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Impact of Mindfulness-Based Stress Reduction (MBSR) on Sleep, Mood, Stress and Fatigue Symptoms in Cancer Outpatients

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Sleep disturbance is a very common problem for cancer patients that has largely not been addressed in the clinical intervention literature. Mindfulness meditation has demonstrated clinical benefits for a variety of patient populations in other areas of functioning. This study examined the effects of an 8-week Mindfulness-Based Stress Reduction (MBSR) program on the sleep quality of a heterogeneous sample of 63 cancer patients. Overall sleep disturbance was significantly reduced ($p < .001$) and participants reported that their sleep quality had improved ($p < .001$). There was also a significant reduction in stress ($p < .001$), mood disturbance ($p = .001$), and fatigue ($p < .001$). The associations among these changes and implications for improving quality of life of cancer patients are discussed.

Key words: mindfulness, meditation, cancer, sleep, stress, fatigue

Mindfulness as a construct is the cornerstone of several clinical interventions, including mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990). Recent attempts at definition have resulted in a two-component model of mindfulness (Bishop et al., 2004). The first component involves self-regulation of attention on immediate experience, resulting in recognition of events arising in present moment awareness. The second component represents an orientation of openness and acceptance of moment-to-moment experience. This is similar to the conceptualization of mindfulness as composed of intention, attention, and attitude (Shapiro, Astin, & Carlson, 2004). Intention in this model describes the purposive nature of directing the faculties of attention towards observing moment-to-moment experience, parallel to the first component in Bishop et al. (2004). The third attribute, attitude, describes the quality of the attention, one of gentle, non-judgemental acceptance of whatever arises in the field of awareness, similar to Bishop et al's second component (2004). Thus, in both these conceptualizations, mindfulness involves not only paying attention, but doing so in a way that encompasses attitudes of non-judging and open acceptance. Mindfulness provides the practitioner with an active method to turn off the pervasive reactivity that is common to many Western lives and replace it with conscious responses. Mindfulness is cultivated by practicing various forms of meditation, or mental training. These can be performed in formal meditation sessions or during day-to-day activities, such as washing the dishes, simply by being present in the moment while allowing oneself to experience it in its fullness.

Researchers have examined the effect of mindfulness meditation on specific patient populations. We (Speca, Carlson, Goodey, & Angen, 2000) investigated the outcomes of a mindfulness meditation program on a heterogeneous sample of cancer patients. The participants reported a significant reduction in mood disturbance (65%) and in overall stress levels (31%), compared to a randomized control group. These benefits persisted at 6-month follow-up (Carlson, Ursuliak, Goodey, Angen, & Speca, 2001). The obtained results are in accordance with other published studies that affirm the effectiveness of mindfulness training to ease some of the physical and psychological symptoms associated with illness in a variety of clinical populations (Miller, Fletcher, & Kabat-Zinn, 1995; Kabat-Zinn, Lipworth, & Burney, 1985; Kaplan, Goldenberg, & Galvin-Nadeau, 1993; Reibel, Greeson, Brainard, & Rosenzweig, 2001; Weissbecker et al., 2002).

Sleep Disturbances in Cancer Patients

The importance of sleep and the treatment of sleep disturbance during and after cancer treatment have been relatively overlooked (Savard & Morin, 2001).

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The statistics on the number of cancer patients with poor quality sleep highlights a neglected area. Research (Savard, Simard, Blanchet, Ivers, & Morin, 2001) on insomnia in women with breast cancer demonstrated that over half the sample reported insomnia symptoms and 19% met the criteria for clinical insomnia. Furthermore, 58% of the patients blamed cancer for causing or aggravating their sleep difficulties. These results indicate that insomnia is twice as prevalent in cancer patients as in the general population, which reports frequency ratings ranging from 9% to 12%. Other research has found similarly high rates of sleep disturbance in cancer patients, with 45% (Engstrom, Strohl, Rose, Lewandowski, & Stefanek, 1999) and 75% (Malone, Harris, & Luscombe, 1994). Because of the high incidence of sleep-related concerns in cancer patients and the problems this creates, it is important to investigate methods that will assist in the management of sleep disturbance for this population. This is particularly the case as many patients undergoing cancer treatments are not in a position to use pharmacological sleep aids that might interfere with their medications.

Mindfulness and Sleep

As summarized above, sleep disturbances are common in cancer patients. The causes of such disturbances, however, have not been clearly elucidated, which confounds the treatment of sleep problems. It is well documented that stressful life events can negatively affect sleep quality (Hall et al., 2000), and a diagnosis of cancer is rated among the most disturbing (Tacon, 2003). This, combined with how one perceives sleep difficulties, contributes to the maintenance of the problem. Dysfunctional cognitions can increase arousal levels and sleep-related performance anxiety, which further impairs sleep ability (Savard et al., 2001).

Research has yielded compelling results to suggest that the MBSR program can have positive effects on the sleep quality of cancer patients (Carlson, Speca, Patel, & Goodey, 2003). Although sleep was only one part of the overall health behaviors that were examined in this study, it generated substantial results. Initially over 40% of the sample reported poor sleep. This number dropped to 20% after program completion. Another study examined the relationship between participation in an MBSR program and sleep quality and efficiency (Shapiro, Bootzin, Figueredo, Lopez, & Schwartz, 2003). This research did not find statistically significant associations between participation in an MBSR group and sleep quality. The authors did, however, find that those who practiced more informal mindfulness reported feeling more rested.

