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Sleep Quality and Fatigue After A Stress Management Intervention For Women With Early-Stage Breast Cancer in Southern Florida

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Abstract

Background—Sleep disruption and fatigue are ubiquitous among cancer patients and is a source of stress that may compromise treatment outcomes. Previously we showed that a cognitive behavioral stress management (CBSM) intervention reduced anxiety and other stress-related processes in women undergoing primary treatment for breast cancer.

Purpose—This study examined secondary outcomes from a CBSM intervention trial for women with early-stage breast cancer to test if CBSM would improve sleep quality and fatigue among these patients at a single site in Southern Florida. CBSM-related effects have already been demonstrated for indicators of psychosocial adaptation (e.g., general and cancer-related anxiety).

Methods—Patients were randomized to CBSM (n = 120) or a one-day psychoeducation control group (n = 120). The Pittsburgh Sleep Quality Index (PSQI) and Fatigue Symptom Inventory were completed prior to randomization and 6 and 12 months after the baseline assignment.

Results—In latent growth analyses, women in CBSM reported greater improvements in PSQI sleep quality scores than controls, although there were no significant differences between conditions on PSQI total scores. Women in CBSM also reported greater reductions in fatigue-related daytime interference than controls, though there were no significant differences in changes in fatigue intensity. Changes in sleep quality were associated with changes in fatigue.

Conclusions—Future work may consider integrating sleep and fatigue content into stress management interventions for women with early-stage breast cancer.

Background

Sleep disruption and fatigue are ubiquitous among early stage breast cancer patients [1, 2] and may influence clinical outcomes, such as cancer progression and survival [3-5]. Significant levels of sleep disruption and fatigue have been demonstrated after surgery and prior to adjuvant treatment [6] and may be exacerbated by chemotherapy and/or radiation treatment [7]. While sleep and fatigue are frequently found to be associated with one another [8-10], the terms are not interchangeable. Fatigue is defined as weariness, exhaustion, or a lack of energy that leaves you unmotivated and is a detriment to your well-being [11]. Sleepiness may be part of fatigue, but is more specifically a desire or need to actually go to sleep (for a more nuanced discussion of sleep and fatigue see Shen et al 2006 [12]. While distinct concepts, there is evidence that sleep-related and fatigue-related complaints may covary [13]. It follows that psychosocial interventions that improve sleep-related symptoms may concurrently improve fatigue and fatigue-related daily functioning. However, research demonstrating the parallel changes in sleep and fatigue during psychosocial interventions is limited. It is plausible that interventions capable of reducing anxiety might show such parallel effects on sleep and fatigue.

Group-based cognitive behavioral stress management (CBSM) has been shown to reduce emotional distress (e.g., anxiety [14]) and improve indicators of functional adaptation (e.g., productivity [15]) among women undergoing treatment for breast cancer. In previous analyses of this sample, CBSM has been shown to improve quality of life and benefit finding [15], anxiety and distress [14], ability to relax [16], cortisol patterns [16], cellular immunity [17], and pro-inflammatory leukocyte gene regulation [18]. It is plausible that

women undergoing CBSM may also show improvements in sleep and fatigue given the well-established link between anxiety and these phenomena.

Moreover, while CBSM does not target sleep or fatigue directly, elements of CBSM, such as relaxation training and cognitive restructuring, are commonly employed in interventions that do target sleep and fatigue [19]. We hypothesized that exposure to these CBSM skills might carry over to improvements in sleep and fatigue even in the absence of specific sleep and fatigue-targeted content and skills training. For example, relaxation training may decrease physiological activation, which could decrease sleep onset problems and improve overall sleep quality over time [20-22]. Those experiencing improved sleep in turn could experience improvements in fatigue. Being in the active phases of treatment (adjuvant therapy with chemotherapy or radiation therapy) might provide a teachable moment for women to learn these relaxation skills, given that these women are likely to be experiencing both sleep disruptions and fatigue symptoms [1]. Learning these skills early on could provide lasting benefits in the months during which women are recovering from treatment, a period also marked by ongoing sleep problems and fatigue [23].

In the current study, we examined secondary outcomes from a CBSM intervention trial and tested three hypotheses. First, it was predicted that women randomized to CBSM in the weeks following surgical treatment for early stage breast cancer would show greater self-reported sleep quality over a one-year period than women randomized to a one-day psychoeducation control condition. Second, it was predicted that women assigned to CBSM would report greater reductions in fatigue and fatigue-related interference in daily living over a one-year period, compared to control participants. Third, it was predicted that treatment-related changes in sleep quality would be associated with improvements in fatigue.

