Published in final edited form as:
Psychosom Med. 2007 ; 69(7): 692–699. doi:10.1097/PSY.0b013e3180cc2ec7.

Attachment Anxiety, Relationship Context, and Sleep in Women With Recurrent Major Depression

Wendy M. Troxel, PhD, **Jill M. Cyranowski, PhD**, **Martica Hall, PhD**, **Ellen Frank, PhD**, and **Daniel J. Buysse, MD**
Department of Psychiatry (W.M.T., M.H., D.J.B.) and the Department of Psychiatry and Psychology (J.M.C., E.F.), University of Pittsburgh, Pittsburgh, Pennsylvania.

Abstract

Objective—To examine the relationship between attachment anxiety, marital status, bed-partner status, and sleep in recurrently depressed women.

Methods—The current study measured polysomnography (PSG) and subjective sleep quality in 107 women with recurrent major depression. Women were categorized as high or low in attachment anxiety based on Bartholomew and Horowitz's Relationship Questionnaire (1991).

Results—There were no significant main or interaction effects of any of the relationship measures on subjective sleep quality. In contrast, PSG results indicated that women with bed partners displayed better sleep efficiency ($p < .005$). Marital status was also associated with sleep efficiency ($p < .05$), and married women displayed significantly shorter sleep latencies as compared with never married women ($p < .05$). Anxiously attached women displayed a reduced percentage of stage 3−4 sleep ($p < .05$). Moreover, a significant interaction between attachment anxiety and marital status ($p < .05$) suggested that anxiously attached women who were previously married (i.e., divorced, separated, or widowed) displayed a particularly low percentage of stage 3−4 sleep.

Conclusions—Depressed women who exhibit an anxious attachment style and have experienced a marital rupture show reduced stage 3−4 sleep, which may signal a concomitant reduction in restorative cognitive and metabolic processes. Relationship context influences sleep continuity. These results provide a more nuanced approach to considering qualitative and structural aspects of relationships that may influence sleep.

Keywords

attachment style; sleep; marital status; bed partner; polysomnography

INTRODUCTION

Married men and happily married women live longer and healthier lives than their unmarried or unhappily married counterparts (1). How marriages “get under the skin” (2) to influence health is less well understood. Previous research has identified several plausible mechanisms through which marriage may affect health, including influencing access to resources, affecting health behaviors, and altering exposure to stress and the concomitant physiological sequelae (3,4). Sleep is an important self-regulatory mechanism that has profound effects on physical

Address correspondence and reprint requests to Wendy M. Troxel, Department of Psychiatry, University of Pittsburgh, 3811 O'Hara Street, Pittsburgh, PA 15213. troxelw@msx.upmc.edu.

health and well being (5,6) and may be linked with relationship quality. Scant research has investigated links between relationship quality and sleep.

Sleep is a physiologically vulnerable state that optimally occurs when one feels sufficiently secure to down-regulate vigilance and alertness—a felt experience that is largely derived from the social context (7). Attachment theorists (8,9) have long suggested that secure relationships facilitate health and well being by attenuating stress responses and providing a sense of safety and security. Given that sleep is typically a shared health behavior between husbands and wives or cohabiting partners, understanding the interface between attachment security and sleep may elucidate how some relationships confer health benefits whereas others confer health risks.

The relationship between attachment style and sleep may be particularly pronounced in depressed patients, who have been shown to have increased rates of both insecure attachment (10) and sleep disruption (11,12). Depression is also an independent predictor of cardiovascular disease, morbidity, and mortality (13). Thus, depressed persons represent a high-risk group for relationship and sleep problems as well as physical health problems. The present study was developed to investigate the associations among attachment style, subjective sleep quality, and polysomnographic (PSG) sleep parameters in a sample of recurrently depressed women.

Attachment and Sleep

Attachment theory posits that early interactions with caregivers lead to the development of expectations regarding the degree to which the caretaker is warm, nurturant, and consistently available and responsive to one's needs (14). Whereas parents or caregivers serve as attachment figures in infancy and childhood, romantic partners or spouses typically serve as attachment figures in adulthood (15). Categorically, the adult attachment literature has differentiated between Secure, Dismissing-Avoidant, Preoccupied (anxious-ambivalent), and Fearful-Avoidant styles (16). However, recent evidence suggests that trait attachment is effectively characterized by two distinct dimensions: anxious attachment (characterized by anxiety about abandonment) and avoidance (characterized by discomfort with closeness or dependency) (17). Mapping the categorical approach within this two-dimensional space, Preoccupied and Fearful-Avoidant styles score high in attachment anxiety, whereas Dismissing-Avoidant and Fearful-Avoidant styles score high in avoidance (16).

Two studies have investigated the relationship between adult attachment and subjective sleep parameters in humans (18,19). Scharfe and Eldredge (19) found that, among college students in committed relationships, higher scores on fearful-avoidant and preoccupied attachment styles were associated with poorer subjective sleep quality. In contrast, a dismissing-avoidant style was associated with poorer sleep quality among the students who were not in a committed relationship. These findings highlight the importance of relationship context when evaluating the attachment-sleep association. However, the findings may not generalize beyond young, unmarried undergraduates. In addition, the primary outcome was subjective sleep quality, and the authors did not control for the potential impact of concurrent depressive symptoms.

In a sample of 78 married couples, Carmichael and Reis (18) similarly showed that attachment anxiety, but not attachment avoidance, was associated with poorer subjective sleep quality, even after controlling for depressed affect. Because this study only included married couples, it did not address the role of attachment in nonmarried individuals. No study to date has investigated the association between attachment and PSG sleep parameters.

