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# Social Support, Insomnia, and Adherence to Cognitive Behavioral Therapy for Insomnia After Cancer Treatment

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## Abstract

**Objective/Background—**While cognitive-behavioral therapy for insomnia (CBT-I) has been shown to be efficacious in treating cancer survivors' insomnia, 30–60% of individuals have difficulty adhering to intervention components. Psychosocial predictors of adherence and response to CBT-I, such as social support, have not been examined in intervention studies for cancer survivors.

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**Participants—**Datafroma randomized placebo-controlled 2 × 2 trial of CBT-I and armodafinil (a wakefulness promoting agent) were used to assess adherence. Ninety-six cancer survivors participated in the trial (mean age 56, 86% female, 68% breast cancer).

**Methods—**CBT-I and armodafinil were administered over the course of seven weeks, and participants were assessed at baseline, during intervention, postintervention, and at a three-month follow-up. Social support was assessed using a Functional Assessment of Chronic Illness Therapy subscale, insomnia severity was assessed using the Insomnia Severity Index, and adherence was measured based on CBT-I sleep prescriptions.

**Results—**At baseline, social support was negatively correlated with insomnia severity ($r = -0.30$, $p = 0.002$) and associations between social support, CBT-I, and insomnia were maintained through the three-month follow-up. Social support was positively associated with adherence to CBT-I during intervention weeks 3, 4, and 5, and with overall intervention adherence. At postintervention, both social support and treatment with CBT-I independently predicted decreased insomnia severity ($p < 0.01$) when controlling for baseline insomnia severity.

**Conclusions—**Higher social support is associated with better intervention adherence and improved sleep independent of CBT-I. Additional research is needed to determine whether social support can be leveraged to improve adherence and response to CBT-I.

Insomnia is highly prevalent in cancer patients. Between 30% and 60% of cancer patients reporting difficulty falling asleep, difficulty staying asleep, or waking up earlier than intended (Ancoli-Israel, 2009; Berger, Farr, Kuhn, Fischer, & Agrawal, 2007; Berger, Grem, Visovsky, Marunda, & Yurkovich, 2010; Palesh etal., 2010; J. Savard & Morin, 2001). Insomnia disorder may occur with disease onset, as a stress response to receiving a cancer diagnosis, or as a side effect of treatment, and an estimated 40% of cancer survivors report sleep disturbance years after completing treatment (J. Savard, Ivers, Savard, &Morin, 2015; J. Savard, Ivers, Villa, Caplette-Gingras, & Morin, 2011). Insomnia in cancer survivors is linked with higher rates of chronic disease comorbidities, increased risk of mortality, and lower quality of life (Partinen, 2005; Pinto & de Azambuja, 2011). Interventions to address insomnia in cancer survivors are therefore highly needed.

Cognitive behavioral therapy for insomnia (CBT-I) is considered the gold standard behavioral intervention for treating insomnia in the population at large, and evidence is mounting for its utility in treating insomnia among cancer survivors (Espie et al., 2008; J. Savard, Simard, Ivers, & Morin, 2005b). CBT-I is a multicomponent treatment comprised of sleep restriction therapy, stimulus control instructions, and cognitive restructuring. CBT-I is highly effective, with pre–post effect sizes of up to 1.05 and durable effects following treatment discontinuation (Koffel, Koffel, & Gehrman, 2015; Mitchell, Gehrman, Perlis, & Umscheid, 2012; Spiegel et al., 2007). Despite the efficacy of CBT-I, 20–50% of patients do not respond to this intervention or respond suboptimally, largely due to nonadherence to components of the intervention (Matthews, Arnedt, McCarthy, Cuddihy, & Aloia, 2013; J. Savard, Simard, Ivers, & Morin, 2005a). Adherence to CBT-I intervention components varies, with rates of adherence to sleep restriction and prescribed time in bed, one of the active components of intervention, ranging from approximately 40% to 70% (Matthews et al., 2013). Despite the fact that better adherence is associated with lower posttreatment

insomnia (Manber et al., 2011), there is a paucity of research examining modifiable psychosocial factors that can predict adherence and response to CBT-I.

Social support predicts insomnia severity in the general population and in cancer survivors specifically (Aldridge-Gerry et al., 2013; Troxel, Robles, Hall, & Buysse, 2007). Studies have begun to assess the impact of social support on response to CBT-I (Rogojanski, Carney, & Monson, 2013). These studies have shown that those who report supportive relationships also report lower severity of insomnia, and that supportive relationships predict better response to CBT-I (i.e., a steeper decrease in insomnia severity; Ellis, Deary, & Troxel, 2015). The latter finding has been reported primarily for healthy populations. As of yet no studies, to our knowledge, have examined the impact of social support on response to CBT-I among cancer survivors.

We examine in this study associations between social support (assessed using a measure of social well-being) and insomnia severity in a sample of survivors of diverse cancer types who participated in a four-arm randomized controlled trial of treatments for insomnia, including CBT-I. Given the importance of adherence in ensuring strong and durable intervention outcomes, we also examine the impact of social support on adherence and response to CBT-I. Our hypotheses are, first, that higher social support will be associated with lower insomnia severity at baseline. Second, we predict that higher social support will be associated with better adherence to CBT-I, as measured by higher rates of adherence to sleep restriction prescriptions and by fewer withdrawals from the study. Third, we predict that social support will moderate the relationship between CBT-I and insomnia severity, such that those who report high social support will experience a greater decrease in insomnia severity when treated with CBT-I than those with low social support.