Method

Participants

Participants were 240 women diagnosed with breast cancer at stage III or below who had recently undergone lumpectomy or mastectomy. Exclusion criteria included prior cancer, prior psychiatric treatment for a serious disorder (e.g., psychosis, suicidality), and lack of fluency in English. The study was approved by the local institutional review board and all participants provided informed consent. Participants had undergone surgery before the baseline assessment and had to complete the baseline assessment before beginning any adjuvant treatment (e.g., chemotherapy or radiation therapy). Most women (approximately 78%) completed their baseline (Time 1) assessment two to eight weeks post-surgery (range = 9-140 days). A second assessment (Time 2) occurred three months after the 10-week intervention ended (six months after the initial assessment). A third assessment (Time 3) occurred six months later. The period of follow-up thus spanned approximately one year after randomization.

Procedure

After the Time 1 assessment, participants were randomly assigned to a 10-week CBSM condition or a control condition in which participants received standard care plus a one-day 6 hour psycho-education session using a 1 to 1 assignment procedure. Staff who conducted randomization did not serve as interventionists or assessors, and the assessor was blind to condition assignment. The CBSM intervention occurred over 10 weekly sessions and consisted of a structured, manualized intervention aimed at teaching women to more effectively cope with daily stressors and optimize their use of social resources [24]. Groups of up to eight women met weekly for two-hour sessions, which included didactic presentations, instruction in empirically-supported cognitive behavioral techniques [25-29] and relaxation exercises such as progressive muscle relaxation and imagery [30]. The intervention protocol has been designed specifically to address the needs of women under treatment for early stage breast cancer including both in-session experiential exercises and at-home practice which were organized in a participant workbook [31]. Participants in the CBSM intervention group attended an average of 6.78 sessions ($SD = 2.78$; median = 7.00).

Women in the psycho-education control group received standard care from their medical team, completed study questionnaires, and were also offered a one-day seminar covering breast cancer related health information and outlines of some stress management techniques including relaxation. This one day experience lacked the full attention time, therapeutic group environment, and home practice aspects of the CBSM intervention and was akin to a self-help seminar.

Measures

For the randomized trial, women provided demographic information and completed self-report measures of sleep and fatigue along with other measures addressing aspects of quality of life, which have been reported elsewhere [14, 15].

Sleep quality—The Pittsburgh Sleep Quality Index (PSQI) is a commonly used retrospective self-report questionnaire that measures quality of sleep and specific sleep disturbances within the past 30 days [32]. The PSQI consists of seven subscales; scores for each subscale range from 0-3. It has good psychometric properties among women with breast cancer patients and a Cronbach's alpha of .72 in this sample [33]. Factor analysis of the PSQI has yielded three factors, which we refer to here as the sleep quality, sleep efficiency, and sleep medication components [34]. The sleep quality component is a sum of the sleep disturbances, sleep latency, daytime dysfunction, and sleep quality subscales. The sleep efficiency component is a sum of the sleep duration and sleep efficiency subscales. For all subscales, higher scores indicate higher levels of sleep disturbance.

Fatigue—The Fatigue Symptom Inventory was developed and validated with breast cancer patients [35]. We used the fatigue intensity and fatigue-related daytime interference subscale scores. Fatigue intensity measures the most, least, and average levels of fatigue in the past week, and the level of fatigue at the time of questionnaire completion, on a 9-point Likert scale (Cronbach's alpha = 0.85). Fatigue-related daytime interference measured the degree to which fatigue interferes in a number of domains of daily life, including relations with others

and enjoyment of life, on a 9-point Likert scale (Cronbach's alpha = 0.94). For both subscales, higher scores indicate greater levels of fatigue and fatigue-related interference.

Data analytic plan

Preliminary analyses included comparisons of attrition between the CBSM and psycho-education control groups, descriptive statistics for variables of interest, and correlations between outcome variables.