Consistent with the limited empirical findings, sleep theory would indicate a potential relationship between patterns of anxious attachment and sleep outcomes. Sleep is a behavior which requires one to be in a state of reduced responsiveness, vulnerable to potential external threats, and thus poses a threat to survival (20). Chronic physiological hyperarousal combined

with cognitive vigilance are implicated in the pathophysiology of insomnia (21,22). Similarly, evidence suggests that anxiously attached individuals show greater physiological reactivity to relational stressors (9,23) and have chronic separation-related thoughts (24). Thus, anxious attachment styles may predispose to sleep problems by influencing stress-arousal systems and cognitions related to the emotional and physical availability of the partner. In contrast, nonanxious attachments may promote deeper, more restorative sleep by reducing vigilance and providing a sense of safety and security. Thus, we would hypothesize that individuals with higher levels of attachment anxiety will display greater sleep disruption.

Marriage, Bed Partners, and Sleep

According to attachment theory, attachment-related concerns are most likely to manifest in the context of close relationships. Given that the marital relationship is the primary attachment for most adults, there are a number of reasons to consider the attachment-sleep association in the context of marriage. Epidemiological evidence suggests that divorced/separated individuals are at increased risk for sleep problems as compared with married or single individuals (25, 26), suggesting perhaps that the stresses of discordant marriages and the subsequent aftermath of marital rupture have significant consequences for sleep (27). According to the National Sleep Foundation (28), 61% of adults share a bed with a significant other, rendering sleep a “shared health behavior” between husband and wife or cohabiting partners. Notably, this statistic highlights the fact that marital status is an imperfect proxy of whether or not one has a bed partner (i.e., bed-partner status), because a significant proportion of married individuals are not sleeping together. We emphasize this distinction because the association between attachment and sleep may depend not only on the marital context but also on the sleeping context itself—a distinction that is rarely tested in sleep studies.

Current Study

In aggregate, the existing, if limited, evidence suggests that attachment anxiety may be an important correlate of subjective sleep quality, and the effects may depend on the relationship status. The aims of the present study were two-fold. First, we sought to extend the previous literature on attachment and subjective sleep by examining the relationship between attachment and sleep on subjective sleep quality and PSG sleep outcomes in a clinically depressed sample. Based on theory and the limited existing evidence, we hypothesized that depressed women characterized by high levels of attachment anxiety would have poorer subjective sleep quality and would exhibit more disturbances in PSG parameters (i.e., shorter sleep duration, increased sleep latency, decreased sleep efficiency, decreased percentage of stage 3−4 sleep, increased rapid eye movement (REM) density, and decreased REM latency) relative to depressed women characterized by low attachment anxiety. Second, we sought to examine the extent to which the relationship between attachment and sleep is moderated by marital status or bed-partner status.

METHOD

Participants

All study procedures and materials were approved by the University of Pittsburgh Institutional Review Board. Participants included 107 women with recurrent major depressive disorder (MDD) who enrolled in an outpatient treatment study (Grant MH 49115, E.F., Principal Investigator) of the effects of Interpersonal Psychotherapy Maintenance (IPT-M, on subsequent remission/recurrence). Detailed descriptions of the recruitment and inclusion/exclusion procedures are available in previous publications (10). The participants had to: a) be in a current episode of MDD, as documented by structured clinical interview (using the Schedule for Affective Disorders and Schizophrenia (29) or the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (30)) with depressive

symptoms of at least modest severity (defined by a Hamilton Rating Scale for Depression (HRSD) score of ≥15) (31); b) have at least one prior episode of MDD occurring no more than 2.5 years before the index episode, with a complete symptomatic remission for at least 10 weeks between episodes; and c) be a female between the ages of 20 and 60 years. Participants were excluded if they met the criteria for a lifetime diagnosis of schizophrenia, schizoaffective disorder, organic affective syndrome, unspecified functional psychosis, bipolar I disorder, cyclothymic disorder, borderline or antisocial personality disorder, or had a history of alcohol/substance dependence in the past 2 years. We also excluded a small number of participants who had a diagnosis of bipolar II disorder (n = 11). Individuals who had a significant medical illness or were taking medically prescribed medications that could influence mood or sleep were excluded from participation. Participants in the sleep studies maintained a regular sleep-wake schedule with no rotating or night-shift work as determined by self-reported sleep-wake diaries. Finally, participants were required to be medication-free of all psychotropic medications for at least 2 weeks before the sleep studies.

Treatment Protocol

All participants were first treated with 12 to 24 weekly individual IPT sessions until remission of the current depressive episode or until a determination of nonresponse was made. Data in the current report were collected from study entry and after the acute treatment phase only, from 1992 to 1999.

Measures

Characteristic Demographics—Participants reported their age (at study entry), marital status, ethnicity, and highest level of education (in years).

Depression Severity—At study entry and before each therapy session, women were administered the HRSD (31) by a trained, independent clinician. The HRSD is a clinician-administered interview scale that assesses the presence and severity of 17 symptoms of depression experienced in the past week using a varied response format ranging from 0 to 2 to 0 to 4 (with higher scores indicating greater depression severity), and exhibits well-documented reliability and validity (32). Given that the HRSD includes three items which pertain to sleep disturbance, we removed these three items from all subsequent analyses. The mean ± standard deviation (SD) depression score on the 17-item HRSD was 18.64 ± 2.92 and the average on the 14-item scale (i.e., sleep items removed) was 16.03 ± 2.60.

Attachment Anxiety—We used Bartholomew and Horowitz's Relationship Questionnaire (RQ) (33), which consists of four brief vignettes, describing each of the four adult attachment profiles: Secure, Dismissing-Avoidant, Preoccupied, and Fearful-Avoidant patterns. The RQ, a widely used measure of adult attachment, shows adequate reliability with observer-based ratings of behavioral and personality characteristics (34). To avoid depressive response bias caused by severe depressive symptoms, participants completed the RQ only after they had achieved an HRSD score of <10, or, on average, 12.8 ± 6.9 weeks post study entry. For the present study, we initially classified attachment style based on the participant's response to which of the four prototypes is “MOST LIKE YOU.” We combined the Preoccupied and Fearful-Avoidant profiles and the Secure and Dismissing-Avoidant profiles, as these combined attachment profiles represent high and low anxiety classifications, respectively (17).

