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Disrupted sleep in breast and prostate cancer patients undergoing radiation therapy: the role of coping processes

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Abstract

***Background*: Sleep problems are a common complaint in cancer patients that have been understudied.**

***Methods*: This study examined changes in sleep in 33 breast cancer (BC) patients and 23 prostate cancer (PC) patients during radiation therapy and over a 6-month followup. Coping processes were examined as predictors of sleep. Self-reported sleep was assessed at eight time-points before, during, and after treatment using the Medical Outcomes Study—Sleep Scale. The COPE Scale was used to assess coping processes before treatment onset.**

***Results*: Mixed effects linear modeling analyses revealed that both BC and PC patients reported the most sleep problems prior to and during the early weeks of treatment. Coping strategies predicted sleep trajectories in both groups. In particular, approach coping predicted better sleep in PC patients, whereas avoidance coping predicted worst sleep in both PC and BC patients (p's < 0.05).**

***Conclusion*: These findings highlight the importance of evaluating sleep in patients as they undergo treatment for cancer. Additionally, they suggest that interventions aimed at increasing the use of approach-oriented coping strategies may improve sleep and quality of life in these patients.**

Keywords: sleep; breast cancer; prostate cancer; coping processes; radiation therapy

Introduction

Sleep problems are a common complaint in cancer patients. Descriptive reports indicate that 20–70% of women with breast cancer (BC), and 30–50% of men with prostate cancer (PC) report having sleep difficulties at some point during the cancer trajectory [1–3]. Cross-sectional studies have documented sleep problems before, during, and after treatment with different modalities, including radiation, chemotherapy, and surgery [3–12]. Additionally, sleep problems are correlated with impairments in quality of life, and may also contribute to other behavioral co-morbidities that afflict cancer patients [4,6,13–15]. Research suggests that among patients with cancer, sleep disturbance is associated with greater intensity of fatigue, more anxiety and depressive symptoms, and poor social functioning [4,13,15].

Despite growing interest in sleep, relatively few studies have examined sleep complaints as a primary outcome of interest in individuals with cancer. In particular, longitudinal studies that attempt to identify the phase at which sleep begins to deteriorate in these patients have been scarce. Of the longitudinal studies published in this area, most have been conducted with BC patients undergoing chemotherapy. These studies have found worse sleep in BC patients during chemotherapy than prior to treatment [13,16]. Additionally, BC patients who undergo chemotherapy report some improvement in sleep 30 days after treatment has been completed [16]. However, more research is needed to understand whether sleep problems persist long after treatment has ended when patients are coping with longer-term side of the disease and treatment.

To our knowledge, no published study has examined longitudinal changes in sleep in PC patients, the most common cancer diagnosed in men. Additionally, no longitudinal studies have examined changes in sleep among cancer patients

undergoing radiation therapy. The lack of longitudinal research in these patients limits our ability to discern whether sleep difficulties are the same in patients with different forms of cancer as well as those who undergo different treatment modalities. This information is crucial in order to identify potential causes of sleep problems, information that is necessary for developing appropriate treatments.

There is also a lack of information about factors that may influence cancer-related sleep problems. Psychosocial factors may play a major role in determining who is at greatest risk for developing sleep problems in response to cancer; indeed, psychosocial variables were shown to be the strongest predictors of insomnia in a large study of BC survivors [17]. However, we currently know very little about specific psychosocial predictors of sleep in cancer patients. Research on psychological adjustment to cancer diagnosis and treatment suggests that coping processes are important predictors of recovery. For example, cancer patients who use more approach-coping strategies report better psychological adjustment [18–20], whereas engaging in more avoidant-coping strategies is associated with distress during and after treatment [21,22]. A similar pattern of results has been found in other clinical populations, with approach-coping strategies being associated with less depression and anxiety as well as better health outcomes [23]. The use of maladaptive coping strategies has been shown to predict cancer-related fatigue in BC patients [24]. However, to our knowledge, no studies have examined the impact of coping processes on sleep within the context of cancer.

The primary goals of this longitudinal study were to (1) evaluate changes in sleep over the course of treatment and followup in patients undergoing radiation therapy for BC or PC and (2) to determine whether coping strategies (approach and avoidance) influenced sleep trajectories in these patient groups. We focused on BC and PC patients, as these are the most prevalent types of cancer among women and men in the US. Several dimensions of sleep were assessed in the current study using the Medical Outcomes Study (MOS) Sleep Scale. These included difficulty falling asleep and maintaining sleep, sleep adequacy, sleep quantity, and overall sleep problems.

Sleep was examined at eight assessment points scheduled at specific intervals before, during, and after treatment. Based on cross-sectional findings that BC and PC patients report poor sleep during treatment [1,2,25] and that sleep difficulties remain a problem after treatment has been completed [10,26], we expected that problems with sleep would develop over the course of treatment and that these sleep problems would remain a significant problem during post-treatment evaluations.