## METHODS

### Design

The parent study from which this data set was drawn was a randomized controlled trial of interventions for insomnia among posttreatment cancer survivors (Roscoe et al., 2015). Survivors were randomized to one of four intervention arms: (a) medication placebo (P); (b) armodafinil (A); (c) CBT-I plus placebo (CBT-I+P); or (d) CBT-I plus armodafinil (CBT-I +A; $n = 24$). Survivors were assessed at baseline (over the course of two weeks before administration of any intervention), during the seven weeks of intervention, at postintervention (over two weeks), and three months postintervention (again over two weeks). This trial follows the CONSORT guidelines for reporting randomized trials of behavioral and pharmacological interventions. The institutional review boards of the University of Rochester and the University of Pennsylvania approved the protocol, and all survivors provided written informed consent. This trial is registered with ClinicalTrials.gov, number NCT01091974.

### Participants

Participants for the parent study were screened and recruited in Rochester, NY, and Philadelphia, PA, between October 2008 and November 2012. Participants had to (a) have

been diagnosed with any type of cancer and completed all cancer treatments not less than one month prior to study start, (b) self-report insomnia lasting for at least three months and state that the insomnia began or became worse with the onset of cancer or treatment, (c) discontinue any prescribed or over-the-counter medications for sleep for the 11-week study period, and (d) have a preferred sleep phase between 7:30 p.m. and 11:00 a.m. Patients must not have ever taken modafinil or armodafinil, had CBT-I therapy, had a history of seizures, severe headaches, uncontrolled cardiac disease, hypertension, substance abuse, or sleep apnea, or have taken amphetamines within the past 30 days.

## Measures

**Demographic factors and partnership status—**An on-study form was used to ascertain age, racial or ethnic background, marital status, employment status, and income.

**Insomnia—**Insomnia was assessed with the Insomnia Severity Index (ISI), a commonly administered, psychometrically validated, seven-item self-report measure. Items are rated on a Likert-type scale from 0 to 4 (total score 0–28). Scores of 0 to 7 indicate absence of insomnia, 8 to 14 indicate subthreshold insomnia severity, 15 to 21 indicate moderate insomnia, and 22 to 28 indicate severe insomnia. This measure has been validated in cancer patients (M. H. Savard, Savard, Simard, & Ivers, 2005).

**Social support—**Social support was assessed with the Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-F) subscale assessing Social Well-Being (SWB). The SWB subscale contains seven items, each rated on a Likert-type scale from 0 to 4 (total score 0–28). Items on the SWB subscale directly measure aspects of social support, including “I get emotional support from my family” and “I feel close to my partner.” Previous studies of cancer populations have used this subscale to measure emotional social support (Yost et al., 2013).

**Sleep diaries—**Intervention adherence was measured with sleep diaries. Participants self-reported their sleep continuity, pattern, and quality on a night-by-night basis, as well as their time into bed and time out of bed over the 11-week study period. Diary-based measures are considered reliable for assessing sleep phase, time in bed, and sleep continuity (Buysse, Ancoli-Israel, Edinger, Lichstein, & Morin, 2006; Carney et al., 2012).

## Intervention Details

CBT-I is a multicomponent intervention that integrates circadian science, behavioral principles of conditioned learning, and cognitive therapy to address the factors that maintain sleep disturbance. Treatment with CBT-I in the parent trial included the following: sleep restriction, stimulus control, sleep hygiene, and cognitive restructuring. Sleep restriction limits the time spent in bed to the time actually spent sleeping, thereby minimizing sleep-related anxiety while lying awake in bed. In the current study, sleep restriction was titrated to ensure that 85% to 90% of the participant’s time in bed was spent sleeping. Interventionists would adjust prescribed time in bed during each session to keep the participant’s sleep efficacy at around 90%. Stimulus control limits the activities performed in bed to sleep and sex only so as to recondition the bed to be associated with sleep as opposed to wakefulness.

Sleep restriction and stimulus control can produce a temporary worsening of daytime sleepiness and discomfort and are thought to be the most difficult components for patients to adhere to (Parikh et al., 2015). Sleep hygiene serves to promote behaviors and practices that facilitate sleep and to discourage behaviors and practices that are thought to contribute to insomnia. Cognitive restructuring is used to identify and address thoughts and beliefs that may contribute to the development of, or reinforce, behaviors that produce presleep arousal and performance anxiety. Participants randomized to receive CBT-I were provided the intervention over the course of seven weekly individual sessions involving the cancer survivor and a single trained therapist. Sessions 1, 2, and 4 were conducted in person (30–60 min in duration), and Sessions 3, 5, 6 and 7 were by phone (15–30 min in duration) in order to reduce burden and increase retention of participants. Previous research has shown that delivery of CBT by phone is comparable to face-to-face delivery (Hammond et al., 2012; Ho, Chung, Yeung, Ng, & Cheng, 2014).