Sleep Measures

PSG Sleep. Participants completed three nights of PSG sleep studies during their habitual sleep-wake times, as determined by self-report sleep-wake diaries. For the present analyses, we included data from night 2 only, given the well-documented adaptation effects associated with

the first night of a PSG study (35), and because some participants were missing night 3 PSG data ($n = 8$) or had serial blood samples obtained throughout night 3 ($n = 4$; as a part of a separate study protocol), which could interfere with the sleep results.

Sleep studies were conducted at pretreatment baseline when participants were depressed. Participants were medication-free of all psychotropics for at least 14 days before the sleep study. The standard sleep montage included a single channel of electroencephalogram (EEG) (C_3 or C_4 referenced to A_1 or A_2), bilateral electrooculogram (EOG) referenced to A_{1-} $A_{2,}$ and bipolar submental electromyogram (EMG). PSG data were collected (Model 78 amplifiers, Grass Technologies, West Warwick, RI) with filter settings of 100 Hz and 0.3 Hz for EEG and EOG, and 90 Hz and 10 Hz for EMG, and a sensitivity of 5 μV/mm. As previously described (36,37), sleep studies were visually scored in 60-second epochs by technicians who maintain a high-level of scoring reliability as indicated by mean κ values of >0.60 for various sleep stages using standard criteria (38).

The derived sleep variables included total sleep duration, sleep latency (time from beginning of the recording period to the first of 10 consecutive minutes of stage 2 or stage 3−4 sleep interrupted by no more than 2 minutes of stage 1 or wakefulness), sleep efficiency (time spent asleep/total recording period × 100), percentage of time spent in slow-wave sleep (sum of sleep stages 3 and 4/time spent asleep × 100), REM latency (time between sleep onset and the first REM period with ≥3 consecutive minutes of REM sleep), and REM density (visually scored estimate of the amount of eye movement activity ona0to8 scale for each minute of REM divided by REM time). Sleep variables with skewed distributions (i.e., sleep latency, efficiency, % stage 3−4, REM density, and REM latency) were normalized using natural logarithmic or square root transformations.

Subjective Sleep Quality—The Pittsburgh Sleep Quality Index (PSQI) (39) was used to assess subjective sleep. The PSQI is a widely used, well-validated, 19-item self-report scale, spanning seven categories that assess sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. Participants are asked to respond to questions about their sleep in the past month. A global score was computed by summing the scores from the seven sleep categories, with a total possible range from 0 (good sleep quality) to 21 (poor sleep quality). Because of missing participant data, the *n* for analyses using subjective sleep quality (i.e., global PSQI score) is 99.

The PSQI also includes an item that asks participants if they have a “regular bed partner.” Because of our interest in the effects of stable relationship context on sleep, participants who responded that they regularly slept with a partner in the same bed were classified as “having a bed partner”; all others were classified as having “no bed partner.” Ninety-seven participants reported their bed-partner status.

Statistical Analyses

A total of 121 participants had PSG data and attachment data available; however, we excluded 11 participants with diagnoses of bipolar II and three participants whose sleep studies occurred >2 years after the psychosocial assessments (>2 SD away from the mean length of time between assessments).

The *t* tests and χ^2 tests were performed to explore potential differences in attachment group, marital status, and bed-partner status related to demographic characteristics (age, education, ethnicity), and clinical variables (age at onset of first depressive episode, length of index episode, number of previous depressive episodes, and baseline HRSD).

For all of the sleep outcomes, we statistically controlled for age at study entry, HRSD scores, and the length of time between the psychosocial assessment and the sleep study. The general linear models included the main effects of attachment and either marital status or bed-partner status (in separate models), and the interaction between attachment and marital (or bed-partner) status. The dependent variables included global PSQI score, PSG-assessed total sleep time, sleep latency, sleep efficiency, percentage of stage 3−4 sleep, REM density, and REM latency. For any significant effects, post hoc comparisons using Tukey's Honestly Significant Difference tests or Bonferroni adjustments for multiple comparisons were conducted.

RESULTS

Sample Characteristics

Thirty-six percent (n = 39) of participants were married, 38% (n = 41) were never married, 19.6% (n = 21) were divorced, 1.9% (n = 2) were separated, and 3.6% (n = 4) were widowed. Because of the small numbers of separated and widowed women, these groups were combined with the divorced group to comprise a “previously married” group. Based on the participants’ responses to the item on the PSQI regarding regular sleeping arrangements, 48% (n = 47) said they “have a regular bed partner.”

There were no significant differences by attachment or bed-partner status on any of the demographic or clinical variables. Table 1 depicts the demographic and clinical characteristics for the total sample and by marital status. The never married women were significantly younger at study entry than the married or previously married women. The never married women also tended to have a younger age of first depression onset ($p < .10$); however, this relationship was not significant, after controlling for participant age at study entry.

Attachment Style

On the item that asked participants to rate which of the attachment profiles is “most like you,” 20.6% of the women reported Secure (n = 22); 17.8% (n = 19) reported Dismissing-Avoidant; 22.4% reported Preoccupied (n = 24); and 39.3% (n = 42) reported Fearful-Avoidant. From these categories, we combined the secure and dismissing-avoidant groups to create a “low-attachment anxiety” group (n = 41); the preoccupied and fearful-avoidant categories comprised the “high-attachment anxiety” group (n = 66).

Marital Status, Bed-Partner Status, and Attachment Anxiety

Ninety-two percent (n = 35) of the married women had a bed partner. An additional 13% (n = 3) and 24% (n = 9) of the previously married and never married women, respectively, also reported having a bed partner. There were no differences in attachment anxiety according to marital status or bed-partner status ($p > .10$)

Group Differences in Sleep Outcomes

For descriptive purposes, we present the unadjusted and untransformed mean and SD values for each of the sleep outcomes according to attachment style, marital status, and bed-partner status in Table 2.