Intervention effects on sleep and fatigue were tested by intent-to-treat analysis using latent growth-curve modeling (LGM [36, 37]) as outlined in Antoni et al [15]. The intercept (starting point) and slope (change over time) were modeled as latent variables from data at baseline (Time 1), six months after baseline (Time 2), and 12 months after baseline (Time 3). Homogeneity of residual variances was assumed. The predictor was CBSM versus psycho-education control (coded as 1 versus 0). The path from condition to intercept reflects group differences at Time 1 and should be non-significant due to randomization. The path from condition to slope reflects group differences on the trajectory of change in the dependent variable over time. Given that previous work has found elevated levels of sleep disruption and fatigue among post-surgical cancer patients [6], we included the number of days between surgery and the Time 1 assessment as a covariate for all analyses (see Table 1). Full information maximum likelihood (FIML) estimation as implemented in Mplus was used to handle missing data [38]; thus, all participants with at least one complete measure for each outcome and the time since surgery covariate were represented in the analyses (valid ns ranged from 216 to 229). In order to statistically control for possible influences of adjuvant treatment (i.e., chemotherapy and radiation) on sleep disruption and fatigue [7], we also examined whether including presence or absence of adjuvant therapy as an additional covariate significantly altered model fit and/or pathways. We began the analyses with a model in which Time 3 was specified as 12 months after Time 1; if that model did not fit the data, we tested a model in which the loading for Time 3 was freely estimated to capture potential nonlinear change (e.g., initial increases followed by plateauing, reflecting a maintenance of training effects).

For each LGM we report chi-square (χ^2), comparative fit index (CFI), root-mean-square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR) as model fit indices [39]. Specific effects were tested with the z statistic, two-tailed $p < .05$. Effect sizes (Cohen's d [40]) were calculated without measurement error [41].

We also tested whether improvements in sleep paralleled changes in fatigue using LGM. Due to limitations of the sample size, these effects were tested using bias-corrected bootstrapping procedures [42]. If changes in sleep quality parallel changes in fatigue, then the sleep quality slope would be correlated with the fatigue slope.

Results

Preliminary analyses

Using CONSORT criteria [43] a flow diagram of participation was created (Figure 1). Attrition did not differ significantly by condition at Time 2, $\chi^2(1, n=240) = 0.33, p > 0.50$, or

Time 3, $\chi^2(1, n=209) = 1.45$, $p > 0.20$. Of those who dropped out between Time 1 and Time 2, Hispanic women, $\chi^2(3, n=239) = 20.68$, $p < 0.01$, women with stage 3 disease, $\chi^2(3, n=238) = 11.13$, $p < 0.02$, and women who had undergone mastectomy, $\chi^2(1, n=240) = 4.91$, $p < 0.03$, were over-represented. In addition, women who dropped out between Time 1 and Time 2 were significantly younger (mean = 45.19, SD = 9.35) than women who remained in the study (mean = 51.11, SD = 8.74), $F(1, 238) = 12.12$, $p < 0.01$. There were no significant differences between completers and non-completers on any other variables in Table 1.

At baseline, participants assigned to the CBSM condition reported a range of PSQI global scores of 2-19 (out of a possible 0-21), while those assigned to the control condition reported a range of 1-20. CBSM participants reported a range of 1-10 on the sleep quality component score (out of a possible 0-12) while control participants reported ranges of 1-11. CBSM participants reported a range of 0-6 on the sleep efficiency component score (out of a possible 0-6), as did controls. In terms of the fatigue scales, the CBSM participants reported ranges of 1.00-8.00 on the intensity scale while control participants reported ranges of 1.00-8.50. Finally CBSM participants ranged from 1.00-8.86 on the daytime interference scale (out of possible scores of 1-9), while controls revealed a comparable range 1.00-8.00.

Characteristics of the sample, by condition, are presented in Table 1. Of clinical interest, CBSM participants reported significantly less use of prescription anxiety and sleep medications at 12-month follow-up compared to controls (Table 1). Additionally, the outcome variables were significantly correlated at the $p < 0.01$ level (averaged across three time points). These correlations should be considered in interpreting the results.

Intervention effects on sleep quality and fatigue

Sleep quality—We examined the effect of condition assignment (i.e., CBSM or psycho-education control) on the overall PSQI score, as well as on the sleep quality and sleep efficiency components. For the overall score, when the loadings associated with the three time points were specified at 0, 6, and 12 months, the LGM model fit the data, $\chi^2(6, n=229) = 10.34$, $p > 0.10$ (CFI = 0.98, RMSEA = 0.06, SRMR = 0.03). Condition did not predict variation in intercept ($z = -0.52$, $p > 0.60$), indicating that the groups did not differ significantly in overall PSQI score at Time 1. Condition also did not relate significantly to slope ($z = -1.44$, $p > 0.10$) indicating no differential slope of change over time between the CBSM and psycho-education control groups (Table 2). Number of days from surgery to Time 1 was not significantly associated with changes in overall PSQI score ($z = 0.94$, $p > 0.30$). Results were similar when presence or absence of adjuvant therapy was added as a covariate, and adjuvant therapy was not significantly associated with changes in the overall PSQI score ($z = 1.24$, $p > 0.20$). When the sleep efficiency component was examined, the model did not fit the data.