Armodafinil is a single isomer formulation of modafinil (R-enantiomer of modafinil) that is indicated for the promotion of wakefulness in several sleep disorders including narcolepsy, sleep apnea syndrome, and shift work disorder. Participants randomized to receive armodafinil were provided a 50 mg dose of armodafinil in the morning (7:00–9:00 a.m.) and a placebo in the afternoon (12:00–2:00 p.m.) for three days, followed by two 50 mg doses of armodafinil per day (morning and afternoon) for 40days, and then finally a 50 mg dose of armodafinil in the morning and a placebo in the afternoon for another four days. Patients randomized to receive placebo were provided a placebo capsule in the morning and afternoon to mimic the dosage times of the medication group.

Study personnel and patients were blinded regarding medication assignment (armodafinil vs. placebo) but not CBT-I assignment (yes vs. no), and participants were not told their randomization assignment until after the completion of their two-week baseline period.

**Intervention adherence—**We assessed adherence in three ways. First, participants' actual time in bed (ATIB) was determined from the time into bed and time out of bed questions on the sleep diary. Prescribed time in bed (PTIB) was recorded by the therapist after each CBT-I session from Week 1 onward. An individual was deemed adherent to the CBT-I sleep prescription if their average ATIB was within 30 min of their PTIB for the week. The additional 30 min was included to allow for normal variation in sleep latency or nocturnal awakenings (Cvengros, Crawford, Manber, & Ong, 2015; Tremblay, Savard, & Ivers, 2009). Adherence was calculated for each week and dichotomously coded as yes/no. Second, we calculated an adherence percentage by dividing the number of adherent weeks by the total number of weekly sleep diaries returned, to account for missing diaries due to participant drop out. Third, we recorded retention and withdrawal rates on a weekly basis as a proxy for adherence (i.e., continuing to attend and engage in intervention sessions).

## Statistical Analyses

We examined demographic characteristics for the sample as a whole and compared across intervention arms. To test hypothesis 1, we used Pearson correlations to assess associations between baseline insomnia and baseline social support. We also present correlations between

insomnia and social support at postintervention and at the three-month follow-up. To test hypothesis 2, we evaluated adherence by comparing ATIB to PTIB for the CBT-I+P and CBT-I+A groups only. We conducted binary logistic regression models to determine whether baseline level of self-reported social support was associated with being adherent versus nonadherent each week, and calculated bivariate correlations and *t*-tests to assess the association between baseline social support, percent adherence, and withdrawal from the study. To test hypothesis 3, we used two separate ANCOVA models, treating the postintervention insomnia score (average of the two postintervention weeks) as the dependent variable, intervention arms as factors, social support as a moderator, and baseline insomnia score as a covariate. Moderation was evaluated using the extra sum of squares principle, adding all interaction terms involving the moderator (i.e., moderator plus intervention arms) to a separate model and comparing change in sum of squares and the resultant *F*-value to the parent model. Analyses were done by intention to treat with the full randomized sample, although 23 (24%) of the 96 randomized eligible patients did not provide postintervention data.

Missing value patterns for the data were examined through visual inspection and logistic regression of missingness versus treatment arm and demographic characteristics. We found no evidence contraindicating a Missing at Random (MAR) assumption and so proceeded with multiple imputation (Little & Rubin, 2002). The results of analyses after multiple imputation were similar to the complete case analyses in which only those patients who provided post-intervention data were included. In addition, 11 participants did not provide data at baseline for item 7 of the SWB scale, which assesses sexual satisfaction. Results did not differ for analyses using the SWB scale after multiple imputation or after using the average value on completed items, rather than the sum. We used SPSS version 22 to conduct analyses.

## RESULTS

### Participant Characteristics

Of the 138 patients who consented to screening, 114 were eligible and 96 were randomized; 88 (77% of eligible patients and 92% of randomized patients) began the intervention, and 73 patients (83% of the 88 patients beginning the intervention) completed the seven-week intervention. No serious study-related adverse events were reported. The mean age of the 96 cancer survivors in this sample was 56 years (range 26 to 75). The majority (87.5%, $n = 84$) reported that they were female, and 89.6% ($n = 86$) were non-Hispanic White. The modal level of education was some college or a college degree (89.6%, $n = 86$). Over half of the sample (61.5%, $n = 59$) was married. The modal type of cancer was breast cancer (67.6%, $n = 65$). On average, survivors had completed treatment 175.05 ($SE = 138.26$) weeks ago. Sample size was balanced across arms (P = 24, A = 23, CBT-I + P = 25, CBTI + A = 24), and there were no significant differences between arms on baseline characteristics. See Table 1 for demographic factors for the sample as a whole and by intervention arm.

**Insomnia and social support—**Insomnia severity and social support were moderately correlated at baseline ($r = -0.30$, $p < 0.01$). Correlation remained significant at

postintervention ($r = -0.50$, $p < 0.001$), and three-month follow-up ($r = -0.48$, $p < 0.001$), pooling across all four intervention arms.