In the full interactive models that included the main effects of marital status and attachment anxiety as well as their interaction (Table 3), we found a significant main effect of marital status on sleep efficiency and sleep latency (partial eta-squared = 0.08 and 0.07, respectively; $p < .05$). Post hoc comparisons were nonsignificant for sleep efficiency. However, post hoc comparisons demonstrated that the married women had significantly shorter sleep latencies as compared with the never married women.

There was a significant main effect of attachment anxiety on the percentage of stage 3−4 sleep ($p < .05$; partial eta-squared = 0.05), and a significant attachment × marital status interaction ($p < .05$; partial eta-squared for the interaction term = 0.13). As depicted in Figure 1, previously married women with high levels of attachment anxiety displayed the lowest percentage of stage 3−4 sleep. Post hoc comparisons of the groups depicted in Figure 1 indicated that the anxiously attached, previously married group displayed a significantly lower percentage of stage 3−4 sleep as compared with the nonanxious, married, nonanxious, previously married, and anxious, never married groups.

In the models including attachment anxiety, bed-partner status, and their interaction (Table 4), having a bed partner was associated with better sleep efficiency ($p < .01$; partial eta-squared = 0.07). In addition, there was a significant main effect of attachment on sleep latency ($p < .05$; partial eta-squared = 0.04), such that the nonanxious women had shorter sleep latencies. There were no significant interactions between attachment anxiety and bed-partner status on any of the sleep outcomes.

Given that there were differences among the groups on select clinical and demographic factors (Table 1), we conducted more conservative follow-up analyses for all significant outcomes, controlling for all clinical variables (age at first onset, number of previous depressive episodes, and baseline HRSD symptoms) and demographic variables (age at study entry, ethnicity, and education). The results were virtually unchanged in these analyses and all significant effects persisted.

DISCUSSION

Emerging evidence suggests that the quality of close personal relationships has important implications for health, well being, and longevity (1). Investigations of the pathways linking relationship quality with health have largely overlooked sleep—an important health behavior that is linked with both morbidity and mortality (5,6) and that is typically “shared” between spouses or cohabiting partners (28). The present study provided a preliminary examination of the association between sleep and one important aspect of relationship functioning, attachment style, within specific relationship contexts, within a well-characterized sample of recurrently depressed women.

The pattern of results showed that, relative to recurrently depressed women with low levels of attachment anxiety, depressed women with high levels of attachment anxiety had a lower percentage of stage 3−4 sleep, particularly if the women were previously married. We also found a significant association between marital status and sleep efficiency, although post hoc comparisons were nonsignificant. Married women had significantly shorter sleep latencies as compared with never married women. In addition, we found that having a regular bed partner was associated with higher sleep efficiency. When including bed-partner status in the model, there was also a significant effect of attachment style on sleep latency. Contrary to predictions, however, the anxiously attached women had shorter rather than longer sleep latencies. Considering that the anxiously attached women also had lesser stage 3−4 sleep, it is possible that their shorter sleep latencies reflect increased need for sleep (i.e., greater homeostatic sleep drive).

Consistent with recent evidence in the marital quality and cardiovascular health literature (40), our findings highlight the importance of evaluating the qualitative aspects of relationship functioning simultaneously with relationship status or structure. Specifically, by evaluating attachment style within the context of marital status, we showed that anxiously attached women who had experienced a relationship rupture may be particularly vulnerable to reductions in stage 3−4 sleep. Similarly, Cartwright and colleagues (41) reported that individuals who were

undergoing a divorce had reduced percentages of stage 3−4 sleep as compared with those for whom the divorce was final. Given that stage 3−4 sleep has shown suggestive links with restorative cognitive and metabolic processes (42), these findings suggest that recurrently depressed women characterized by anxiety in relationships and who have experienced the stresses of a relationship rupture may be at particularly heightened risk for physical health problems, including cardiovascular disease and metabolic disorders.

Our findings are also unique in precisely defining the context of the relationship. Marital status was associated with both sleep latency and sleep efficiency. In addition, having a bed partner was associated with better sleep efficiency. To date, sleep research has largely considered sleep as an individual phenomenon, with little consideration of the dyadic nature of sleep for most adults (43,44). Inferences that are made regarding adaptation effects or homeostatic mechanisms of sleep based on laboratory sleep studies (in which the individual generally sleeps alone) may be biased because of the failure to take into account the dyadic nature of the individual's usual sleep environment.

In contrast to the two previous studies (18,19) on attachment style and subjective sleep quality in nonclinical samples, we found no association between attachment style, marital status, or bed-partner status and subjective sleep. Our failure to replicate the previous results is likely because of the greater prevalence and severity of sleep disturbance and sleep complaints in a clinically depressed population, as compared with a general population of married adults or college students. For example, Carmichael and Reis used a cut-point of a score of 5 on the PSQI to identify disturbed sleepers. In our sample, however, 83% of the women had PSQI scores of >5 (18). Thus, there may have been a ceiling effect with respect to self-reported levels of subjective sleep disturbance, reducing our ability to detect differences in sleep complaints among the different relationship groups.

The significant effects we reported were relatively small (partial eta-squared = 0.04−0.13) but comparable to the effect sizes we obtained for age, a well-documented risk factor sleep disturbance. Similarly, depressive symptoms were unrelated to the PSG outcomes in the present study, despite the well-documented association between depressive symptoms and sleep disturbance in the extant literature.

