Researchers have found, for example, that high marital satisfaction results in fewer sleep problems in women (Troxel et al., 2009). On the flip side of the coin, poorer relationship functioning disturbs sleep. For example, more relationship conflict is related to worse self-reported sleep quality in cohabiting partners (Hicks & Diamond, 2011), as well as difficulties with objectively measured sleep (El-Sheikh et al., 2013, 2015). Comprehensive discussion of mechanisms linking relationship functioning and sleep is beyond the scope of this article and can be found elsewhere. For example, Troxel et al. (2007) provide a model of the "dynamic associations" among various relationship variables (e.g., closeness, avoidance) and sleep, via multiple pathways (e.g., behavioral, physiological), and in the context of a number of vulnerability factors (e.g., psychopathology, stressful life events).

The impact of relationship functioning on sleep quality is not surprising when viewed through the lens of attachment theory. Although seminal theoretical and empirical attachment literature emphasized child-caretaker bonds, in recent decades attachment theory has been increasingly invoked to understand romantic relationships in adulthood (e.g., Cassidy & Shaver, 2018; Mikulincer & Shaver, 2017). Among other propositions, attachment theory holds that "threat of loss [of an affectional bond] arouses anxiety" and the "unchallenged maintenance of a bond is experienced as a source of security" (Bowlby, 1980, p. 40). Because sleep is "a vulnerable physiological state that optimally occurs when one feels sufficiently safe and secure to down-regulate vigilance and alertness" (Troxel, 2010, p. 389), and that factors conducive to sleep are largely derived via social relationships (e.g., romantic bonds), attachment has emerged as a promising paradigm to account for the link between relationship and sleep quality. For example, it has been shown that perceived partner responsiveness—or the degree to which a person feels their partner cares for, understands, and appreciates them—contributes to better sleep via lower levels of anxiety (Selcuk et al., 2017). Neural evidence also suggests that stronger bonds confer a calming effect on the brain in the face of threat (e.g., Coan et al., 2006). These findings can be understood in terms of secure attachment, which is characterized by emotional engagement, accessibility, and responsive. Conversely, attachment *insecurity* is associated with sleep problems in adults (Adams et al., 2014; Adams & McWilliams, 2015). Although research is needed to understand how attachment systems and sleep influence each other (Adams et al., 2014), attachment theory adds conceptual weight to empirical observations that relationship factors impact sleep.

Better relationship quality confers benefit among married individuals with respect to physical (e.g., Robles et al., 2014) and mental health (e.g., Whisman, 2007), and limited evidence suggests this extends to university students in committed romantic relationships. For example, among a large sample of college students, Braithwaite et al. (2010) found that being in a committed relationship was associated with fewer mental health problems—specifically those perceived by students as relating to academic difficulties. Moreover, the *quality* of nonmarital romantic relationships—not merely being in one—is associated with better mental health among young adults (Simon & Barrett, 2010). Given the close association of sleep and mental health (Alfano & McGlinchey, 2020), the impact of relationship functioning on sleep observed among married individuals may also be observable among college students. Among 443 Colombian university students, higher levels of

satisfaction in one's romantic relationship were found to be associated with reporting needing fewer hours of sleep to feel rested (Talero-Gutierrez et al., 2017). Also, Huelsnitz et al. (2019) found that the impact of relationship functioning in young adults may have robust and enduring effects on sleep. Data from 112 individuals drawn from a longitudinal cohort study demonstrated that relationship effectiveness at age 23—the extent to which participants were judged to be "competently engaged in romantic relationships" (p. 81) by trained coders of recorded relationship history interviews—was associated with better subjectively rated sleep quality at age 37, but not sleep duration (Huelsnitz et al., 2019).

Previous literature on sleep quality within relationships has mainly focused on the context of marriage (e.g., Chen, Waite, & Lauderdale, 2015), which may not generalize fully to the undergraduate population. Relationships among undergraduate students—as compared to married individuals—are likely to differ in ways that may have implications for sleep (e.g., less likely to cohabitate, shorter duration). Also, marital strain's adverse impact on health may increase with age (Umberson et al., 2006), and so any effects of relationship functioning on sleep observed among older couples may not generalize to university students in magnitude, if even in kind. Examination of the relationship between couple satisfaction and sleep quality among nonmarital student samples is therefore a fruitful area of inquiry. If relationship satisfaction is found to be related to the prevalent and detrimental sleep problems observed in this age group, such knowledge could inform campus intervention strategies (e.g., psychoeducation, couple-based interventions). These efforts hold promise to address students' requests for information about sleep and to ameliorate the substantial academic, health, and societal costs of poor sleep among undergraduate students.