Coping strategies were assessed at baseline and examined as predictors of sleep over time in both BC and PC patients. To date, no published study has examined the impact of coping strategies on trajectories of sleep over the course of treatment and followup. Thus, this is a novel aspect of the current study. Based on research suggesting that approach coping is associated with well-being in cancer patients [19,27], we hypothesized that patients who used approach-oriented coping strategies would report fewer sleep problems over the course of treatment and followup, whereas those high in avoidance coping would report more sleep problems. All hypotheses were tested using mixed effects linear modeling.

Methods

Participants

Participants consisted of patients undergoing radiation therapy for early-stage BC ($N = 33$) or PC ($N = 23$) at the UCLA Medical Center. Patients were recruited as part of a parent study examining immune changes and fatigue during radiation treatment [28]. Patients were eligible for study participation if they met the following criteria: (1) age 25–75; (2) diagnosed with localized BC (stage 0, I, or II) or PC (T1-T3, N0, M0); (3) were planning to undergo external beam radiation therapy as part of the primary treatment plan, which they had not begun prior to entering the study; (4) had completed definitive primary surgery (for BC patients); and (5) were able to read and write English. Exclusion criteria included: (1) recurrent cancer; (2) prior or planned treatment with chemotherapy; and (3) regular use of immunosuppressive medication or tobacco.

Demographic characteristics are listed in Table 1.

Recruitment for the current study took place between September 2001 and December 2006 at UCLA Medical Center Radiation Oncology clinic. Participants were approached during their initial consultation before beginning the treatment. Of the 107 patients screened for study eligibility, 41 were not eligible due to medical conditions (e.g. previous cancer treatment) or use of tobacco. Ten patients were eligible but refused participation due to time demands or general lack of interest. Thus, the final sample for these analyses included 56 patients ($n = 33$ BC patients, $n = 23$ PC patients).

Approximately half of the PC patients ($N = 11$) were also undergoing adjuvant hormone therapy during the study. Prior to participation, informed consent was obtained in accordance with an IRB protocol, which was approved by the University of California, Los Angeles, Institutional Review Board.

Procedures

Participants were evaluated at eight time-points, which were scheduled to capture the trajectory of

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Table I. Sample characteristics

	Breast cancer ($N = 33$)	Prostate cancer ($N = 23$)
Education		
High school	0	13%
Some college	30.3%	26.1%
BA degree	24.2%	17.4%
Graduate or professional training	45.5%	43.4%
Income		
$<45\,000$	17.2%	23.8%
45 000–60 000	17.2%	23.8%
60 000–100 000	17.2%	19.1%
$>100\,000$	48.3%	33.3%
Marital status		
Married	60.6%	69.6%
Single	39.4%	304%
Ethnicity		
African-American	9.1%	17.4%
Asian-American	9.1	8.7%
Caucasian-American	69.7%	65.2%
Hispanic	6.1%	8.7%
Other	6.1%	0
	Mean (SEM)	Mean (SEM)
Body mass index	24.02 (0.32)	26.84 (0.60)
Age	56.96 (0.66)	69.69 (1.37)
Coping strategies		
Approach coping	9.97 (0.32)	8.75 (0.74)
Avoidance coping	1.11 (0.03)	1.19 (0.07)

changes in behavioral symptoms during and after radiation treatment. At each time-point, participants completed questionnaires during in person appointments evaluating their sleep and psychological functioning. These assessments were completed at baseline (within 1 month before treatment began), as well as the following points in the treatment trajectory: after 5 days of treatment, after 10 days of treatment, after 20 days of treatment, during the final week of treatment, and at three regularly scheduled follow-up visits targeted at 2 weeks, 2 months, and 6 months after treatment completion. Within the BC sample, one participant failed to complete sleep questionnaires during the third assessment and two failed to complete sleep questionnaires during final assessment. Within the PC sample, five participants failed to complete the final two assessments. Participants received $175 for completing the study.

Measures

Medical Outcomes Survey—Sleep Scale (MOS-Sleep [29])

The MOS is a nationwide, multi-site study of health and quality of life in patients with chronic conditions (hypertension, diabetes, heart disease). It provides excellent normative data for instruments used to assess physical and behavioral symptoms. The MOS-Sleep Scale was used to assess sleep problems. This is a reliable and valid 12-item self-report measure that assesses general sleep problems as well as several dimensions of sleep, including sleep disturbance (trouble falling asleep, time it takes to fall asleep, sleep was not quiet, awaken during sleep time, and have trouble falling asleep again), sleep adequacy (get enough sleep to feel rested upon awakening, get amount of sleep needed), daytime somnolence (drowsy during the day, trouble staying awake during the day, take naps), sleep latency (time it takes to fall asleep), and hours of sleep. Respondents indicated on a 6-point scale (1, none of the time; 6, all of the time) the extent to which they experienced each sleep problem during the past week. Higher scores on each scale are indicative of more sleep difficulties. The Sleep Problems Index I is derived from 6 of the 12 items and provides a general measure of sleep problems. Participants completed the MOS-Sleep scale at each of the eight assessment time-points. Because daytime somnolence had an internal consistency reliability estimate below the accepted cutoff of 0.70 [30], this subscale was dropped from analyses. Internal consistency reliability estimates for the other subscales were between 0.73 and 0.82 for each subscale.