The present analyses represented secondary analyses of an existing dataset. As such, the findings must be considered in the context of several limitations. Specifically, the nature of the study sample and associated constraints on variability imposed by the inclusion and exclusion criteria for the parent study may limit the generalizability of study results to recurrently depressed women. The small cell sizes, particularly for the interaction terms, may have limited our power to detect significant effects. In addition, current PSG sleep research conventions now use 20- or 30-second scoring epochs, rather than the 60-second scoring epochs used in the current study. Although shorter scoring epochs may provide greater precision in sleep staging, particularly in sleep-disordered populations (45), our sleep laboratory has demonstrated that sleep variables obtained from 60- versus 20-second epochs are highly correlated (with *r* ranging from .95 to .99 in a sample of approximately 360 sleep records).

Other assessment limitations are worthy of note. First, bed partner status was obtained from a single item drawn from the PSQI. Women may have differentially interpreted what it means to have a “regular bed partner,” which may have added heterogeneity to this variable. In addition, by focusing analyses on the anxious attachment dimension, we essentially ignored potential heterogeneity related to the avoidant attachment patterns. However, exploratory analyses (data not shown) comparing the four attachment categories showed a similar pattern of results, despite being limited by small cell sizes. Even with the use of the anxious attachment

dimension, power may have been limited to detect significant associations, particularly for the interactions.

The reported associations may not hold within male study samples or the magnitude of the association may differ for men and women. The two previous studies on attachment style and sleep quality, although likely underpowered, did not find a moderating effect of gender (18, 19). Nevertheless, an existing body of evidence suggests that, as compared with males, females display greater levels of relational interdependence as well as greater emotional sensitivity (46) and physiological reactivity (1) to marital problems or negative marital interactions. Thus, women's sleep may similarly show greater sensitivity to relational factors. Moreover, drawing on evolutionary theories of sleep (20), the association between relationship quality and sleep may be stronger in women than in men, given women's traditional reliance on the larger, more physically aggressive male bed partner to ward off potential animal or human predators from the evolutionary past. However, this question awaits future research with larger study samples of men and women.

Finally, we hypothesized that attachment style would be associated with sleep outcomes, but the cross-sectional nature of the study precludes inferences regarding causality. Given that sleep deprivation is known to impair cognitive and social functioning (47), it is also plausible that poor sleep had cumulative effects on relationship functioning leading to different patterns of attachment. It is also possible that some other third variable or set of variables could account for the reported associations.

These limitations notwithstanding, the current study has several strengths. Our study is the first to investigate the association between attachment style and PSG outcomes in a clinically depressed population. In addition, we highlighted the utility of simultaneously evaluating the influence of attachment style and two measures of relationship structure. Finally, the current study cohort of recurrently depressed women represents a high-risk population that is vulnerable to interpersonal difficulties as well as sleep and other physical health problems. Our findings suggest that understanding patients' relationship histories as well their current relationship dynamics has important implications for sleep. These findings show preliminary support for a theoretical model that suggests that high levels of anxiety in relationships may lead to sleep disturbance, but replication of these findings is clearly needed in both clinical and nonclinical samples, as our findings may not generalize beyond mid-life women with well-established histories of recurrent depression. Understanding the links between relationship quality and sleep may elucidate a key pathway through which relationships ultimately influence health and well-being.

Acknowledgments

This research was supported by Grants HL-076852/076858 (D.J.B., J.M.C., M.H.), MH-49115 (E.F.), T32 MH-016804 (W.M.T.), MH-24652 (D.J.B., M.H.), AG19362 (D.J.B., M.H.), and RR-00056 (D.J.B., M.H.) and MH-64144 (J.M.C.) from the National Institutes of Health.

Glossary

PSG, polysomnography; MDD, major depressive disorder; REM, rapid eye movement; PSQI, Pittsburgh Sleep Quality Index; HRSD, Hamilton Rating Scale for Depression; IPT-M, Interpersonal Psychotherapy Maintenance; RQ, Relationship Questionnaire; MS, marital status; A, attachment style; BP, bed-partner status.