For the sleep quality component, when the three time points were specified at 0, 6, and 12 months, the LGM model fit the data, $\chi^2(6, n=229) = 7.18$, $p > 0.30$ (CFI = 0.99, RMSEA = 0.03, SRMR = 0.03). There were no significant differences in sleep quality between groups at Time 1 ($z = -0.74$, $p > 0.40$). However, the CBSM group did report a significantly greater rate of improvement in sleep quality over the 12-month follow-up compared to psycho-education controls (Table 2 and Figure 2; $z = -2.26$, $p < 0.03$). Number of days from surgery to Time 1

was not significantly associated with changes in sleep quality ($z = 0.93, p > 0.30$). Results were similar when presence or absence of adjuvant therapy was included as a covariate, and adjuvant therapy was not significantly associated with changes in the sleep quality component score ($z = 0.87, p > 0.30$).

Fatigue—For the fatigue intensity subscale, when the loading associated with the third time point was freely estimated, the LGM model fit the data, $\chi^2(5, n=218) = 6.05, p > 0.30$ (CFI = 0.99, RMSEA = 0.03, SRMR = 0.02). Condition did not predict Time 1 fatigue intensity scores ($z = -0.90, p > 0.30$) or change in fatigue intensity score over time ($z = -1.01, p > 0.30$; Table 2). Time 3 was estimated at 7.10 months after Time 1, indicating a non-linear rate of change over time. Number of days from surgery to Time 1 was not significantly associated with changes in fatigue intensity ($z = -0.14, p > 0.80$). Results were similar when presence or absence of adjuvant therapy was included as a covariate, and adjuvant therapy was not significantly associated with changes in fatigue intensity ($z = 0.71, p > 0.40$).

For the fatigue-related daytime interference subscale, when the loading associated with the third time point was freely estimated, the LGM model fit the data well, $\chi^2(5, n=218) = 4.35, p > 0.40$ (CFI = 1.00, RMSEA = 0.00, SRMR = 0.03). Condition did not predict Time 1 fatigue-related daytime interference scores ($z = 0.61, p > 0.50$). However, condition did significantly predict changes in fatigue-related daytime interference ($z = -1.99, p < 0.05$), with those in CBSM reporting a significantly greater rate of reduction in fatigue-related daytime interference over time versus psycho-education control (Table 2 and Figure 3). Time 3 was estimated at 8.24 months after Time 1 indicating a non-linear rate of change in fatigue-related daytime interference. Number of days from surgery to Time 1 was not significantly associated with changes in fatigue-related daytime interference ($z = -0.55, p > 0.50$). Results were similar when presence or absence of adjuvant therapy was included as a covariate, and adjuvant therapy was marginally associated with changes in fatigue-related daytime interference ($z = 1.87, p < 0.07$).

Association between sleep and fatigue

Next we tested whether CBSM-related improvements in sleep quality paralleled improvements in fatigue-related daytime interference over time. These associations were tested with bias-corrected bootstrapping using a 95% confidence interval based on 5000 bootstrap samples [42]. We used an LGM model that included both CBSM effects on the slope of sleep quality and CBSM effects on the slope of fatigue-related daytime interference, as well as a predictive path from the slope of sleep quality to the slope of fatigue-related daytime interference. This model included days from surgery to Time 1 assessment as a covariate. Based on modification indices, we let the sleep quality and fatigue-related daytime interference scores correlate at Time 2 which allowed the model to fit the data ($\chi^2(17, n=216) = 17.90, p > 0.30$ (CFI = 1.00, RMSEA = 0.02, SRMR = 0.04). In this model, the direct effect of condition on changes in fatigue-related daytime interference was non-significant ($CI = -0.09; 0.14$). The path from the slope of sleep quality to slope of fatigue-related daytime interference was significant ($CI = 0.46; 4.05$) and a test of indirect effect was also significant ($CI = -0.29; -0.01$). These findings suggest that the effects of CBSM on

improved fatigue-related daytime interference were accounted for, in part, by CBSM-associated improvements in sleep quality.