Current Study

Relationships in emerging adulthood are potentially associated with subjective and objective sleep. The research on relationship functioning has largely been conducted on older, married samples, and research on sleep has often relied on assessment at a single time point and subjective measurement (Taylor et al., 2013). Importantly, there are discrepancies between subjective and objective sleep assessment (Zhang & Zhao, 2007). As a result, using both objective and subjective sleep measures provide a more reliable assessment of sleep profiles. The primary aim of the present study was to examine the relationship between romantic relationship satisfaction and sleep, measured both objectively and subjectively, in undergraduate students. It was hypothesized that higher relationship satisfaction would be associated with better sleep quality, fewer insomnia symptoms, and longer and less fragmented sleep, over and above covariates known to influence sleep.

Method

Participants

Participants were drawn from the baseline data of a larger study examining the relationship between facets of mindfulness and sleep in undergraduate students. Participants were recruited through the SONA research participation system at a major university in a large Canadian city. The research participation system (RPS) displays psychology studies recruiting participants at the university where students can self-select to participate based on eligibility criteria in exchange for course credit. To be considered eligible for the study, participants were required to have English proficiency and be at least 18 years of age at the time of the study. One hundred seventy-four psychology undergraduate students participated in the initial study. Only participants who reported that they were in a romantic relationship were included in this study. The resulting subsample included 60 students (50.0% female) between the ages of 18–39 years ($M = 21.0 \pm 4.25$); 95% of the participants were 29 or younger. Half of the participants were Caucasian (50.0%) and 45% lived with their parents. Demographic characteristics of the sample are displayed in Table 1.

Measure

Secondary Measure

Participants self-reported demographics such as age, sex, ethnicity, and socioeconomic indicators (e.g., highest level of education, current household income, and employment

Table 1
Sociodemographic Characteristics of Sample

Sociodemographic variable	(N = 60)
Age (M years, SD)	20.95 (4.25)
Body Mass Index (BMI M, SD)	23.96 (5.93)
Ethnicity (%)	
White	50.0
Asian	26.7
Black	5.0
Pacific Islander	1.7
Hispanic	5.0
First Nation/Indigenous	1.7
Other	10.0
Living conditions (%)	
Living alone	13.3
Living with parents	45.0
Living with roommates	23.3
Living with romantic partner	10.0
Other	8.3
Season (%)	
Winter	16.7
Spring	30.0
Summer	15.0
Fall	38.3

Note. "First Nation" and "Indigenous" are preferred terms for first inhabitants of Canada. These terms correspond to the more familiar term of "Native American" in the United States.

status). Participants also reported on romantic relationship status, duration of the relationship, cohabitation, cosleeping habits, and sexual orientation.

Insomnia Severity Index

The Insomnia Severity Index (ISI) is a seven-item self-report questionnaire evaluating the severity of insomnia symptoms experienced in the last 2 weeks. Items assess difficulties falling asleep, maintaining sleep, waking up early, sleep satisfaction, noticeability of sleep problems by others, interference with daytime functioning and overall distress (Morin, 1993). Items are rated on a 5-point Likert scale with total scores ranging from 0 to 28. Total scores comprise four categories: no clinically significant insomnia (ISI = 0–7); subthreshold insomnia (ISI = 8–14); clinical insomnia with moderate severity (ISI = 15–21); and severe clinical insomnia (ISI = 22–28; Morin, 1993). The ISI has demonstrated convergent validity with clinical interviews, and corroboration against polysomnography and sleep diary measures (Bastien et al., 2001). The ISI has good content validity as it converges with insomnia diagnostic criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; DSM-IV; American Psychiatric Association, 1994; Smith & Wegener, 2003). It has also been found to have high internal consistency in both community and clinical samples (Cronbach's αs of .90 and .91, respectively; Morin et al., 2011). The Cronbach's α for the sample was .88.

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a 19-item scale evaluating sleeping difficulties in the past month along seven dimensions: sleep latency, sleep duration, subjective sleep quality, sleep disturbances, habitual sleep efficiency, daytime dysfunction, and the use of sleeping medications (Buysse et al., 1989). Scores from the seven domains are weighted equally from 0 to 3 and aggregated to form a global score, resulting in scores ranging from 0 to 21, where lower scores indicate healthier sleep quality (Buysse et al., 2008). A systematic review demonstrated the PSQI had good internal consistency (Cronbach's α of .70–.83), construct validity, and discriminative validity (Mollayeva et al., 2016). The Cronbach's α for the sample was .66.