REFERENCES

1. Kiecolt-Glaser JK, Newton TL. Marriage and health: his and hers. Psychol Bull 2001;127:472–503. [PubMed: 11439708]
2. Taylor SE, Repetti RL, Seeman T. Health psychology: what is an unhealthy environment and how does it get under the skin? Annu Rev Psychol 1997;48:411–47. [PubMed: 9046565]
3. Smith TW, Gallo LC. Hostility and cardiovascular reactivity during marital interaction. Psychosom Med 1999;61:436–45. [PubMed: 10443751]
4. Wickrama KAS, Lorenz FO, Conger RD, Elder GHJ. Marital quality and physical illness: a latent growth curve analysis. J Marriage Fam 1997;59:143–55.
5. Dew MA, Hoch CC, Buysse DJ, Monk TH, Begley AE, Houck PR, Hall M, Kupfer DJ, Reynolds CF III. Healthy older adults' sleep predicts all-cause mortality at 4 to 19 years of follow-up. Psychosom Med 2003;65:63–73. [PubMed: 12554816]
6. Dinges DF, Douglas SD, Hammarman S, Zaugg L, Zapoor S. Sleep deprivation and human immune function. Adv Neuroimmunol 1995;5:97–110. [PubMed: 7496616]
7. Dahl RE, Lewin DS. Pathways to adolescent health: sleep regulation and behavior. J Adolesc Health 2002;31:175–84. [PubMed: 12470913]
8. Ainsworth, MDS.; Bell, SM.; Stayton, DJ. Infant-mother attachment and social development: "socialization" as a product of reciprocal responsiveness to signals.. In: Woodhead, M.; Carr, R.; Light, P., editors. Becoming a person. Child development in social context, Vol 1. Taylor & Francis/ Routledge; Florence, KY: 1991.
9. Feeney BC, Kirkpatrick LA. Effects of adult attachment and presence of romantic partners on physiological responses to stress. J Pers Soc Psychol 1996;70:255–70. [PubMed: 8636881]
10. Cyranowski JM, Bookwala J, Feske U, Houck P, Pilkonis P, Kostelnik B, Frank E. Adult attachment profiles, interpersonal difficulties, and response to interpersonal psychotherapy in women with recurrent major depression. J Soc Clin Psychol 2002;21:191–217.
11. Germain A, Nofzinger EA, Kupfer DJ, Buysse DJ. Neurobiology of non-REM sleep in depression: further evidence for hypofrontality and thalamic dysregulation. Am J Psychiatry 2004;161:1856–63. [PubMed: 15465983]
12. Perlis ML, Giles DE, Buysse DJ, Tu X, Kupfer DJ. Self-reported sleep disturbance as a prodromal symptom in recurrent depression. J Affect Disord 1997;42:209–12. [PubMed: 9105962]
13. Krantz DS, McCeney MK. Effects of psychological and social factors on organic disease: a critical assessment of research on coronary heart disease. Annu Rev Psycho 2002;53:341–69.
14. Bowlby, J. Attachment and loss. Vol 2. Separation: anxiety and anger. Basic Books; New York: 1973.
15. Hazan, C.; Shaver, PR. Attachment as an organizational framework for research on close relationships.. In: Reis, HT.; Rusbult, CE., editors. Close relationships, key readings. Psychology Press; New York, NY: 2004.
16. Bartholomew, K.; Shaver, PR. Methods of assessing adult attachment: do they converge?. In: Simpson, JA.; Rholes, WS., editors. Attachment theory and close relationships. Guilford Press; New York: 1998.
17. Fraley RC, Shaver PR. Adult romantic attachment: theoretical developments, emerging controversies, and unanswered questions. Rev Gen Psychol 2000;4:132–54.
18. Carmichael CL, Reis HT. Attachment, sleep quality, and depressed affect. Health Psychol 2005;24:526–31. [PubMed: 16162047]
19. Scharfe E, Eldredge D. Associations between attachment representations and health behaviors in late adolescence. J Health Psychol 2001;6:295–307.
20. Voss U, Kolling T, Heidenreich T. Role of monitoring and blunting coping styles in primary insomnia. Psychosom Med 2006;68:110–5. [PubMed: 16449420]
21. Hall M, Thayer JF, Germain A, Vasko R, Puhl M, Buysse DJ. Psychological stress is associated with heightened physiological arousal during NREM sleep in primary insomnia. Behav Sleep Med. In Press
22. Roth T, Roehrs T, Pies R. Insomnia: pathophysiology and implications for treatment. Sleep Med Rev 2007;11:71–9. [PubMed: 17175184]

23. Gallo LC, Matthews KA. Adolescents' attachment orientation influences ambulatory blood pressure responses to everyday social interactions. Psychosom Med 2006;68:253–61. [PubMed: 16554391]
24. Mikulincer M, Dolev T, Shaver PR. Attachment-related strategies during thought suppression: ironic rebounds and vulnerable self-representations. J Pers Soc Psychol 2004;87:940–56. [PubMed: 15598116]
25. Chen Y, Kawachi I, Subramanian SV, Acevedo-Garcia D, Lee Y-J. Can social factors explain sex differences in insomnia? Findings from a national survey in Taiwan. J Epidemiol Community Health 2005;59:488–94. [PubMed: 15911645]
26. Ford DE, Kamerow D. Epidemiologic study of sleep disturbances and psychiatric disorders: an opportunity for intervention? JAMA 1989;262:1479–84. [PubMed: 2769898]
27. Cartwright RD, Wood E. Adjustment disorders of sleep: the sleep effects of a major stressful event and its resolution. Psychiatry Res 1991;39:199–209. [PubMed: 1798820]
28. National Sleep Foundation. Sleep in America poll. [October 6, 2005]. Available at http://sleepfoudnation.org.
29. Endicott J, Spitzer RL, Gibbon M, Williams JB. A diagnostic interview: the schedule for affective disorders and schizophrenia. Arch Gen Psychiatry 1995;35:837–44. [PubMed: 678037]
30. First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JB. Structured clinical interview for the DSM-IV axis I disorders—patient edition (SCID I/P, Version 2.0). Biometrics Research Department, New York State Psychiatric Institute; New York: 1995.
31. Hamilton M. A rating scale for depression. J Neurol Neurosurg Psychiatry 1960;23:56–62. [PubMed: 14399272]
32. Prien RF, Carpenter LL, Kupfer DJ. The definition and operational criteria for treatment outcome of major depressive disorder. A review of the current research literature. Arch Gen Psychiatry 1991;48:796–800. [PubMed: 1929769]
33. Bartholomew K, Horowitz LM. Attachment styles among young adults: a test of a four-category model. J Pers Soc Psychol 1991;61:226–44. [PubMed: 1920064]
34. Klohnen EC, Bera S. Behavioral and experiential patterns of avoidantly and securely attached women across adulthood: a 31-year longitudinal perspective. J Pers Soc Psychol 1998;74:211–23. [PubMed: 9457783]
35. Tamaki M, Nittono H, Hayashi M, Hori T. Examination of the first-night effect during the sleep-onset period. Sleep 2005;28:195–202. [PubMed: 16171243]
36. Buysse DJ, Hall M, Begley A, Cherry CR, Houck PR, Land S, Ombao H, Kupfer DJ, Frank E. Sleep and treatment response in depression: new findings using power spectral analysis. Psychiatry Res 2001;103:51–67. [PubMed: 11472790]
37. Buysse DJ, Tu XM, Cherry CR, Begley AE, Kowalski J, Kupfer DJ, Frank E. Pretreatment REM sleep and subjective sleep quality distinguish depressed psychotherapy remitters and nonremitters. Biol Psychiatry 1999;45:205–13. [PubMed: 9951568]
38. Rechtschaffen, A.; Kales, A. A manual of standardized terminology, techniques, and scoring system for sleep stages of human subjects. UCLA Brain Information Service/Brain Research Institute; Los Angeles: 1968.
39. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193–213. [PubMed: 2748771]
40. Troxel WM, Matthews KA, Gallo LC, Kuller LH. Marital quality and occurrence of the metabolic syndrome in women. Arch Intern Med 2005;165:1022–7. [PubMed: 15883241]
41. Cartwright RD, Kravitz HM, Eastman CI, Wood E. REM latency and the recovery from depression: getting over divorce. Am J Psychiatry 1991;148:1530–1535. [PubMed: 1928468]
42. Tononi G, Cirelli C. Sleep function and synaptic homeostasis. Sleep Med Rev 2006;10:49–62. [PubMed: 16376591]
43. Edinger JD, Glenn DM, Bastian LA, Marsh GR, Daile D, Hope TV, Young M, Shaw E, Meeks G. Sleep in the laboratory and sleep at home II: comparisons of middle-aged insomnia sufferers and normal sleepers. Sleep 2001;24:761–70. [PubMed: 11683479]
44. Monroe LJ. Transient changes in EEG sleep patterns of married good sleepers: the effects of altering sleeping arrangement. Psychophysiology 1969;6:330–7. [PubMed: 4311056]