Additional analyses

We conducted four additional LGMs to explore which specific parameters of the sleep quality component (e.g., sleep disturbances, sleep latency, daytime dysfunction, and sleep quality) were most affected by CBSM. Only changes in the sleep latency subscale were significantly affected by condition. When the loadings associated with the three time points were set at 0, 6, and 12 months, the LGM model fit the data, $\chi^2(6, n=229) = 10.56, p > 0.10$ (CFI = 0.97, RMSEA = 0.06, SRMR = 0.03). There were no significant differences in sleep latency between groups at Time 1 ($z = -0.95, p > 0.30$). However, those who were assigned to CBSM did report less difficulty falling asleep over time versus psycho-education control ($z = -2.27, p < 0.03, d = 0.51$). Number of days from surgery to Time 1 was included as a covariate and was not significantly associated with changes in sleep latency ($z = 0.83, p > 0.40$). Results were similar when presence or absence of adjuvant therapy was included as a covariate, and adjuvant therapy was not significantly associated with changes in the sleep latency subscale ($z = -0.61, p > 0.50$). Specifically, when examining sleep latency as a single continuous variable (self-reported average minutes to fall asleep over the past 30 days), those assigned to CBSM reported reductions in time to sleep onset (in minutes) from Time 1 (mean = 27.51, SD = 28.14) to Time 3 (mean = 16.14, SD = 21.78).

We then tested whether confidence in one's ability to relax, as measured by the relaxation subscale of the Measure of Current Status (MOCS-R [44]) may be associated with improved sleep latency among CBSM participants. First, we retested the effects of CBSM on the MOCS-R using LGM (a relationship that was established in a subset of these data [15]). When the loading associated with the third time point was freely estimated, the model fit the data. Condition did not predict variation in MOCS-R intercept, but did predict variation in slope, such that those in CBSM reported increases in self-reported confidence in ability to use relaxation. Time 3 was estimated at 5.66 months, indicating that relaxation confidence plateaued at about 6 months after enrollment. Next, we used LGM examined whether changes in MOCS-R was associated with CBSM-related improvements in the sleep latency subscale and the model fit the data well, $\chi^2(14, n=240) = 18.15, p = 0.20$ (CFI = 0.99, RMSEA = 0.04, SRMR = 0.05). In this model, the previously significant condition effect on sleep latency ($z = 3.00, p < 0.01$) became non-significant ($z = -1.03, p > 0.30$), indicating that confidence in one's ability to relax is related to the effect of condition on sleep latency.

Finally, we explored whether the effects of CBSM might be strongest in a subgroup of women with clinically elevated PSQI scores at study entry. In a subgroup analysis of women with PSQI scores greater than 5 (about 70% of the overall sample), we maintained significant CBSM-related changes on the sleep quality component score ($z = -3.04, p < 0.01$) as well as the sleep latency subscale of the PSQI ($z = -3.07, p < 0.01$). Unlike the overall analysis, we also found significant CBSM-related changes on the PSQI global score ($z = -2.28, p < 0.03$) and the sleep quality subscale of the PSQI ($z = -2.02, p < 0.05$). All models demonstrated good model fit indices (all $\chi^2 < 3.00, p > 0.70$, CFI = 1.00, RMSEA = 0.00,

SRMR< 0.03), and there were no significant differences between the CBSM and PE groups at baseline for any of these outcomes (all $p>.05$).

Discussion

The analyses reported here from are a secondary analysis of a CBSM-related changes in sleep and fatigue in 10-week stress management intervention study whose primary aims examined psychosocial indicators of adaptation such as quality of life, benefit finding, and distress. The results suggest that a group-based 10-week CBSM intervention administered to women while they are undergoing treatment for early stage breast cancer can produce modest improvements in some aspects of sleep quality and can reduce fatigue-related daytime interference over a 12-month follow-up period. The CBSM effects on sleep quality and fatigue-related daytime interference paralleled each other. This is consistent with previous studies that have shown that reductions in fatigue among cancer patients may coincide with improvements in sleep [13]. However, to our knowledge, no prior work has tested this relationship using latent growth modeling with women in the midst of breast cancer treatment.

We did not find a significant effect of CBSM on overall PSQI score, though we did see a significant improvement in the sleep quality component in the CBSM group versus the psycho-education control ($d = 0.60$) which approached those found in studies of psychological interventions designed specifically for insomnia (e.g., 0.65 to 0.88 [45]). This suggests a lack of CBSM effects on the sleep efficiency component of the PSQI. This is similar to another RCT that found CBT-related changes on reported sleep quality, but not on objective indicators of sleep (i.e., polysomnography [46]). It is possible that while exposure to components of CBSM helped women get to sleep more quickly, there were no intervention-related effects on factors that might contribute to longer sleep duration or greater sleep efficiency throughout the night. There are likely cancer-related factors (e.g., hot flashes) that were well beyond the scope of the intervention that may have made difficult for women to sleep longer and stay asleep [47]. However, we were unable to confirm such an effect as the LGMs for sleep efficiency had poor model fit. Thus, we cannot draw conclusions about specific model paths.