Actigraphy

Objective sleep was assessed using an Actiwatch II, Phillips, USA. Wrist actigraphy is a nonintrusive device that records continuous activity and sleep through movement sensors that estimate sleep parameters with algorithms (Ancoli-Israel et al., 2003). Actigraphy is regarded as a valid instrument for use in objective assessment of total sleep time and wake and sleep onset (Martin & Hakim, 2011). Actigraphers were utilized to measure total sleep time (TST), sleep efficiency (SE), sleep onset latency (SOL), wake after sleep onset (WASO). Devices were configured to collect activity in 30-s epochs. Actiwatch software (Actiware 5.70, Respironics) was utilized to store and analyze actigraphy data. Data were collected on weekdays only to reduce potential sleeping pattern variability between weekdays and weekends.

Actigraphy data were standardized and scored using the Washington cleaning method (Rabbitts et al., 2015). Rest intervals were scored as starting after and ending before 20 consecutive epochs

of sleep equating to 10 min permitting only two wake epochs in between. Sleep periods and naps were corroborated with times specified by the participant in their sleep diary. Rest intervals of at least 3 min were created to start and end the data set for software recognition. Data for the whole day were excluded when daytime activity was less than 8 hr within a 24-hr day. Exclusion intervals were created when sharp breaks in the data suggested removal of the watch for over a 30-min period. Data collected indicating watch malfunctions were also excluded. A reliability analysis was conducted following the scoring by two independent raters. Actigraphy scoring had good internal consistency (Cronbach's α of = .94).

Sleep Diary

Participants were directed to fill out a daily sleep diary to corroborate actigraphy data. Each morning, participants were asked to record the time they went to bed, woke up, naps taken, and time when they removed the actiwatch and put it back on. The sleep diary was used to verify and check for discrepancies in calculated sleep periods or to exclude potential periods when the participant was not wearing the watch (Buysse et al., 2006).

Couple Satisfaction Index

The Couple Satisfaction Index (CSI-16) is a self-report scale containing 16 statements evaluating relationship satisfaction. The first item is rated on a 7-point Likert scale ("Please indicate the degree of happiness, all things considered, of your relationship") and the rest on a 6-point Likert scale (e.g., "I have a warm and comfortable relationship with my partner"). Summation of the 16 items creates a composite CSI-16 score ranging from 0 to 81, with higher scores indicative of greater levels of relationship satisfaction. Scores below 51.5 are interpreted as reflecting significant relationship dissatisfaction. Funk and Rogge (2007) developed the CSI scales using the most psychometrically sound items from other scales. They demonstrated that the CSI-16, when compared to other prevailing measures such the Dyadic Adjustment Scale (DAS; Spanier, 1976) and the Locke-Wallace Marital Adjustment Test (MAT; Locke & Wallace, 1959), has greater power and offers refined sensitivity for detecting different levels of relationship satisfaction (Funk & Rogge, 2007). The CSI-16 demonstrates excellent internal consistency (Cronbach's α of .98) as well as convergent validity with other existing measures of relationship satisfaction (Funk & Rogge, 2007). The Cronbach's α for the sample was .77.

Center for Epidemiologic Studies Depression Scale-Revised

The Center for Epidemiologic Studies Depression Scale-Revised (CESD-R) is a 20-item self-report scale that evaluates depression criteria according to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-V; American Psychiatric Association, 2013; Eaton et al., 2004). Frequency of depressive symptoms including dysphoria, anhedonia, appetite loss, sleeping difficulties, lack of concentration, worthlessness, fatigue, agitation, and suicidal ideation are rated on a 5-point Likert scale scored from 0 (*not at all*) to 4 (*nearly every day for 2 weeks*) (Eaton et al., 2004). Summation of the 20 items results in a composite CESD-R score ranging from 0 to 60. Scores above 16 are interpreted as reflecting risk for clinical depression (Radloff, 1977). The scale demonstrates good internal consistency (Cronbach's α of .92), and good psychometric properties (Van Dam & Earleywine, 2011). The Cronbach's α for the sample was .75.