**Adherence to CBT-I by social support—**As was reported previously, there was no significant difference in overall adherence to CBT-I observed between those patients assigned to CBT-I+A and CBT-I+P (Garland et al., 2016). In addition, retention was evenly distributed across study arms (Roscoe et al., 2015). On average, the majority of individuals who turned in their sleep diaries reported being adherent to PTIB after week 1 of the intervention (60.0%–75.7%). With regard to the first definition of adherence, looking across weeks, self-reported baseline social support was positively associated with adherence to the CBT-I sleep prescription during weeks 3, 4, and 5, but not weeks 1, 2, 6, or 7, such that a one-unit increase in score on the FACIT-F SWB subscale was associated with up to 29% increased odds of being adherent. See Table 2 for details.

With regard to the second definition of adherence, social support at baseline was highly correlated with percent adherence over the course of the CBT-I intervention ($r = 0.45$, $p = 0.003$). With regard to the third definition of adherence, those who completed the intervention (i.e., did not withdraw before the postintervention assessment) had higher baseline social support than those who withdrew from the study before the postintervention assessment (mean = 21.06 vs. 17.99, respectively, on the SWB subscale of the FACIT-F; $p = 0.02$). While women were more likely to complete the intervention than men (66.7% vs. 41.2%, $p = 0.04$), women did not report statistically higher social support, and controlling for gender did not affect the association between social support and retention.

**Response to CBT-I by social support—**As previously reported, those randomized to receive CBT-I reported significantly lower insomnia severity postintervention than those not randomized to receive placebo, even while controlling for baseline report of insomnia severity (CBT-I+P effect size $d = 1.02$, CBTI+A effect size $d = 1.31$). Armodafinil had little to no impact on report of insomnia severity, either individually or in combination with CBT-I (Roscoe et al., 2015). In analyses for the current study, we found that armodafinil was not significantly associated with social support.

We tested social support as an independent predictor of insomnia severity in an ANCOVA model. Social support demonstrated a significant main effect on postintervention insomnia severity when included in a model with baseline insomnia severity, CBT-I, armodafinil, and the interaction between the intervention arms ($R$-squared = 0.61). See Table 3 for details. Finally, we tested for moderation of the effect of CBT-I by social support, adding the interaction terms between CBT-I and social support and between CBT-I, armodafinil, and social support. The main effect of social support remained significant in this model ($F = 6.54$, $p = 0.01$), though the interaction terms themselves were not significant (CBT-I by social support $F = 0.14$, $p = 0.71$; CBT-I by armodafinil by social support $F = 0.62$, $p = 0.61$). The model including these interaction terms did not significantly improve prediction of variance in insomnia ($F = 0.62$, $p = 0.60$; $R$-squared change = 0.02).

## DISCUSSION

In this study, we examine the association between social support, insomnia severity, and adherence and response to CBT-I among cancer survivors. The results of our analyses indicate that level of social support is associated with insomnia severity among cancer survivors. At baseline, social support and insomnia were negatively correlated, such that those reporting higher social support also reported lower insomnia severity; this association persisted throughout the intervention and follow-up assessment period. In addition, this study is the first to indicate that higher social support is associated with lower insomnia severity among cancer survivors even in the context of treatment with CBT-I, as social support and CBT-I both had strong independent effects on insomnia severity. Although social support was associated with increased adherence to CBT-I, the interaction between CBT-I and social support was nonsignificant, and hence we did not find evidence that social support moderates the effectiveness of CBT-I. Given the nature of the measure of social support, which included items assessing both amount of and satisfaction with support, we cannot tell from these analyses whether the quantity or the quality of social support better predicts lower insomnia severity.

Our 60.0%–75.7% rate of adherence, using a 30-min criterion for adherence based on our previous work and our experience delivering interventions to cancer survivors (Garland et al., 2016), was consonant with a 64% rate of adherence in another study using the same cutoff (Riedel & Lichstein, 2001). We also found that increased social support is associated with adherence to CBT-I, whether looking at adherence from week to week during the seven weeks of CBT-I, looking at overall percentage of adherence across the entirety of the intervention, or assessing adherence as retention in the parent trial through the postintervention assessment. With regard to the first assessment of adherence, an association between social support and adherence to PTIB was seen only for weeks 3, 4, and 5, not weeks 1, 2, 6, or 7. The association may have been limited to this time period because the early weeks (1 and 2) of CBT-I in the current study involved less specific focus on sleep restriction, and often served as an opportunity for patients and therapists to calibrate the sleep prescription. Similarly, by the final weeks of the intervention (6 and 7), focus shifted away from sleep restriction toward cognitive restructuring. Social support may then have had the strongest effect on adherence in the weeks when sleep prescriptions were the most strongly emphasized. Alternately, given that social support was linked to retention, it may be that those participants with low social support had opted out of the intervention by weeks 6 and 7, diminishing the association between social support and adherence.