There was some evidence that this form of stress management may be specifically effective in reducing sleep onset problems. Indeed, in follow-up analyses, CBSM had the largest impact on the sleep latency subscale of PSQI. Specifically, CBSM participants averaged 28 minutes to fall asleep at Time 1 and 16 minutes at Time 3 (the 12-month follow-up), a 43% reduction. While - based on this 30 day retrospective measure of sleep quality - the participants did not report a mean sleep onset of latency that would meet clinical criteria for insomnia (> 30 minutes), the reduction in sleep onset latency was fairly large for this sample of women with breast cancer. Relaxation training, which teaches techniques to decrease anxiety and physiological activation [48], is a common component of interventions that are aimed to improve sleep and fatigue [19], and may be specifically effective in reducing sleep onset insomnia [49]. In follow-up analyses, we showed that increased confidence in one's ability to relax (as measured by the MOCS-R) was associated with reductions in sleep latency among CBSM participants. While the CBSM-related improvements in relaxation

confidence plateau at about 5.6 months after baseline, intervention-associated improvements in SQ and sleep latency continued out to 12 months. Thus, while the growth in confidence about relaxation skills levels off shortly after training, it is plausible that applying these skills over longer periods leads to improvements in sleep for at least several more months.

Even though clinical sleep disturbance was not a criterion for inclusion in this stress management study and it is likely that most of the women would not have met clinical criteria for insomnia or other clinical sleep disorders, 23% of the participants reported evidence of sleep problems such as insomnia at Time 1 (i.e., sleep onset latency of greater than 30 minutes [50]). Additionally, the women in this study reported a mean PSQI overall score of just over 8.0 which indicates disturbed sleep patterns [33], with approximately 70% reporting a PSQI score greater than the typical cutoff of 5. This mean score is higher than a study of a similar population of pre-adjuvant breast cancer patients where the average overall PSQI score was 7.0 [8]. Thus, the level of sleep disturbance in our sample highlights the prevalence of sleep problems among breast cancer patients in the weeks after surgery and before adjuvant treatment. Even with a sample of women that were not selected on the basis of clinical sleep problems, and thus may represent the wider range of sleep quality among women with breast cancer, we found a high level of disturbed sleep at baseline and CBSM-related improvements over time.

In a subgroup analysis of women with clinically elevated sleep problems (PSQI scores > 5), we maintained significant CBSM-related changes on the sleep quality component score as well as the sleep latency subscale of the PSQI. Unlike the overall analysis, we also found significant CBSM-related changes on the PSQI global score and the sleep quality subscale of the PSQI. This is not surprising given that poorer sleep quality at baseline and the increased room for growth and improvement in the subsample. Future studies should explore sleep quality as a moderator of improvements in outcomes as the present subgroup analysis is limited in scope.

Women receiving CBSM reported improvements in fatigue-related daytime interference and these effects were proportional to improvements in reported sleep quality over time. However, CBSM was not associated with changes in intensity of fatigue, though the effect size ($d = 0.37$) approached that of psychological interventions aimed at improving cancer-related fatigue (0.48 [51]). A recent review of treatments for fatigue in cancer patients concluded that these interventions are generally more effective if they contain fatigue-specific education including self-care and coping training, and activity management [52]. Others have suggested that behavioral interventions produce smaller effects sizes for fatigue intensity if they investigate patients undergoing adjuvant treatment versus a post-treatment or mixed group [51]. Thus, CBSM effects on fatigue intensity may have been larger if tested among cancer survivors who have completed treatment and if CBSM contained fatigue-specific content.

Limitations

This study has several limitations that restrict the degree to which we can draw conclusions and generalize those conclusions to other cancer populations. First, the assessment of sleep parameters was limited to a single retrospective, self-report measure and its component

scores. While the PSQI is one of the most commonly used self-reported measures of sleep, and has shown good psychometric properties in cancer populations, it addresses only subjective reports of sleep. Future studies may consider including actigraphy or a daily sleep diary [53] to further explore the evolution of sleep among breast cancer patients as they progress through treatment. In addition, the PSQI asked women to recall sleep over the past month, while the fatigue measure had a one-week recall period. Future work should use similar recall periods for each construct.