45. Carskadon, MA. The second decade.. In: Guilleminault, C., editor. Sleeping and waking disorders: indications and techniques. Addison-Wesley; Menlo Park, CA: 1982.

46. Cross SE, Madson L. Models of the self: self-construals and gender. Psychol Bull 1997;122:5–37. [PubMed: 9204777]

47. Kahn-Greene ET, Lipizzi EL, Conrad AK, Kamimori GH, Killgore WDS. Sleep deprivation adversely affects interpersonal responses to frustration. Pers Individ Diff 2006;41:1433–43.

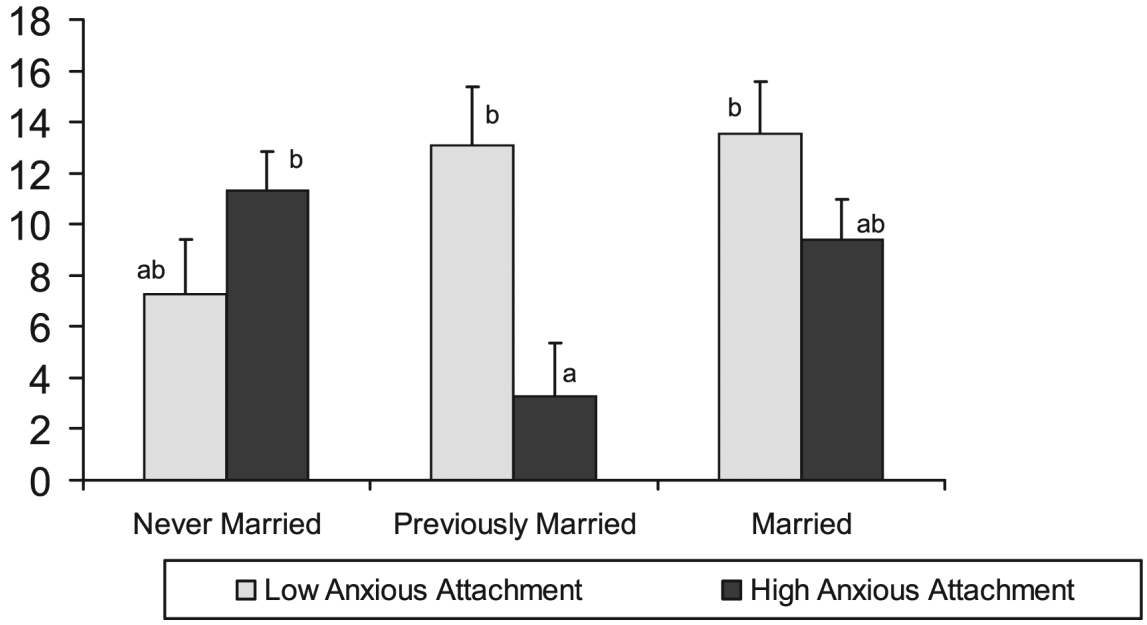

Figure 1.
Interaction between attachment style and marital status on % stage 3−4 sleep (n = 107). Results are from General Linear Model with baseline age, depressive symptoms, length of time between psychosocial assessment and PSG, main effects of attachment style and marital status, and the interaction of attachment style and marital status. To facilitate interpretation, values in the figure are based on nontransformed data. Differing superscripts indicate significant post hoc comparisons.

TABLE 1

Descriptive Statistics for Demographic and Clinical Characteristics For the Total Sample and According to Marital Status

Variable	Total Sample (*n* = 107)	Never Married (*n* = 41)	Previously Married (*n* = 27)	Married (*n* = 39)	Test Statistic (*F* Statistic or χ^2)
Age (years)	38.4 ± 10.2	32.9 ± 9.0[a]	43.9 ± 9.0[b]	40.5 ± 9.6[a,b]	13.1**
Education (years)	15.2 ± 1.9	15.2 ± 1.9	15.0 ± 1.7	15.1 ± 2.1	.0
Non-Hispanic white (%)	87.9	80.5	92.6	92.3	3.4
Number of previous depressive episodes	4.6 ± 1.7	4.4 ± 1.8	4.9 ± 1.6	4.6 ± 1.7	.8
Duration of index episode (weeks)	28.5 ± 22.1	27.0 ± 20.7	26.9 ± 21.9	31.1 ± 23.9	.4
Age at first episode (years)	23.9 ± 8.8	21.0 ± 7.6	26.0 ± 8.7	25.6 ± 9.4	3.9*
HRSD	16.0 ± 2.6	15.7 ± 2.2	17.0 ± 3.1	15.6 ± 2.6	2.8#

HRSD = Hamilton Rating Scale for Depression.

Numbers in each column indicate mean ± standard deviations, unless otherwise noted. There were no differences in demographic or clinical characteristics according to attachment style or bed-partner status.