COPE Inventory (COPE-brief [31])

The COPE was administered to assess how participants were coping with the cancer experience. We did not expect coping strategies used by participants to change significantly across time. Therefore, we only assessed coping at baseline. This method has been employed in previous studies examining relationships between coping and psychological distress in cancer patients [32,33].

The COPE includes a broad range of coping strategies; for the purposes of this study, we focused on strategies reflecting approach- and avoidance-oriented coping. Participants indicated on a 4-point scale (1, not at all, 4, a lot) the extent to which they were using each of the coping strategies assessed in response to their cancer diagnosis. Approach coping was assessed by combining scores on the active coping and positive re-appraisal subscales of the COPE, as well as emotional expression, a subscale developed by Stanton *et al.* [18]. Scores on the approach coping scale ranged from 1 to 12, with high scores reflecting more use of this coping strategy. Avoidance coping was assessed using the behavioral disengagement scale, which assesses the extent to which individuals reduce their effort to deal with a particular stressor or give up the attempt to attain goals with which the stressor is interfering. Scores ranged from 1 to 4, with high scores reflecting more use of avoidance coping. Internal consistency coefficients for avoidance coping and approach

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coping ranged from 0.79 to 0.84. The COPE scale has been found to be a valid and reliable measure of coping with sound psychometric properties [31] in both healthy and chronically ill populations. Consistent with previous research [18], both BC and PC patients reported little use of avoidance coping, and quite a bit of approach-coping strategies (see Table 1).

Cancer treatment-related symptoms

The occurrence of treatment-related symptoms was assessed using questions drawn from validated scales assessing treatment-related symptoms in BC [34,35] and PC [36] patients. We focused on symptoms that might impact sleep, including items assessing pain and tenderness in the breast/chest wall in BC patients and items assessing urinary symptoms in PC patients. Participants were asked to rate how bothered they were by each symptom in the past week on a 5-point scale (0, not at all, 4 extremely).

Statistical analysis

Mixed effects linear model

Hierarchical Linear and Nonlinear Modeling (HLM 6.04, Student Version; [37]) statistical software was used to examine changes in sleep over time. These analyses were conducted separately in BC and PC patients.

To determine the trajectory of sleep before, during, and after treatment, we conducted HLM analyses testing the linear (day) and quadratic (day^2) trends in sleep variables. Day and Day^2 were both entered as level-1 units in the analyses. Outcome variables included the Sleep Problems Index I, hours of sleep, and each of the sleep subscales (sleep disturbance, sleep adequacy, and sleep latency).

For those sleep scales that changed significantly over the course of treatment and followup, we examined whether coping strategies predicted these changes. In these analyses, baseline coping strategies (avoidance coping, approach coping) were entered as predictors of sleep trajectories on level-2 of the analyses. This enabled us to examine whether sleep trajectories varied in patients who reported using approach versus avoidant-coping strategies at baseline.

Preliminary bivariate correlation analyses revealed that urinary symptoms were associated with sleep in PC patients (r's = 0.184–0.395, p's < 0.05) and tenderness in the breast/chest wall was associated with sleep in BC patients (r's = 0.169–0.178, p's < 0.05). Thus, we controlled for the influence of these treatment-related symptoms by entering them as level-1 covariates in each analysis.

χ^2 tests examined whether slopes depicting the influence of time and coping strategies on sleep variables randomly varied across participants. Because these tests were non-significant, time and coping strategies were treated as fixed effects.

Secondary analyses: depressed mood as a mediator of coping and sleep trajectories

Using the method described by Kenny *et al.* [38] for testing mediation in multilevel models, depressive symptoms were examined as a potential mediator of relationships between control appraisals/coping and sleep trajectories. In separate HLM analyses, we first estimated the effects of the predictor variables (control appraisals, approach coping, avoidance coping) on sleep variables. Next, we estimated the effects of predictor variables on the mediator (depressive symptoms). We then estimated the effects of the predictor and mediator simultaneously. To establish mediation, depressive symptoms must remain a significant predictor of sleep when it is entered with control appraisals and coping. Additionally, control appraisals and coping must no longer be significant predictors of sleep in this final step of the analyses in order to establish mediation.

Results

Participant characteristics are listed in Table 1. PC patients were between the ages of 54 and 79, and BC patients were between the ages of 29 and 79. The majority of study participants were Caucasian-American, married, with an annual household income of over $45 000.