Procedure

Consent and Data Collection

Individuals who expressed interest in study participation and met eligibility criteria were instructed to contact the study coordinator to schedule a lab visit to receive more information about the research. Participants provided written informed consent for participation. Participants were then asked to complete the questionnaire battery and measurements of height and weight were recorded by a research assistant. Following these procedures, participants were provided with an actigrapher; they were instructed to wear the device on their nondominant wrist for three consecutive nights immediately after the visit. Participants were also asked to complete a sleep diary each morning during this period. After completing three days of actigraphic assessment, participants returned the actigrapher to the lab and were

awarded course credits for their participation. All study procedures were approved by the University Research Ethics Board.

Statistical Analyses

Data were analyzed using SPSS statistical software (SPSS Version 24, IBM). Assumptions for hierarchical multiple regression were tested prior to conducting analyses. Residual and scatter plots demonstrated normality, homoscedasticity, and linearity. Pearson's bivariate correlations were reviewed to check for violations of multicollinearity. Multicollinearity was also examined by reviewing variance inflation factor (VIF) values; all variables were within accepted limits (VIF < 3). An examination of the Mahalanobis distance scores indicated no multivariate outliers. Extreme univariate outliers were evaluated and none resulted in participants' data not being used. Two observations (3.33%) were excluded from analyses of actigraphy data due to values that deviated significantly from sleep diaries (e.g., actigraphy report of 14 min of total sleep where the participant reported 7 hr). There were no missing data, with the exception of a single observation for body mass index (1.67%).

Hierarchical multiple regression analyses were conducted to examine the associations between undergraduates' relationship satisfaction and sleep while accounting for relevant covariates. The covariates were selected due to their established associations with sleep and included: BMI (Fatima et al., 2016), sex (Zhang & Wing, 2006), age (Ohayon et al., 2004), ethnicity (Whinnery et al., 2014), and CESD-R total scores (Dinis & Bragança, 2018). To avoid redundancy with sleep variables, the CESD-R total score excluded this instrument's sleep item. As seasonal variations in objective sleep have been observed in northern latitudes (Hashizaki et al., 2018), season was also included as a covariate. To test our hypothesis, relationship satisfaction was added in a second block to determine its contribution in explaining variance in sleep measures after accounting for other covariates. Relationship duration and bed sharing were initially included in regression models, but were not retained as they were not predictive of sleep outcomes. Descriptive statistics were calculated to describe the clinical and demographic characteristics of the sample.

Result

Participant Characteristics

Table 2 contains descriptive clinical statistics about the sample. Respondents had total sleep time (6.42 hr) below the recommended average for this age group (Hirshkowitz et al., 2015). Overall, the sample had scores indicative of poor subjective sleep quality, subthreshold insomnia symptoms, but good relationship satisfaction; however, there was substantial variability in scores.

Relationship Between Relationship Satisfaction and Sleep Health

Bivariate Pearson correlations between couple satisfaction scores (CSI-16) and sleep variables are shown in Table 3. There were significant associations between couple satisfaction and WASO, and SE such that lower satisfaction was associated with higher WASO and lower SE. Associations were not observed between relationship satisfaction and subjectively assessed sleep quality or insomnia symptoms.

After adjusting for relevant covariates, couple satisfaction was associated with several measures of objectively assessed sleep including TST, WASO, and SE. CSI scores were associated with TST, $F(1, 49) = 4.41$, $p = .041$, $\Delta R^2 = .07$, such that TST increased 1.29 min for each unit score increase on the CSI, resulting in a difference of 1.31 hr between the lowest and

Table 2
Means and Standard Deviations of Key Variables

Variable	*M*	*SD*
PSQI	6.90	3.30
ISI	8.57	5.55
TST	385.32	68.60
WASO	41.29	20.08
SE	83.20	8.91
SOL	16.84	18.35
CSI-16	62.82	15.35
CESD-R	22.45	6.56

Note. PSQI = Pittsburgh Sleep Quality Index; ISI = Insomnia Severity Index; TST = total sleep time; WASO = wake after sleep onset; SE = sleep efficiency; SOL = sleep onset latency; CSI-16 = Couple Satisfaction Index; CESD-R = Center for Epidemiologic Studies Depression Scale-Revised. The displayed CESD-R score excludes the sleep item.