[a,b] Differing superscripts indicate significant post hoc comparisons, using Tukey's honestly significant difference test.

* $p < .05$

** $p < .01$

# $p < .10$.

Psychosom Med. Author manuscript; available in PMC 2009 August 10.

TABLE 2

Mean Values of Subjective and PSG Sleep According to Attachment Profile, Marital Status, or Bed-Partner Status (n = 107)

Sleep Parameter	Attachment Profile		Marital Status			Bed-Partner Status	
	Low Attachment Anxiety (n = 41)	High Attachment Anxiety (n = 66)	Never Married (n = 41)	Previously Married (n = 21)	Married (n = 35)	No (n = 46)	Yes (n = 43)
PSQI[a]	9.8 ± 3.5	9.1 ± 3.7	8.8 ± 3.7	9.5 ± 4.1	9.7 ± 3.2	9.0 ± 3.9	9.7 ± 3.3
Total sleep (min)	440.8 ± 50.4	442.6 ± 51.3	438.6 ± 53.6	449.1 ± 59.0	440.4 ± 41.6	444.7 ± 60.1	436.3 ± 41.1
Sleep latency (min)	21.1 ± 17.2	16.3 ± 12.5	21.8 ± 14.9	16.2 ± 14.2	15.7 ± 14.0	21.1 ± 16.0	16.0 ± 13.3
Sleep efficiency (%)	89.4 ± 8.3	90.9 ± 6.2	89.4 ± 7.4	89.3 ± 8.8	92.0 ± 5.0	88.5 ± 7.8	92.2 ± 5.4
Stage 3−4 (%)	11.2 ± 9.3	8.9 ± 7.3	10.8 ± 6.7	7.6 ± 7.7	10.3 ± 9.7	8.6 ± 6.3	9.5 ± 9.3
REM density	1.3 ± 0.5	1.3 ± 0.5	1.3 ± 0.6	1.3 ± 0.6	1.2 ± 0.4	1.2 ± 0.5	1.4 ± 0.5
REM latency (min)	70.4 ± 28.2	67.7 ± 30.8	70.3 ± 32.0	69.2 ± 24.8	66.7 ± 31.0	68.4 ± 26.2	69.0 ± 34.8

PSG = polysomnography; PSQI = Pittsburgh Sleep Quality Index; REM = visually scored rapid eye movement sleep.

Values are unadjusted mean ± standard deviation (SD) values. To facilitate interpretation, all mean and SD values are nontransformed values.

[a]Due to missing data, the n for analyses of marital status and attachment style for the PSQI is 99 and the n for bed-partner status and PSQI is 87.

TABLE 3

Analysis of Variance of Subjective and PSG Sleep Outcomes With Attachment Style,[a] Marital Status, and the Marital Status by Attachment Style Interaction

Sleep Outcome	*F* Statistic	*df*
PSQI		
Attachment style (A)	.13	1, 89
Marital status (MS)	.10	2, 89
A × MS	.84	2, 89
Total sleep duration (min)		
Attachment style (A)	.01	1, 107
Marital status (MS)	.81	2, 107
A × MS	.25	2, 107
Sleep efficiency[b]		
Attachment style (A)	.64	1, 107
Marital status (MS)	4.08*	2, 107
A × MS	.50	2, 107
Sleep latency[b]		
Attachment style (A)	2.74	1, 107
Marital status (MS)	3.39*	2, 107
A × MS	1.29	2, 107
% Stage 3 to 4 activity[c]		
Attachment style (A)	4.83*	1, 107
Marital status (MS)	1.61	2, 107
A × MS	7.10**	2, 107
REM density[c]		
Attachment style (A)	.97	1, 107
Marital status (MS)	.50	2, 107
A × MS	.91	2, 107
REM latency[c]		
Attachment style (A)	.33	1, 107
Marital status (MS)	.73	2, 107
A × MS	1.06	2, 107

PSQI = Pittsburgh Sleep Quality Index; REM = rapid eye movement.

[a] Preoccupied or fearful-avoidant versus secure or dismissing-avoidant. All analyses statistically adjusted for age, baseline depressive symptoms, and length of time between psychosocial assessment and PSG. Analyses and significance levels are based on [b] log-transformed or [c] square-root transformed data, respectively.

* $p < .05$

** $p < .01$.

TABLE 4

Analysis of Variance of Subjective and PSG Sleep Outcomes with Attachment Style,[a] Bed Partner, and the Bed Partner by Attachment Style Interaction

Sleep Outcome	*F* Statistic	*df*
PSQI		
Attachment style (A)	.37	1, 89
Bed partner (BP)	.08	1, 89
A × BP	.09	1, 89
Total sleep duration (min)		
Attachment style (A)	.06	1, 99
Bed partner (BP)	.61	1, 99
A × BP	.15	1, 99
Sleep efficiency[b]		
Attachment style (A)	.74	1, 99
Bed partner (BP)	9.39**	1, 99
A × BP	.12	1, 99
Sleep latency[b]		
Attachment style (A)	4.22*	1, 99
Bed partner (BP)	1.65	1, 99
A × BP	.12	1, 99
% Stage 3 to 4 activity[c]		
Attachment style (A)	.30	1, 99
Bed partner (BP)	.17	1, 99
A × BP	.20	1, 99
REM density[c]		
Attachment style (A)	.63	1, 99
Bed partner (BP)	1.59	1, 99
A × BP	.06	1, 99
REM latency[c]		
Attachment style (A)	.51	1, 99
Bed partner (BP)	.00	1, 99
A × BP	1.40	1, 99

PSG = polysomnography.

[a] Preoccupied or fearful-avoidant versus secure or dismissing-avoidant. All analyses statistically adjusted for age, baseline depressive symptoms, and length of time between psychosocial assessment and PSG. Analyses and significance levels are based on [b] log-transformed or [c] square-root transformed data, respectively.

* $p < .05$

** $p < .01$.