Social support could influence insomnia on several levels. First, those who have more satisfying and supportive social relationships may have less sleep disturbance in general, and may recover quickly from nascent sleep disturbance when it develops as a result of better overall psychological functioning (Troxel etal., 2007). The reduction observed in this study could therefore reflect a natural process that would have occurred for those with high support regardless of intervention. A second interpretation is that those with a supportive social environment may find it easier to make behavioral changes to compensate for and address their insomnia severity. A cancer survivor with a supportive partner, for example, may find it easier to maintain a regular sleep schedule and avoid distractions in the bedroom

because his or her partner may be more willing to adjust to meet the survivor's needs. Supportive friends or family members may follow up with the survivor about his or her sleep and thereby reinforce these behavioral changes. By contrast, those who experience higher-quality sleep may feel better prepared to engage with their social networks, or the relationship between sleep and social support may be mediated by a third factor, such as depression (Murthy et al., 2016). Future research designed to look at the interplay between specific types of support and insomnia would be needed to test these interpretations.

Despite some evidence regarding the association between partnership status and CBT-I, we focused in this paper on social support in general and not on marital or partnership status. There are several reasons why social support may be a better predictor of insomnia than partnership status. Multiple studies have shown that partnership status is a strong predictor of health and quality of life after cancer, but also that the quality of the partner relationship matters more than existence of the relationship alone (Kamen et al., 2015). For sleep, in particular, previous research has indicated that happy and supportive partnerships lead to better sleep, while social strain, particularly with partners and family members, is associated with poor sleep (Troxel, 2010). As the FACIT-F Social Well-Being scale includes items about family and partner support, this scale may be able to capture variance both in partnership status and in the quality of partnered relationships, while also assessing the quality of a survivor's broader social environment. Further research is needed to replicate these findings and confirm theories regarding the link between partnership status, social support, and insomnia.

If these results are replicated, however, they could indicate a need to expand our conceptualization of the sleep environment when providing CBT-I to cancer survivors. Particularly with regard to the link between social support and insomnia, future research and clinical applications should consider including a support partner in CBT-I sessions. Addressing a dyad, rather than an individual cancer survivor, could allow researchers and interventionists to improve sleep quality through both CBT-I and through increased social support. Additional research is needed to test a dyadic approach to CBT-I for both feasibility and efficacy among cancer survivors and their caregivers or support partners. Short of including a partner in CBT-I sessions, assessment of sleep disturbance could be expanded to incorporate measures of social support, as this may provide additional information about factors contributing to sleep disturbance.

## Limitations

Findings of the current study must be interpreted in the light of several limitations. First, this was a secondary data analysis of a completed randomized controlled trial. The analyses conducted in this study were not part of the parent study's aims or design. Future research specifically designed to investigate links between support and insomnia is needed. Second, we were limited to the measure of social support used in the parent trial; this measure does not allow us to parse types, quantity, and quality of social support. Future studies should include measures of partner support specifically, along with assessment of nonmarital and same-sex partnerships. We were also limited by the sample size of the parent trial, and consequently this secondary analysis is underpowered and its results should be taken as

preliminary. While diaries are an accepted method of assessing adherence, future studies could use more nuanced measures such as actigraphy to more accurately measure time in bed. The parent study was conducted in two geographically limited regions among cancer survivors who opted to take part in a clinical trial; nationwide trials would allow more generalizability of study findings. Finally, we could only hypothesize about mechanistic links between the factors assessed in the current study (e.g., the extent to which changes in sleep quality influence social support and changes in social support influence sleep quality). Longitudinal studies involving more nuanced assessment strategies would be needed to parse the contribution of types of social support to insomnia and recovery from insomnia. Such studies could also make use of complex and nuanced modeling procedures, such as longitudinal mixed models, to examine idiographic trajectories of sleep in cancer patients.

### Conclusion

The current study offers a preliminary perspective on the impact of psychosocial factors on insomnia and response to CBT-I among cancer survivors. The finding that sleep disturbances are more pronounced in individuals with lower social support highlights the importance of accounting for social and environmental factors when designing and delivering a sleep intervention to this population. Our results suggest that interventions that address sleep disturbances directly (e.g., CBT-I) could be complemented by interventions that improve social support. We hope that future research will continue to examine the interplay between these factors and will tailor sleep interventions to account for cancer survivors' social environments.

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## References

Aldridge-Gerry A, Zeitzer JM, Palesh OG, Jo B, Nouriani B, Neri E, Spiegel D. Psychosocial correlates of sleep quality and architecture in women with metastatic breast cancer. Sleep Medicine. 2013; 14(11):1178–1186. DOI: 10.1016/j.sleep.2013.07.012 [PubMed: 24074694]

Ancoli-Israel S. Recognition and treatment of sleep disturbances in cancer. Journal of Clinical Oncology. 2009; 27(35):5864–5866. DOI: 10.1200/JCO.2009.24.5993 [PubMed: 19884528]

Berger AM, Farr LA, Kuhn BR, Fischer P, Agrawal S. Values of sleep/wake, activity/rest, circadian rhythms, and fatigue prior to adjuvant breast cancer chemotherapy. Journal of Pain & Symptom Management. 2007; 33(4):398–409. [PubMed: 17397701]

Berger AM, Grem JL, Visovsky C, Marunda HA, Yurkovich JM. Fatigue and other variables during adjuvant chemotherapy for colon and rectal cancer. Oncology Nursing Forum. 2010; 37(6):E359–E369. DOI: 10.1188/10.ONF.E359-E369 [PubMed: 21059569]