A second limitation is that we did not target the intervention to sleep-disturbed patients. While scores on the PSQI did indicate disturbed sleep patterns and poor sleep quality for many participants, we did not do any follow up assessment to determine who may have had diagnosable clinical sleep disorders. This is a preliminary evaluation of secondary effects to prompt further analysis of the potential of CBSM to affect changes in sleep and fatigue.

A third limitation is the absence of a time-matched control group. This precludes us from ruling out the possible effects of attention time and group support underlying CBSM effects. In addition, the one-day psychoeducation control did include stress management topics (e.g., relaxation) that were also covered in the CBSM intervention condition. This may have limited our ability to find differences between the CBSM and control groups due to some exposure of the control group to the intervention content.

A fourth limitation is that this study addresses sleep and fatigue among women during treatment for breast cancer (i.e., in the weeks post-surgery and through adjuvant treatment) and, thus, may lack generalizability to women who are pre-surgical or cancer survivors (for a discussion of issues patients face along the cancer continuum see Kreps et al [54]). On the other hand embedding such interventions within the context of active treatment may offer benefits at the point when they are most needed. This may also offer a teachable moment when women can learn skills that could serve them into the survivorship period.

A fifth limitation is the lack of maintenance sessions after the final CBSM session that would have helped sustain participants' home practice and confidence in using learned skills. Finally, the women in this sample were predominantly non-Hispanic white, partnered, employed, well educated, and English speakers. This limits our ability to generalize these findings to minority women who experience greater breast cancer morbidity [55] and who may benefit significantly from a stress management intervention.

Conclusion

This study showed that a group-based multi-modal cognitive behavioral stress management intervention can have positive effects on some aspects of sleep quality, specifically sleep onset latency, and fatigue-related daytime interference that approach those found in directed insomnia and fatigue interventions for cancer patients. There was also evidence that improvements in sleep quality parallel effects on fatigue-related daytime interference. Psychosocial interventions such as CBSM may represent an underutilized opportunity to improve sleep and fatigue symptoms among early-stage breast cancer patients whether or not they meet criteria for clinical sleep disturbance. First, some of the components of the CBSM intervention are similar to those found in sleep and fatigue interventions (e.g.,

cognitive therapy, relaxation training [46]) representing a logical place to bring together stress management techniques and those meant to specifically target sleep and fatigue. Second, in this study, CBSM has demonstrated modest effects on some aspects of sleep and fatigue without including sleep- and fatigue-specific content. We hypothesize that including sleep- and fatigue-specific content would maximize improvements in sleep quality and reductions in fatigue-related daytime interference, while also addressing more global aspects of psychosocial functioning [14, 15]. Future CBSM-based interventions should consider integrating sleep and fatigue-targeted intervention content, such as that found in interventions aimed to improve sleep (e.g., cognitive-behavioral therapy for insomnia [56]) in order to optimize these effects and to become more comprehensive approaches to improving quality of life and treatment outcomes among women with breast cancer.

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Figure 1. Experimental design and flow diagram of participants

Figure 2.

Changes in sleep quality among post-surgical patients with early breast cancer randomly assigned to either a 10-week cognitive behavioral stress management (CBSM) intervention or a psycho-education (PE) control including means by time point and standard error bars (condition effect on slope $z = -2.26, p < .03$)

Figure 3.

Changes in fatigue-related daytime interference among post-surgical patients with early breast cancer randomly assigned to either a 10-week CBSM intervention or a 1-day psycho-education control including means by time point and standard error bars (condition effect on slope $z = -1.99, p < .05$)

Table 1
Demographic and medical variables (means and standard errors or n's and percentages, test statistics, and *p* values)