Sleep trajectories in BC patients

There was a downward linear trend in sleep latency ($\beta = -4.35$, $t_{29,234} = -2.92$, $p = 0.004$) and sleep disturbance ($\beta = -2.46$, $t_{29,246} = -5.05$, $p < 0.001$) for BC patients. As shown in Figure 1, women reported taking longer to fall asleep and having more sleep disturbance prior to treatment, but these symptoms gradually improved during treatment and over the course of the 6-month followup. There were no significant changes in hours of sleep, sleep adequacy, or overall sleep problems over the assessment period (Table 2).

Coping and sleep trajectories in BC patients

Avoidance coping predicted changes in sleep latency among BC patients. Women who were high in avoidance coping took longer to fall asleep at baseline than women who were low in this coping strategy, and this difference persisted across the assessment period ($\beta = -1.81$, $t_{29,240} = -2.38$, $p = 0.02$) (see Figure 2). Approach-coping strategies

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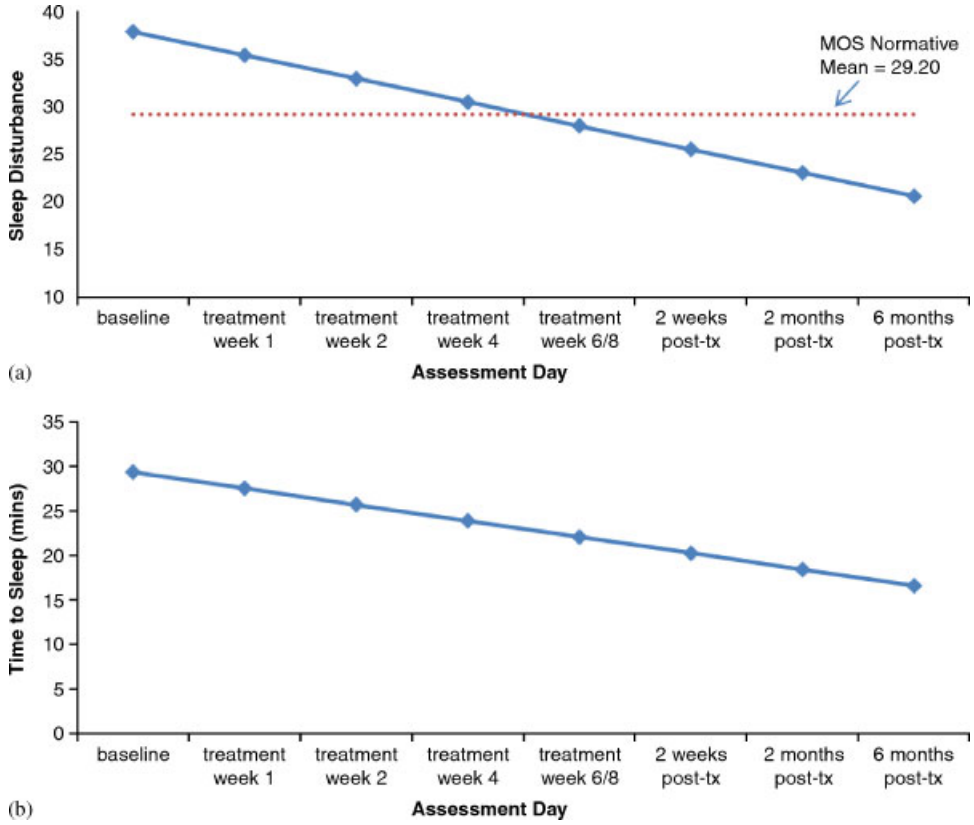

Figure 1. Predicted trajectories in sleep disturbance (a) and sleep latency (b) in BC patients over the course of treatment and followup. The normative mean for MOS sleep disturbance is depicted in the figure. Normative data for MOS-sleep latency was unavailable

Table 2. HLM model of sleep trajectories in breast and prostate cancer patients after controlling for covariates

Sleep variable	MOS normative data (SD)	Baseline mean (SD)	β	SEB	*T*-ratio	d. f.	*p*-Value
Breast cancer							
Hours of sleep	6.93 (1.40)	6.95 (1.09)	0.01	0.08	0.225	29, 234	NS
Sleep adequacy	60.67 (25.38)[a]	65.45 (24.19)	−0.15	0.18	−0.844	29, 234	NS
Sleep disturbance	29.20 (23.37)[a]	39.37 (16.43)	−2.46	1.21	−5.05	29, 234	<0.001
Sleep Problems Index I	28.31 (18.09)[a]	34.08 (10.84)	−0.89	0.76	−0.99	29, 234	NS
Sleep Latency		30–45 min	−4.35	1.51	−2.92	29, 234	0.004
Prostate cancer							
Hours of Sleep	6.93 (1.40)[a]	6.65 (1.46)	−0.23	0.11	−2.06	21, 150	0.041
Sleep Adequacy	60.67 (25.38)[a]	66.52 (26.39)	−0.20	0.26	−1.13	21, 150	NS
Sleep Disturbance	29.20 (23.37)[a]	30.43 (11.41)	−0.73	0.59	1.06	21, 150	NS
Sleep Problems Index	28.31 (18.09)	31.01 (8.20)	−0.20	0.14	−1.95	21, 146	0.05
Sleep Latency		30 minutes	−0.38	0.18	−1.88	21, 146	0.06

[a]Based on one sample *t*-test, baseline mean from current sample significantly different from MOS normative data ($p < 0.05$).

were not associated with trajectories of sleep problems in BC patients.