Buysse DJ, Ancoli-Israel S, Edinger JD, Lichstein KL, Morin CM. Recommendations for a standard research assessment of insomnia. Sleep. 2006; 29(9):1155–1173. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17040003. [PubMed: 17040003]

Carney CE, Buysse DJ, Ancoli-Israel S, Edinger JD, Krystal AD, Lichstein KL, Morin CM. The consensus sleep diary: Standardizing prospective sleep self-monitoring. Sleep. 2012; 35(2):287–302. DOI: 10.5665/sleep.1642 [PubMed: 22294820]

Cvengros JA, Crawford MR, Manber R, Ong JC. The relationship between beliefs about sleep and adherence to behavioral treatment combined with meditation for insomnia. Behavioral Sleep Medicine. 2015; 13(1):52–63. DOI: 10.1080/15402002.2013.838767 [PubMed: 24354360]

Ellis JG, Deary V, Troxel WM. The role of perceived partner alliance on the efficacy of CBT-I: Preliminary findings from the Partner Alliance in Insomnia Research Study (PAIRS). Behavioral Sleep Medicine. 2015; 13(1):64–72. DOI: 10.1080/15402002.2013.838768 [PubMed: 24527869]

Espie CA, Fleming L, Cassidy J, Samuel L, Taylor LM, White CA, Paul J. Randomized controlled clinical effectiveness trial of cognitive behavior therapy compared with treatment as usual for persistent insomnia in patients with cancer. Journal of Clinical Oncology. 2008; 26(28):4651–4658. DOI: 10.1200/JCO.2007.13.9006 [PubMed: 18591549]

Garland SN, Roscoe JA, Heckler CE, Barilla H, Gehrman P, Findley JC, Perlis ML. Effects of armodafinil and cognitive behavior therapy for insomnia on sleep continuity and daytime sleepiness in cancer survivors. Sleep Medicine. 2016; 20:18–24. DOI: 10.1016/j.sleep.2015.12.010 [PubMed: 27318221]

Hammond GC, Croudace TJ, Radhakrishnan M, Lafortune L, Watson A, McMillan-Shields F, Jones PB. Comparative effectiveness of cognitive therapies delivered face-to-face or over the telephone: An observational study using propensity methods. PloS ONE. 2012; 7(9):e42916.doi: 10.1371/journal.pone.0042916 [PubMed: 23028436]

Ho FY, Chung KF, Yeung WF, Ng TH, Cheng SK. Weekly brief phone support in self-help cognitive behavioral therapy for insomnia disorder: Relevance to adherence and efficacy. Behaviour Research and Therapy. 2014; 63C:147–156. DOI: 10.1016/j.brat.2014.10.002

Kamen C, Mustian KM, Heckler C, Janelsins MC, Peppone LJ, Mohile S, Morrow GR. The association between partner support and psychological distress among prostate cancer survivors in a nationwide study. Journal of Cancer Survivorship. 2015; 9(3):492–499. DOI: 10.1007/s11764-015-0425-3 [PubMed: 25603949]

Koffel EA, Koffel JB, Gehrman PR. A meta-analysis of group cognitive behavioral therapy for insomnia. Sleep Medicine Reviews. 2015; 19:6–16. DOI: 10.1016/j.smrv.2014.05.001 [PubMed: 24931811]

Little RJA, Rubin DB. Statistical analysis with missing data. Hoboken, NJ: Wiley; 2002.

Manber R, Bernert RA, Suh S, Nowakowski S, Siebern AT, Ong JC. CBT for insomnia in patients with high and low depressive symptom severity: Adherence and clinical outcomes. Journal of Clinical Sleep Medicine. 2011; 7(6):645–652. DOI: 10.5664/jcsm.1472 [PubMed: 22171204]

Matthews EE, Arnedt JT, McCarthy MS, Cuddihy LJ, Aloia MS. Adherence to cognitive behavioral therapy for insomnia: a systematic review. Sleep Medicine Reviews. 2013; 17(6):453–464. DOI: 10.1016/j.smrv.2013.01.001 [PubMed: 23602124]

Mitchell MD, Gehrman P, Perlis M, Umscheid CA. Comparative effectiveness of cognitive behavioral therapy for insomnia: A systematic review. BMC Family Practice. 2012; 13:40.doi: 10.1186/1471-2296-13-40 [PubMed: 22631616]

Murthy P, Kidwell KM, Schott AF, Merajver SD, Griggs JJ, Smerage JD, Henry NL. Clinical predictors of long-term survival in HER2-positive metastatic breast cancer. Breast Cancer Research and Treatment. 2016; 155(3):589–595. DOI: 10.1007/s10549-016-3705-3 [PubMed: 26875184]

Palesh OG, Roscoe JA, Mustian KM, Roth T, Savard J, Ancoli-Israel S, Morrow GR. Prevalence, demographics, and psychological associations of sleep disruption in patients with cancer: University of Rochester Cancer Center-Community Clinical Oncology Program. Journal of Clinical Oncology. 2010; 28(2):292–298. DOI: 10.1200/JCO.2009.22.5011 [PubMed: 19933917]

Parikh DA, Chudasama R, Agarwal A, Rand A, Qureshi MM, Ngo T, Hirsch AE. Race/ethnicity, primary language, and income are not demographic drivers of mortality in breast cancer patients at a diverse safety net academic medical center. International Journal of Breast Cancer. 2015; 2015:835074.doi: 10.1155/2015/835074 [PubMed: 26605089]

Partinen MHC. Epidemiology of sleep disorders. Philadelphia, PA: Elsevier; 2005.