Table 3
Bivariate Pearson Correlations of Key Variables and Covariates

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. CSI	—												
2. PSQI	−.12	—											
3. ISI	−.22	.72**	—										
4. TST	.13	−.09	.01	—									
5. WASO	−.42**	.08	.24	−.24	—								
6. SE	.36**	−.13	−.18	.67**	−.68**	—							
7. SOL	−.18	.03	.06	−.32*	.12	−.65**	—						
8. Age	−.36**	.03	.12	.11	.17	−.02	.09	—					
9. Sex	.25	0	.05	.27*	−.29*	.28*	−.18	−.27*	—				
10. BMI	−.12	.16	.19	.07	−.02	0	.09	.46**	−.02	—			
11. Ethnicity	.19	.02	−.12	−.34**	.05	−.30*	.16	−.13	−.07	−.11	—		
12. Season	−.03	.07	.12	.04	−.01	−.04	.02	−.14	.31*	−.03	−.04	—	
13. CESD-R	−.38**	.38**	.47**	.07	.09	−.05	.07	.06	.17	.22	−.32*	.26*	—

Note. $N = 60$. CSI = Couple Satisfaction Index; PSQI = Pittsburgh Sleep Quality Index; ISI = Insomnia Severity Index; TST = total sleep time; WASO = wake after sleep onset; SE = sleep efficiency; SOL = sleep onset latency; BMI = Body Mass Index; CESD-R = Center for Epidemiologic Studies Depression Scale-Revised. The CESD-R score excluded the sleep item.
* $p <$ .05 two-tailed test. ** $p <$ .01 two-tailed test.

highest scores on the CSI in our sample, $b = 1.29$, $t(49) = 2.10$, $p = .041$. See Table 4.

Couple satisfaction was also associated with WASO, $F(1, 49) = 6.77$, $p = .012$, $\Delta R^2 = .11$, such that WASO decreased .52 min for every one unit increase on the CSI, resulting in a 31.84 min difference between the highest and lowest CSI score, $b = -.52$, $t(49) = -2.60$, $p = .012$. See Table 5.

Table 4
Hierarchical Multiple Regression of Couple Satisfaction Index (CSI-16) Predicting Total Sleep Time (TST)

Predictor	β	*SE*	*t*	*p*
Block 1				
Sex	40.831	17.682	2.309	.025
BMI	−.648	1.941	−.334	.740
Age	3.140	2.193	1.432	.158
Ethnicity	−38.079	16.760	−2.272	.027
Season	−5.293	7.882	−.671	.505
CESD-R	−.742	1.346	−.551	.584
Block 2				
CSI-16	1.292	.615	2.100	.041

Note. Block 1 yielded $F = 2.517$, $p = .041$, $R^2 = .198$ while Block 2 yielded $F = 3.018$, $p = .036$, $\Delta R^2 = .068$. BMI = Body Mass Index; CESD-R = Center for Epidemiological Studies Depression Scale; CSI-16 = Couple Satisfaction Index. The displayed CESD-R score excluded the sleep item.

Finally, couple satisfaction significantly predicted participants' SE, $F(1, 49) = 9.53$, $p = .003$, $\Delta R^2 = .13$. Participants' SE increased by .25% for every one unit increase on the CSI, resulting in a difference of 15.49% between highest and lowest CSI score, $b = .25$, $t(49) = 3.09$, $p = .003$. See Table 6. Couple satisfaction was not associated with SOL, $F(1, 49) = .80$, $p = .375$, $R^2 = .015$.

After adjusting for covariates, CSI scores were not significantly associated with self-reported (i.e., subjective) sleep measures, including sleep quality (PSQI); $b = .01$, $t(51) = .32$, $p = .751$, or insomnia symptoms (ISI); $b = .001$, $t(51) = .02$, $p = .984$.

Discussion

This study was the first to demonstrate a relationship between couple satisfaction and objectively measured sleep within a sample of undergraduate students. As hypothesized, relationship satisfaction was associated with several objectively measured sleep variables, even after adjusting for theoretically relevant covariates, including symptoms of depression. This finding is consistent with previous research conducted among older, married samples (e.g., Prigerson et al., 1999; Troxel et al., 2009). As couple satisfaction increased, so did sleep duration, while wake

Table 5
Hierarchical Multiple Regression of Couple Satisfaction Index (CSI-16) Predicting Wake After Sleep Onset (WASO)