Secondary analyses: depressed mood as a mediator of coping and sleep in BC patients

A mediation analysis was conducted to determine whether the association between avoidance coping and sleep latency was explained by depressed mood. This analysis revealed a significant relationship between depressed mood and sleep latency over time. Specifically, on weeks when patients reported more depression, they also reported taking longer to fall asleep ($\beta = 0.37$, $t = 2.65$, $p = 0.013$). However, avoidance coping was not associated with changes in depressed mood over time. In order to establish mediation, predictors must be associated with changes in the mediator in HLM analyses. As this assumption was not met, we concluded that depression did not mediate relationships between avoidance coping and sleep latency in BC patients.

Sleep trajectories in PC patients

For PC patients, there was a downward linear trend in hours of sleep, with men reporting fewer hours of sleep over the course of treatment and

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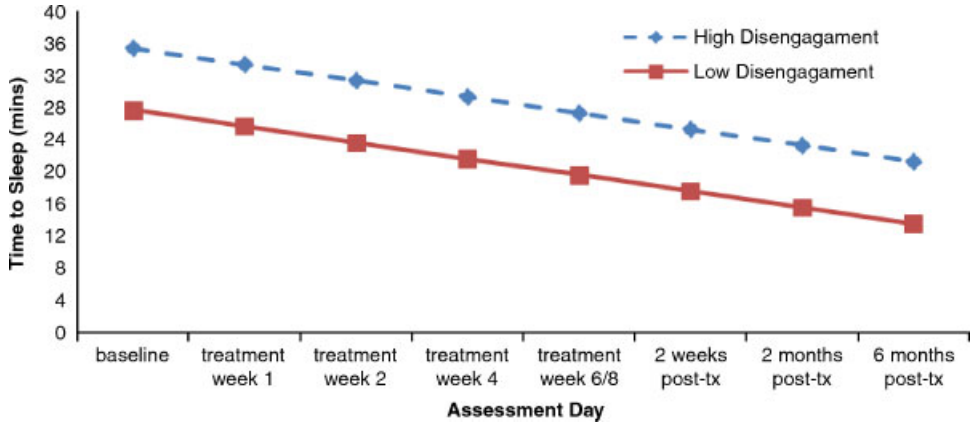

Figure 2. Predicted effect of coping strategies on sleep latency in BC patients over the course of treatment and followup. For illustrative purposes, high and low groups were created using the median split of approach coping