Pinto AC, de Azambuja E. Improving quality of life after breast cancer: Dealing with symptoms. Maturitas. 2011; 70(4):343–348. DOI: 10.1016/j.maturitas.2011.09.008 [PubMed: 22014722]

Riedel BW, Lichstein KL. Strategies for evaluating adherence to sleep restriction treatment for insomnia. Behaviour Research and Therapy. 2001; 39(2):201–212. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11153973. [PubMed: 11153973]

Rogojanski J, Carney CE, Monson CM. Interpersonal factors in insomnia: A model for integrating bed partners into cognitive behavioral therapy for insomnia. Sleep Medicine Reviews. 2013; 17(1):55–64. DOI: 10.1016/j.smrv.2012.02.003 [PubMed: 22609123]

Roscoe JA, Garland SN, Heckler CE, Perlis ML, Peoples AR, Shayne M, Morrow GR. Randomized placebo-controlled trial of cognitive behavioral therapy and armodafinil for insomnia after cancer treatment. Journal of Clinical Oncology. 2015; 33(2):165–171. DOI: 10.1200/JCO.2014.57.6769 [PubMed: 25452447]

Savard J, Ivers H, Savard MH, Morin CM. Cancer treatments and their side effects are associated with aggravation of insomnia: Results of a longitudinal study. Cancer. 2015; 121(10):1703–1711. DOI: 10.1002/cncr.29244 [PubMed: 25677509]

Savard J, Ivers H, Villa J, Caplette-Gingras A, Morin CM. Natural course of insomnia comorbid with cancer: An 18-month longitudinal study. Journal of Clinical Oncology. 2011; 29(26):3580–3586. DOI: 10.1200/JCO.2010.33.2247 [PubMed: 21825267]

Savard J, Morin CM. Insomnia in the context of cancer: A review of a neglected problem. Journal of Clinical Oncology. 2001; 19(3):895–908. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11157043. [PubMed: 11157043]

Savard J, Simard S, Ivers H, Morin CM. Randomized study on the efficacy of cognitive-behavioral therapy for insomnia secondary to breast cancer: Part I. Sleep and psychological effects. Journal of Clinical Oncology. 2005a; 23(25):6083–6096. DOI: 10.1200/JCO.2005.09.548 [PubMed: 16135475]

Savard J, Simard S, Ivers H, Morin CM. Randomized study on the efficacy of cognitive-behavioral therapy for insomnia secondary to breast cancer: Part II. Immunologic effects. Journal of Clinical Oncology. 2005b; 23(25):6097–6106. DOI: 10.1200/JCO.2005.12.513 [PubMed: 16135476]

Savard MH, Savard J, Simard S, Ivers H. Empirical validation of the Insomnia Severity Index in cancer patients. Psychooncology. 2005; 14(6):429–441. DOI: 10.1002/pon.860 [PubMed: 15376284]

Spiegel D, Butler LD, Giese-Davis J, Koopman C, Miller E, DiMiceli S, Kraemer HC. Effects of supportive-expressive group therapy on survival of patients with metastatic breast cancer: A randomized prospective trial. Cancer. 2007; 110(5):1130–1138. DOI: 10.1002/cncr.22890 [PubMed: 17647221]

Tremblay V, Savard J, Ivers H. Predictors of the effect of cognitive behavioral therapy for chronic insomnia comorbid with breast cancer. Journal of Consulting and Clinical Psychology. 2009; 77(4):742–750. DOI: 10.1037/a0015492 [PubMed: 19634966]

Troxel WM. It's more than sex: Exploring the dyadic nature of sleep and implications for health. Psychosomatic Medicine. 2010; 72(6):578–586. DOI: 10.1097/PSY.0b013e3181de7ff8 [PubMed: 20467000]

Troxel WM, Robles TF, Hall M, Buysse DJ. Marital quality and the marital bed: Examining the covariation between relationship quality and sleep. Sleep Medicine Reviews. 2007; 11(5):389–404. DOI: 10.1016/j.smrv.2007.05.002 [PubMed: 17854738]

Yost KJ, Thompson CA, Eton DT, Allmer C, Ehlers SL, Habermann TM, Cerhan JR. The Functional Assessment of Cancer Therapy-General (FACT-G) is valid for monitoring quality of life in patients with non-Hodgkin lymphoma. Leukemia & Lymphoma. 2013; 54(2):290–297. DOI: 10.3109/10428194.2012.711830 [PubMed: 22799432]