Predictor	β	*SE*	*t*	*p*
Block 1				
Sex	−11.807	5.888	−2.005	.050
BMI	−.431	.646	−.666	.508
Age	.696	.730	.953	.345
Ethnicity	3.378	5.580	.605	.548
Season	1.585	2.625	.604	.549
CESD-R	.478	.448	1.066	.292
Block 2				
CSI-16	−.522	.201	−2.603	.012

Note. Block 1 yielded $F = 1.480$, $p = .213$, R^2=.127 while block 2 yielded $F = 2.505$, p =.012, $\Delta R^2 = .104$. BMI = body mass index; CESD-R = Center for Epidemiological Studies Depression Scale; CSI-16 = Couple Satisfaction Index. The CESD-R score excluded the sleep item.

after sleep onset and sleep efficiency decreased. What is more, these associations were not contingent on bed sharing or relationship duration.

Multiple sleep researchers have underscored the importance of the perception of high-quality social relationships to sleep because this restorative state is a time of vulnerability that requires an experience of safety conferred by social connection (Hawkley & Cacioppo, 2010; Kurina et al., 2011; Troxel, 2010). For example, Hawkley and Cacioppo (2010) stated that "loneliness heightens feelings of vulnerability and unconscious vigilance for social threat, implicit cognitions that are antithetical to relaxation and sound sleep" (p. 221). Although participants in the present study were in committed relationships, loneliness is synonymous with *perceived* and not *actual* social isolation, and is therefore "more closely associated with the quality rather than the number of relationships" (Kurina et al., 2011, p. 1519). It is possible that university students in relatively dissatisfying romantic relationships are prone to loneliness, given the disproportionate influence of these bonds relative to others among emerging adults (Barry et al., 2009). Further, the calming effects of attachment relationships in adulthood (e.g., committed partnerships) have been directly observed in the brain. Neural evidence has demonstrated that romantic partners act as safety signals during threatening experiences, consequently reducing the sensation of pain (Eisenberger et al., 2011) and attenuating threat responses in anticipation of a painful stimulus (Coan et al., 2006). Moreover, these soothing effects are more pronounced among individuals reporting greater perceived partner support (Eisenberger et al., 2011) and marital quality (Coan et al., 2006). Our findings may be partially accounted for by experiences of safety enjoyed by students reporting higher relationship quality, leading to better sleep. Behavioral factors may also account for the observed relationship between relationship satisfaction and sleep. College students in less satisfying relationships may be more likely to spend time socializing at night, drinking, or participating in other activities to be away from their partners, which may detract from healthy sleep.

Table 6
Hierarchical Multiple Regression of Couple Satisfaction Index (CSI-16) Predicting Sleep Efficiency (SE)

Predictor	β	*SE*	*t*	*p*
Block 1				
Sex	5.968	2.478	2.408	.020
BMI	−.035	.272	−.129	.898
Age	.061	.307	.199	.843
Ethnicity	−5.547	2.349	−2.362	.022
Season	−1.141	1.105	−1.033	.307
CESD-R	−.229	.189	−1.217	.229
Block 2				
CSI-16	.254	.082	3.088	.003

Note. Block 1 yielded $F = 2.639$, p=.034, R^2=.206 while block 2 yielded $F = 4.035$, p =.004, ΔR^2 =.121. BMI = Body Mass Index; CESD-R = Center for Epidemiological Studies Depression Scale Revised; CSI-16 = Couple Satisfaction Index. The CESD-R score excluded the sleep item.

Although participants' relationship satisfaction was associated with several objectively measured sleep variables, it was not related to subjective sleep quality or insomnia symptoms. This discrepancy has been shown previously whereby a stronger relationship between marital status (specifically positive marital quality) and TST and WASO from actigraphic measures was observed whereas relationships with self-reported sleep were not (Chen, Waite, & Lauderdale, 2015) and may be accounted for by factors that influence subjective—but not objective—assessment strategies. It is not surprising that these divergent findings between subjective and objective measures emerged, as the two are only weakly associated across multiple populations, including our sample (Chen, Waite, Kurina, et al., 2015; Chen, Waite, & Lauderdale, 2015). Additionally, self-reported sleep (vs. objectively assessed sleep) tends to be

more highly correlated with symptoms of depression (e.g., Grandner et al., 2006). Depth of sleep is sensitive to stressors, such that higher levels of perceived or social stress are associated with less slow-wave sleep (SWS; Tomfohr et al., 2012; Zhang et al., 2019). Although actigraphy does not assess SWS directly, the observed amount of time spent awake after sleep may be a proxy indicating that poor relationship quality is associated with decreased depth of sleep.