Variable	PE Control	CBSM	Test Statistic	<i>p</i>
Age at diagnosis	50.99 (9.06)	49.69 (8.98)	$F(1,238) = 1.25$	0.26
Years of education	15.47 (2.26)	15.69 (2.50)	$F(1,238) = 0.53$	0.47
Race/ethnicity			$\chi^2(3,N=239) = 1.96$	0.58
non-Hispanic white	74 (62%)	78 (65%)		
non-Hispanic black	10 (8%)	11 (9%)		
Hispanic	31 (26%)	30 (25%)		
Asian	4 (3%)	1 (1%)		
Initially partnered	75 (62%)	75 (62%)	$\chi^2(1,N=240) = 0.00$	1.00
Initially employed	92 (77%)	86 (72%)	$\chi^2(1,N=240) = 0.78$	0.38
Cancer stage			$\chi^2(3,N=238) = 2.96$	0.40
Stage 0	19 (16%)	19 (16%)		
Stage 1	51 (43%)	39 (33%)		
Stage 2	41 (34%)	50 (42%)		
Stage 3	8 (7%)	11 (9%)		
Nodes (n positive nodes)	39 (32%)	49 (41%)	$\chi^2(1,N=239) = 1.93$	0.16
Surgery			$\chi^2(1,N=240) = 3.27$	0.07
Lumpectomy	68 (57%)	54 (45%)		
Mastectomy	52 (43%)	66 (55%)		
Days from surgery to time 1 assessment	44.71 (25.46)	36.63 (19.99)	$F(1,229) = 7.21$	<0.01 *
Received radiation	60 (54%)	58 (54%)	$\chi^2(1,N=220) = 0.00$	0.98
Received chemotherapy	56 (50%)	62 (57%)	$\chi^2(1,N=220) = 1.21$	0.27
Received tamoxifen/anti-hormone therapy	71(63%)	74(68%)	$\chi^2(1,N=220) = 0.64$	0.42
Underwent reconstructive surgery	40 (33%)	45 (38%)	$\chi^2(1,N=240) = 0.46$	0.50
Menopause status			$\chi^2(1,N=240) = 0.02$	0.90
Pre	53 (44%)	54 (45%)		
Peri/Post	67 (56%)	66 (55%)		
Prescribed anti-depressant medication				
Time 1	12 (10%)	14 (12%)	$\chi^2(1,N=240) = 0.17$	0.68
Time 2	14 (15%)	9 (9%)	$\chi^2(1,N=193) = 1.29$	0.26
Time 3	17 (18%)	12 (12%)	$\chi^2(1,N=190) = 1.14$	0.28

Variable	PE Control	CBSM	Test Statistic	p
Prescribed anti-anxiety medication				
Time 1	20 (17%)	22 (18%)	$\chi^2(1, N=240) = 0.12$	0.73
Time 2	18 (19%)	11 (11%)	$\chi^2(1, N=193) = 2.08$	0.15
Time 3	24 (26%)	10 (10%)	$\chi^2(1, N=190) = 7.38$	0.01*
Prescribed sleep medication				
Time 1	19 (16%)	24 (20%)	$\chi^2(1, N=240) = 0.71$	0.40
Time 2	11 (12%)	11 (11%)	$\chi^2(1, N=192) = 0.00$	0.96
Time 3	20 (21%)	8 (8%)	$\chi^2(1, N=191) = 6.18$	0.01*
Prescribed pain medication				
Time 1	32 (27%)	28 (23%)	$\chi^2(1, N=240) = 0.36$	0.55
Time 2	13 (14%)	11 (11%)	$\chi^2(1, N=193) = 0.27$	0.60
Time 3	14 (15%)	10 (10%)	$\chi^2(1, N=190) = 0.86$	0.35

PE=psycho-education; CBSM=cognitive-behavioral stress management

Note. Standard deviations and valid percentages are in parentheses.

* Significant at the $p < 0.01$ level (two-tailed)

Table 2

Estimated means (M) and standard errors (SE) of outcomes at three time points, by experimental and control condition, and condition effects on slope over time including test statistic for unstandardized latent growth model results (z), significance (p), and effect size (d)

Outcome	Time 1		Time 2		Time 3		Condition effect on slope		
	M	SE	M	SE	M	SE	z	p	d
Pittsburgh Sleep Quality Index ^a							-1.44	>0.10	0.45
PE Control	8.42	0.37	7.33	0.42	6.23	0.63			
CBSM	8.15	0.37	6.67	0.40	5.18	0.58			
Sleep Quality Component							-2.26	<0.03	0.60
PE Control	5.59	0.20	5.01	0.23	4.43	0.36			
CBSM	5.38	0.20	4.44	0.22	3.51	0.33			
Fatigue Intensity							-1.01	>0.30	0.37
PE Control	4.46	0.16	4.15	0.22	4.09	0.26			
CBSM	4.27	0.16	3.74	0.22	3.64	0.26			
Fatigue-Related Daytime Interference							-1.99	<0.05	0.48
PE Control	3.53	0.19	3.01	0.20	2.82	0.25			
CBSM	3.69	0.19	2.78	0.20	2.45	0.24			

PE=psycho-education; CBSM=cognitive-behavioral stress management

^aHigher Pittsburgh Sleep Quality Index and Sleep Quality Component scores indicate greater reported sleep problems; Higher Fatigue Intensity and Fatigue-Related Daytime Interference scores indicate greater levels of fatigue and interference