**TABLE 1**

Survivor Demographics at Baseline for the Full Sample ($n = 96$) and by Intervention Arm

| | ***Full sample*** | ***CBT-I + Placebo*** | ***CBT-I + Armodafinil*** | ***Placebo*** | ***Armodafinil*** |
|---|---|---|---|---|---|
| | ***N = 96*** | ***N = 24*** | ***N = 23*** | ***N = 25*** | ***N = 24*** |
| Age, Mean (range) | 56.09 (26–75) | 58.88 (30–74) | 56.26 (36–73) | 52.28 (26–69) | 57.13 (43–75) |
| Sex: | | | | | |
| Male, *N* (%) | 12 (12.5) | 3 (12.5) | 1 (5) | 7 (28) | 1 (4.2) |
| Female, *N* (%) | 84 (87.5) | 21 (87.5) | 22 (95.7) | 18 (72) | 23 (95.8) |
| Ethnicity: | | | | | |
| Non–Hispanic | 91 (94.8) | 23 (95.8) | 22 (95.7) | 24 (96) | 22 (91.7) |
| Unknown | 5 (5.2) | 1 (4.2) | 1 (4.3) | 1 (4) | 2 (8.3) |
| Race: | | | | | |
| White | 86 (89.6) | 23 (95.8) | 21 (91.3) | 19 (76) | 23 (95.8) |
| African American | 8 (8.3) | 1 (4.2) | 2 (8.7) | 4 (16) | 1 (4.2) |
| Other/Unknown | 2 (2.1) | | | 2 (8) | |
| Education: | | | | | |
| More than high school | 86 (89.6) | 20 (83.4) | 20 (86.9) | 23 (92) | 23 (95.8) |
| High school or less | 10 (10.4) | 4 (16.6) | 3 (13) | 2 (8) | 1 (4.2) |
| Married | 59 (61.5) | 13 (54.2) | 16 (69.6) | 18 (72) | 12 (50) |
| Weeks from last cancer tx to intervention: Mean (range) | 175.05 (1–1,429) | 217.34 (3–997) | 311.00 (1–1,429) | 81.93 (3–272.71) | 186.83 (11–870) |
| Type of cancer | | | | | |
| Breast | 65 (67.6) | 16 (66.7) | 17 (73.9) | 15 (60) | 17 (70.8) |
| Other | 31 (32.4) | 8 (33.3) | 6 (26.1) | 10 (40) | 7 (29.2) |
| Cancer treatment type | | | | | |
| Chemotherapy | 77 (80.2) | 17 (70.8) | 17 (73.9) | 21 (84) | 22 (91.7) |
| Radiotherapy | 71 (74.0) | 19 (79.2) | 18 (78.3) | 17 (68) | 17 (70.8) |
| Surgery | 11 (11.5) | 3 (12.5) | 2 (8.7) | 1 (4.0) | 5 (20.8) |
| Baseline insomnia[1] | 14.14 (4.81) | 14.44 (4.58) | 13.30 (5.75) | 15.21 (4.96) | 13.58 (3.88) |
| Baseline social support[2] | 20.16 (5.82) | 19.92 (5.29) | 22.44 (5.74) | 18.17 (6.56) | 20.19 (5.14) |

[1] From Insomnia Severity Index.

[2] From FACIT-F Emotional Support Scale.

**TABLE 2**

Adherence to Prescribed Time in Bed (PTIB) Per Week as Predicted by Baseline Social Support Among Participants Randomized to CBT-I($n$ = 47)

| *Week* | *% Adherent* | *Odds ratio* | *95% CI* |
|---|---|---|---|
| 1 | 37.5 | 1.01 | 0.89–1.14 |
| 2 | 72.2 | 1.10 | 0.96–1.26 |
| 3 | 75.7 | 1.16* | 1.00–1.35 |
| 4 | 67.6 | 1.27* | 1.05–1.53 |
| 5 | 75.0 | 1.29* | 1.02–1.61 |
| 6 | 61.3 | 1.17 | 0.97–1.41 |
| 7 | 60.0 | 1.03 | 0.84–2.25 |

Note.

*Statistically significant at the 0.05 level.

**TABLE 3**

ANCOVA Models Testing the Effect of Social Support as Main Effect ($N = 96$)

| ***Moderator*** | ***Social support alone*** | | | ***Social support + moderation*** | | |
|---|---|---|---|---|---|---|
| ***Variable*** | ***Sum of Squares*** | ***df*** | ***F*** | ***Sum of Squares*** | ***df*** | ***F*** |
| Baseline ISI | 345.03 | 1 | 23.19* | 324.26 | | 21.39* |
| CBTI | 540.82 | 1 | 36.35* | 115.99 | 1 | 5.66* |
| Armodafinil (A) | 26.08 | 1 | 1.75 | 0.19 | 1 | 0.01 |
| CBTI by A | 42.26 | 1 | 2.84 | 9.23 | 1 | 0.61 |
| Social Support (S) | 126.21 | 1 | 8.48* | 99.21 | 1 | 6.54* |
| CBTI by S | | | | 3.03 | 1 | 0.20 |
| A by S | | | | <0.01 | 1 | 0.00 |
| CBTI by A by S | | | | 22.06 | 1 | 1.46 |
| Error | 1811.467 | 90 | | 1782.10 | 87 | |
| Extra SS F–value | | | | $F = 0.62$, $p = 0.60$ | | |

Note.

*Statistically significant at the 0.05 level.