Implications and Applications

Understanding students' relationship satisfaction as a modifiable factor implicated in sleep health could guide academic administrative and health professionals in the implementation of effective programs to improve sleep quality. Programs of this nature are also likely to have material benefits for academic institutions and society. For example, Prichard and Hartmann (2019) estimated that the cost of early identification and treatment of sleep problems in university students would be more than offset by the economic benefit of enhanced graduation rates and future earnings. Hartmann and Prichard (2018) also reported that sleep difficulties had similar or larger negative associations with academic achievement than other factors that tend to be focused on to a great extent by university administrators, like stress and binge drinking.

Campus-wide prevention/educational efforts should be a high priority in addressing sleep problems, including relationship functioning as a contributing factor. Campus-wide efforts are justifiable given the lack of an association between relationship satisfaction and self-reported sleep quality. The concept of stages of change (e.g., Norcross et al., 2011) would predict that students acknowledging a sleep problem would be most receptive to and benefit most from interventions to improve sleep and relationship functioning. Those who report relationship problems but not a sleep difficulty would likely be less inclined to partake of intervention, but may be open to information which may subsequently influence treatment readiness. Routine monitoring of relationship status and satisfaction as an element of comprehensive biopsychosocial assessment of sleep problems (e.g., in university wellness centres) and educating student bodies about the social nature of sleep would therefore be important first steps in a coordinated campus response. These interventions may raise awareness among students with lower relationship satisfaction to consider how their sleep may be impacted, even if not experienced subjectively as poor sleep quality per se, and therefore increase motivation to address relationship difficulties. Thorough screening and intervention (e.g., education) would also help address the discrepancy between the large percentage of undergraduate students that express interest in receiving information about sleep from their universities and the relatively few that report receiving any (Hartmann & Prichard, 2018).

In addition to preventative measures, relevant options for intervention exist for clinicians, agencies, and training programs. Stavrianopoulos (2015) found that an 8-week group education program, *Hold Me Tight* (HMT; Johnson, 2008), reduced relationship distress in a small sample of university couples. The success of this program with university students is consistent with research conducted among other clinical samples of couples (Conradi et al., 2018). HMT is based on Emotionally Focused Couple Therapy (EFT; Johnson, 2020), which is rooted in attachment theory and aims to enhance emotional accessibility, responsiveness, and engagement (i.e., attachment security) between romantic partners. This model may therefore be particularly salient in improving sleep via relationship intervention, given evidence that the impact of relationship quality on health is likely mediated by partner responsiveness (Slatcher & Selcuk, 2017). Troxel (2010) provided further support for this possibility, as they found that improvement in marital quality over the course of couple therapy (a large percentage of which was EFT) was associated with a decreased risk of insomnia at 3-month follow-up among men (no such relationship was observed for women). Also, because more positive relationship processes act as stress buffers and tend to be associated with better health (Farrell & Simpson, 2017) further therapeutic benefits of relational interventions beyond improved sleep are reasonable to expect. This basic premise underlies a longstanding tradition of using "general" couple therapy to address co-occurring psychological issues in one partner (e.g., Baucom et al., 2014).

An EFT approach (including HMT) helps couples establish more secure connection and greater relationship satisfaction prior to assisting them in arriving at solutions to pragmatic problems. This sequencing is strategic because problem-solving requires collaboration and

comprise that is unlikely to achieve early in therapy when emotional reactivity is high and even everyday relationship issues tend to be steeped in attachment significance (Johnson, 2020). As with at all stages in an EFT/HMT process, the problems addressed in this later stage of treatment are couple-specific, and could include factors contributing to inadequate sleep (e.g., nighttime routines), if not resolved with improvements in relationship satisfaction alone. For example, early in treatment a request from one's partner to stop reading and turn off the light earlier in the evenings could be interpreted as evidence that one's needs and desires are not important, and experienced as a lack of caring in the relationship. However, later in treatment, in the context of more secure attachment, such a perception is unlikely and therefore more effective collaboration and mutual support more probable.