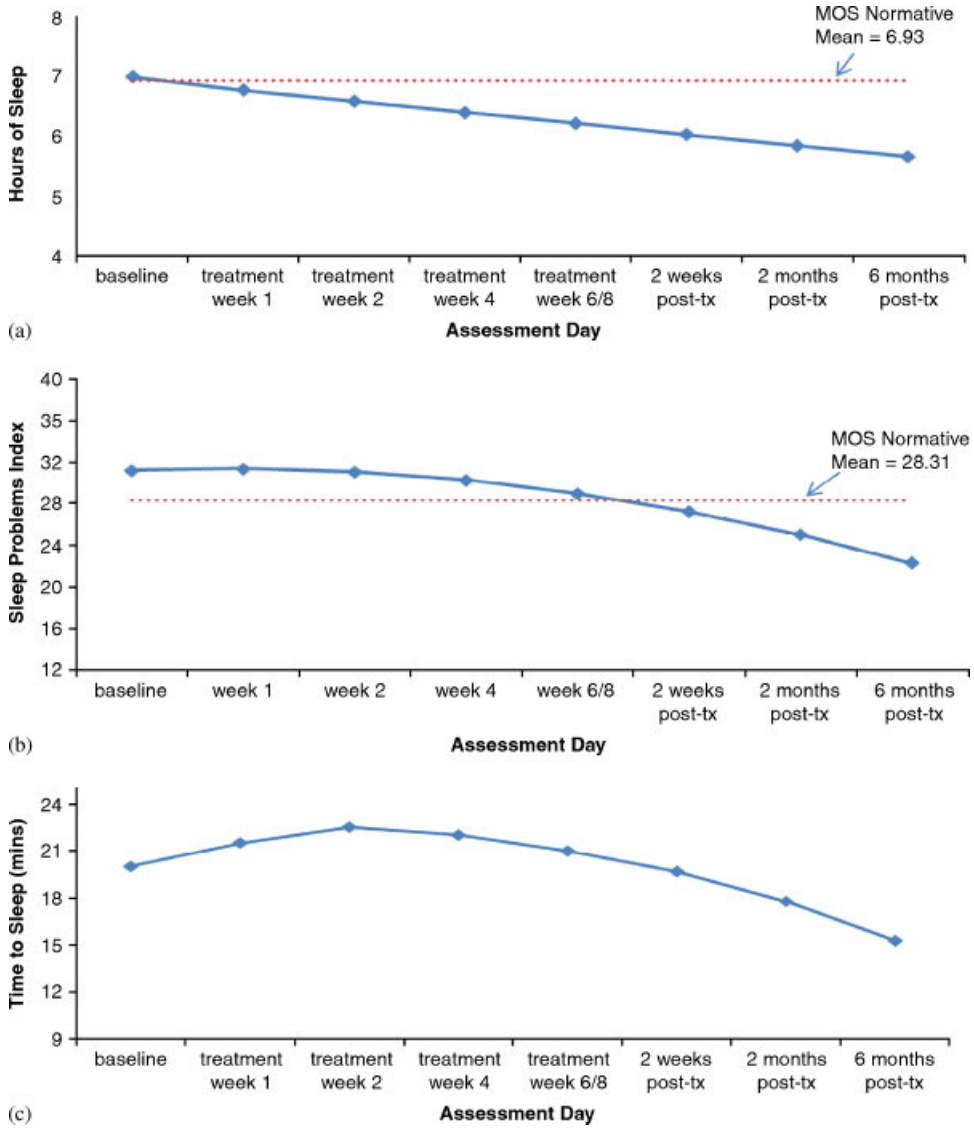

Figure 3. Predicted trajectories in hours of sleep (a), sleep problems (b), and sleep latency (c) during treatment and followup. Normative means for MOS Sleep Problems Index I and hours of sleep are depicted in figures. Normative data for MOS-sleep latency was unavailable

followup ($\beta = -0.23$, $t_{21,150} = -2.06$, $p = 0.041$) (see Figure 3(a)). There was also a quadratic trend in overall sleep problems, such that scores on Sleep Problems Index I were highest at baseline and during the early weeks of treatment, but gradually declined over time ($\beta = -0.20$, $t_{21,150} = -1.95$,

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$p = 0.05$) (see Figure 3(b)). There was a similar but non-significant quadratic trend in sleep latency, such that the time it took to fall asleep was highest at baseline and during early treatment but decreased over time ($\beta = -0.37$, $t_{21,146} = -1.88$, $p = 0.06$) (see Figure 3(c)). There were no significant changes in sleep disturbance or sleep adequacy over the course of treatment.

Coping and sleep trajectories in PC patients

Baseline approach coping predicted trajectories of scores on the Sleep Problems Index I ($\beta = 0.003$, $t_{19,136} = 2.42$, $p = 0.02$) and sleep latency ($\beta = 0.08$, $t_{19,136} = 2.19$, $p = 0.03$) in PC patients. Those high in approach coping showed declines in sleep latency over the course of treatment and followup, whereas those low in approach coping showed no improvements in these symptoms over time (see Figure 4(a)). Baseline avoidance coping also predicted trajectories of scores on the overall Sleep Problems Index I ($\beta = -0.02$, $t_{19,136} = -2.38$, $p = 0.02$). Specifically, scores on the Sleep Problems Index remained elevated throughout treatment and followup in patients who were high in avoidance coping, but gradually declined in those who reported being low in avoidance coping (see Figure 4(b)). Coping strategies were not associated with trajectories in hours of sleep in PC patients (Table 3).

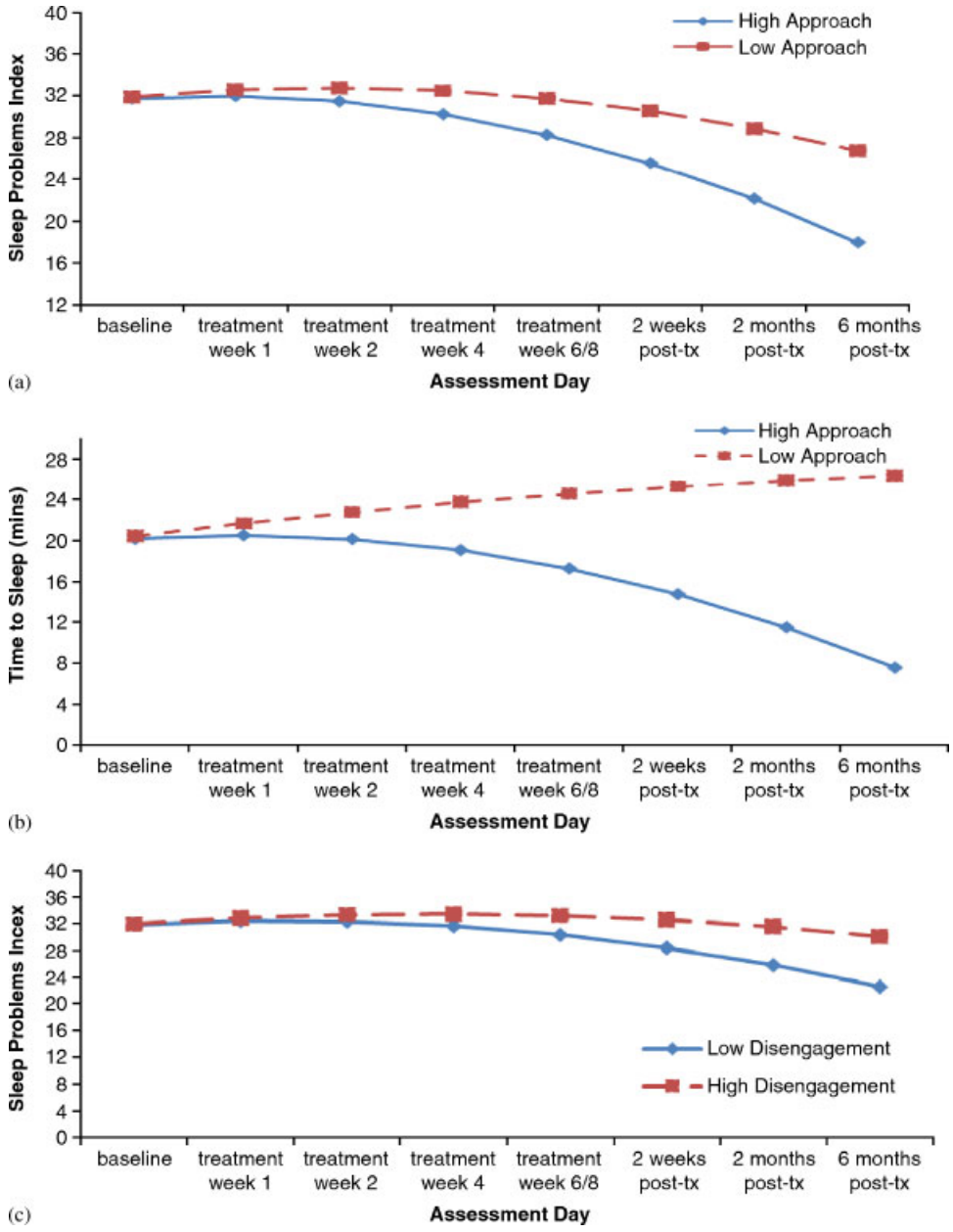

Figure 4. Predicted effect of coping strategies on Sleep Problems Index (a) and sleep latency (b) in PC patients over the course of treatment and followup. For illustrative purposes, high and low groups were created using the median split of approach and avoidance coping

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Table 3. HLM model with coping as predictors of sleep trajectories in breast and prostate cancer patients after controlling for covariates

	Breast cancer patients					Prostate cancer patients				
	β	SEB	*T*-ratio	d. f.	*p*-Value	*β*	SEB	*T*-ratio	d. f.	*p*-Value
Approach coping										
Sleep Problems Index	0.004	0.003	0.121	29, 240	NS[a]	0.003	0.001	2.42	19, 136	0.02
Sleep latency	−0.01	0.008	−1.29	29, 240	NS[a]	0.08	0.036	2.19	19, 136	0.03
Avoidance coping										
Sleep Problems Index	−0.002	0.004	−0.06	29, 240	NS[a]	−0.02	0.008	−2.38	19, 136	0.02
Sleep latency	−1.81	0.18	−2.38	29, 240	0.02	−0.056	0.041	−1.23	19, 136	NS[a]

[a]NS = non-significant.

Secondary analyses: depressed mood as a mediator of coping and sleep in PC patients

Mediation analyses were conducted to determine whether associations between coping and sleep were explained by depressed mood. There was a significant relationship between depression and scores on Sleep Problems Index I over time in PC patients, such that on days when patients reported more depression, they also reported more overall sleep problems on Sleep Problems Index I ($\beta = 0.04$, $t = 2.27$, $p = 0.03$). However, neither approach nor avoidance coping were associated with changes in depressive symptoms over time. In order to establish mediation, predictors must be associated with changes in the mediator in HLM analyses. As this assumption was not met, we concluded that depression did not mediate relationships between coping and trajectories of sleep in PC patients. Depressed mood was unrelated to sleep latency or hours of sleep in PC patients.