Further, because sleep is increasingly conceptualized as a dyadic phenomenon for bed partners, recommendations for incorporating romantic partners into cognitive behavioral therapy for insomnia (CBT-I) have also been offered (Rogojanski et al., 2013). Although this model is not primarily an intervention to address relationship satisfaction, the delivery of CBT-I, usually provided in an individual format, has strong evidence in the treatment of sleep problems. The considerations offered by Rogojanski and colleagues highlight for couples and clinicians alike systemic influences on sleep and makes relational factors that may affect sleep more accessible to intervention (e.g., accommodation of poor sleep hygiene). Consistent with the foregoing discussion about the sequencing of EFT interventions, recruiting one partner as a "surrogate therapist" to facilitate treatment for the other partner could be problematic if there is not adequate relationship satisfaction or functioning (see Baucom et al., 2014). Under these circumstances, interventions aimed at enhancing relationship functioning may have to precede a partner-assisted treatment protocol aimed at addressing an "individual" problem, such as insomnia, in one of the partners.

Several further considerations are warranted. First, although promising approaches, HMT and couple-involved CBT-I are untested in the treatment of insomnia and other sleep problems (but see Troxel et al., 2017). However, a large randomized effectiveness trial of partner-assisted CBT-I versus traditional individual CBT-I among bed partners is underway (Mellor et al., 2019). Nevertheless, existing empirical and theoretical literature suggest that application of these manualized approaches are likely to prove quite useful for clinicians addressing sleep difficulties that occur in relational contexts among emerging adults, perhaps beyond more usual, individually-oriented approaches. Second, any effort to assist individuals to improve sleep via couple-based interventions or through a systemic lens should consider clients' place in the family life cycle, as the undergraduate student population includes relatively unattached individuals, married people, and parents of young children in reasonable numbers (Institute for Women's Policy Research, 2020). Although age and relationship status do not appear to significantly influence the relationship functioning-sleep link—at least among individuals identifying as being in committed relationships—some aspects of family life have implications for interventions related to sleep, in particular the transition to parenthood.

Finally, couple-based interventions—those most likely to enhance romantic relationship satisfaction—unfortunately do not appear prominent among college counseling center services (see Brunner et al., 2014). This is a noteworthy gap as relationship problems are among the most common complaints of undergraduate students seeking services in university counseling centers (Brunner et al., 2014; Center for Collegiate Mental Health, 2021), and often the top concern when reported (Center for Collegiate Mental Health, 2021). In fact, Brunner and colleagues conclude that "the intensified emotional and behavioral problems of today's students require a different kind of counseling center ... they must provide outreach and consultation to 'teach' stress management and relationship skills" (p. 277). In spite of the well-documented effectiveness of couple-based interventions in resolving relationship distress and individual symptoms in partners (e.g., Baucom et al., 2014), such services have traditionally been underrepresented in healthcare settings, and college counseling centers appear to be no exception.

Limitations and Future Directions

Several study limitations should be noted. First, the use of a cross-sectional design precluded the establishment of causal relationships. As sleep quality is also implicated in relationship

outcomes (Maranges & McNulty, 2017; Troxel, 2010), longitudinal data would better illuminate the mutual influences among romantic relationship and sleep variables. Second, our study sample was moderate in size, which may have limited our ability to detect some true relationships among study variables. The sample size also did not allow for meaningful subgroup analyses by sex, ethnicity, or sexual preference. Third, we had access to data from only one partner in romantic relationships. Future research should consider the examination of couple satisfaction and sleep quality in larger samples of dyads to best flesh out the influences of relationship functioning on partners' sleep. Actor-Partner Interdependence Models may be particularly illustrative, as would examinations of gender effects. Fourth, we only used a measure of relationship satisfaction, although other relationship variables may be as or more important to sleep. Although satisfaction is perhaps the most commonly measured construct assessed in studies of romantic relationship functioning, and the CSI is a gold standard measure for this purpose, other relationship variables have been implicated in sleep health—such as self-disclosure, conflict, perceived partner responsiveness, and attachment security—and warrant inclusion in future investigations (Kane et al., 2014; Selcuk et al., 2017; Troxel, 2010).

Conclusion

Our findings extend the current literature documenting robust associations between relationship satisfaction and sleep to undergraduate students, and do so via objective measurement of sleep. Understanding pathways through which romantic relationship functioning regulates sleep quality among undergraduates is needed to best address the prevalent and detrimental impact of poor sleep in this population. Future research should elucidate the underlying mechanisms of the relationship between satisfaction and related variables and health among large, diverse samples of romantic dyads. As the association between relationship functioning and sleep may not be static over the lifespan or relationship stage, longitudinal investigations are warranted. This research would be instrumental to the development, implementation, and evaluation of optimal programs to enhance students' sleep and well-being.

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