Discussion

This study examined longitudinal changes in sleep in BC and PC patients during radiation treatment and over the course of a 6-month post-treatment followup. Results showed that sleep problems were more prevalent prior to treatment onset and during the early weeks of treatment but gradually improved over time, reaching their lowest levels at the 6-month followup. The specific dimensions of sleep that improved over time were somewhat different in the two patient groups; while both groups showed improvements in sleep latency, BC patients also showed improvements in sleep disturbance, whereas PC patients showed improvements in an overall index of sleep problems (Sleep Problems Index I). It is noteworthy that prior to and during the early weeks of treatment, patients in this study had worse sleep than MOS normative levels, which were based on individuals seen at outpatient clinics for chronic medical conditions, including hypertension and diabetes [29]. Both BC and PC patients experienced significant improvements on most sleep outcomes as time passed, and reported fewer sleep problems than MOS normative levels by the 6-month followup. This suggests that sleep problems may be at their worst before and during the early weeks of radiation therapy. Thus, addressing sleep problems early in the course of treatment may facilitate early resolution of these symptoms, with beneficial effects on quality of life.

These findings support previous studies documenting that cancer patients have problems with sleep prior to cancer treatment [39]. Additionally, the current study supports the results of previous longitudinal studies finding that sleep improves significantly in BC patients following cancer treatment [13,16]. In spite of experiencing improvements on several dimensions of sleep, PC patients reported getting less hours of sleep over the course of treatment and followup than they did prior to treatment. This is a puzzling finding that requires further investigation in future research.

Another primary goal of this study was to examine whether coping processes are associated with sleep trajectories in BC and PC patients. As predicted, we found that avoidance coping was associated with more sleep problems in both BC and PC patients. This supports previous research showing that avoidance coping is associated with poor psychological adjustment in patients with chronic illness [19,22] and extends these findings to sleep. Also as predicted, approach coping was associated with better sleep, but only in the PC group. These findings are in line with research showing that cancer patients who engage in more approach-oriented coping evidence better psychological adjustment [18–20,22], whereas those who engage in more avoidance coping report more distress [21,22].

Interestingly, approach coping was unrelated to sleep trajectories in BC patients. This stands in contrast to previous research showing beneficial effects of approach coping on psychological outcomes in women with BC [19], although this is the first study to examine effects on sleep. Using approach coping to manage cancer-related stress may be less beneficial in BC patients who are coping with additional stressful life events. Low

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et al. [32] reported that emotional approach coping was only associated with less depression and more vitality in BC patients who reported low perceived stress from other events, but not in those who reported higher stress from life events in addition to BC. Given this, it is possible that the association between approach coping and sleep in BC patients may be moderated by stressful life events. Future research should explore this.

The primary limitation of this study is the small sample size; although we did have multiple observations on each participant, the total number of patients enrolled was relatively small and findings need to be replicated in larger samples. Another limitation is the demographic homogeneity of the population studied, which may limit the generalizability of our findings. Most participants in the current study were from higher SES brackets, with 60% of them having an annual household income of over $60 000 and approximately 50% having college degrees. Additionally, only 17% of the current sample was African-American. Although these demographics reflect the population of cancer patients seen at the UCLA Medical Center, it might be particularly interesting to examine these factors in more diverse sample. Given that African Americans have higher rates of PC than any other ethnic group in the US, future research should examine psychosocial factors associated with sleep in this group of cancer patients.

This study examined coping strategies and sleep in patients who underwent radiation treatment for BC or PC. Thus, these results may not generalize to individuals who undergo other treatments for BC and PC. This study should be replicated in patients who undergo chemotherapy for BC or radical prostatectomy for PC. Finally, this study used subjective measures to characterize sleep as opposed to polysomnographic measures of sleep. Although self-report measures provide important information about perceptions of sleep problems, they may be confounded by mood [13] or personality characteristics and are not always correlated with objective measures [40]. Inclusion of objective sleep measures would provide valuable information about other components of sleep.

The current findings highlight the importance of conducting longitudinal studies of sleep in BC and PC patients. There are a number of studies demonstrating the importance of sleep in mental and physical health outcomes [26,39,41,42]. Additionally, sleep has been linked to physiological systems with potential relevance for cancer recurrence and progression, including circadian rhythm of the HPA axis and proinflammatory cytokines [43,44]. We report that sleep is disrupted in BC and PC patients at different stages over the course of treatment, and that coping processes may influence the risk of poor sleep. These findings underscore the necessity for a greater focus on sleep problems in cancer patients. Additionally, they suggest that interventions aimed at reducing avoidance coping and increasing the use of approach-oriented coping strategies may help to alleviate sleep problems in these patients.

Several studies have demonstrated that cognitive and behavioral techniques are effective in treating insomnia in cancer patients [26,41,45–47]. These interventions focus on the use of CBT approaches to treat sleep problems directly and typically involve helping patients change maladaptive thoughts and behavioral patterns. The results of the current study suggest that in addition to these techniques, training patients to utilize appropriate coping strategies to deal with cancer-related and other stressors may indirectly improve sleep. Identifying and treating patients who are at risk for sleep problems and understanding the stages at which they are most vulnerable may help to improve overall quality of life and possibly physical health in this group.

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