Cancer and Fatigue

Fatigue is a common complaint of cancer patients and it has also been rated the longest lasting and the most disruptive symptom that results from treatment (Ancoli-Israel, Moore, & Jones, 2001; Barnes & Bruera, 2002; Carlson et al., 2004) In addition, fatigue is often the first symptom that patients experience and it is usually one of the last to disappear, persisting in 17% of cancer survivors one year after treatment (Cella, Davis, Breitbart, & Curt, 2001). A recent study reported that 48.5% of a large sample of cancer patients, half of whom were in follow-up, identified fatigue as a problem (Carlson et al., 2004). Fatigue was the number one problem identified by this representative group of cancer patients. The nonpharmacologic treatment of choice that has been investigated for cancer-related fatigue is exercise (Berger, 2003; Schwartz, Mori, Gao, Nail, & King, 2001; Barnes et al., 2002; Berger & Higginbotham, 2000). It is possible that the yoga component of MBSR might tap into some of the beneficial aspects of exercise on sleep quality as identified in previous research.

A relationship between sleep disturbance and fatigue seems logical, as it may be the case that poor sleep leads to increased fatigue. However, some studies have found sleep disturbance to be independent from levels of fatigue (Lavidor, Weller, & Babkoff, 2003). One objective of the current study was to investigate the relationships between sleep and fatigue levels pre- and post-MBSR.

Hypotheses

This study was conducted to examine the relationship between MBSR and sleep quality in a heterogeneous sample of cancer patients. Three general hypotheses were addressed: (1) Participation in the MBSR program would result in positive changes in sleep measures, stress symptoms, mood and fatigue scores pre- to postintervention; (2) Absolute levels of stress would be related to sleep quality both pre- and postintervention; (3) Changes in sleep measures would be correlated with concomitant changes in stress symptoms, mood and fatigue scores pre- to postintervention.

Method

Participants

Sixty-three patients participated, accrued from a waiting list for the MBSR program at the Tom Baker Cancer Center. There were no restrictions placed on the type or stage of cancer or on the prognosis of partic-

ipants. Individuals were required to have a basic command of the English language in order to complete the questionnaire package at both the start and the completion of the program, which took approximately 60 minutes. To be eligible for the post-assessment, participants needed to complete 5 of the 8 sessions. Data related to attendance and retention was also collected.

Questionnaires

Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989): This instrument was specifically designed for use in clinical populations to assess sleep. The PSQI has seven component scores and a global score. It consists of 19 self-rated questions that are scored on a 0 to 3 scale over a period of one month. Acceptable measures of internal homogeneity, consistency (test–retest reliability), and validity have been demonstrated. It has sensitivity in distinguishing good and poor sleepers. The psychometric properties of the PSQI in a clinical sample that included women with breast cancer were evaluated and the results supported the utility of using the PSQI in cancer populations (Carpenter & Andrykowski, 1998). A more recent publication (Beck, Schwartz, Towsley, Dudley, & Barsevick, 2004) also confirmed the PSQI's reliability and validity for detected sleep disturbance in clinical samples, particularly with cancer patients.

The Symptoms of Stress Inventory (SOSI; Leckie & Thompson, 1979): The SOSI was designed to measure physical, psychological, and behavioral responses to stressful situations. It consists of 95 items which are rated on Likert scale from 1 (*never*) to 5 (*very frequently*). The SOSI produces an overall stress score and ten subscale scores can be calculated. Chronbach's alpha for the SOSI total score was 0.97, with acceptable subscale coefficients and test-retest correlations.

The Profile of Mood States (POMS; McNair, Lorr, & Droppelman, 1971): The POMS is widely used to study the psychological aspects of cancer. It has demonstrated sensitivity to mood changes within clinical groups. It includes 65 items and is rated on a 5-point scale. It produces a global score as well as scores on six subscales. The POMS measures state (vs. trait) attributes and therefore previous administrations do not influence subsequent administrations, which makes it very good for measuring repetitive administrations. It has demonstrated acceptable Kuder-Richardson internal consistency on the subscales and test–retest stability over a period of 20 days on average.

Procedure

Patients on the MBSR program wait list were informed of the mindfulness meditation and sleep quality study and were invited to participate. Those who agreed were asked to come in before beginning the program to complete the questionnaires, followed by the usual pre-program orientation at the TBCC. Informed consent was obtained at this time and the pre-program assessment was completed in a small group format. In the evaluation sessions participants were given an envelope containing four measures: (1) PSQI, (2) SOSI, (3) POMS, and (4) a brief demographics questionnaire to collect information regarding age, education, marital status, cancer diagnosis, duration of illness, treatment, and prior experience with meditation. The participants were asked to simply read the instructions for each questionnaire and answer all items honestly. When finished, the participants were thanked for their involvement. The data collection procedures were repeated at the end of the eighth session.

Overview of the MBSR Program

The Mindfulness-Based Stress Reduction program is an ongoing clinical program at the Tom Baker Cancer Center. A detailed description of the program components has been published previously (Speca et al., 2000). Classes are 90 minutes long and are held once a week for eight weeks. There is also a three hour silent retreat offered in the sixth week of the program. Mindfulness practice takes three forms: Theoretical, experiential and group processes. Foundational mindfulness theory is introduced as a complement to practice. Meditation techniques are practiced in the classes as well as at home. These include the body scan meditation, sitting and walking meditation and hatha yoga. Yoga mats are provided for in-class use. Group process is designed to provide support and problem solving among participants. A booklet and a guided meditation tape are provided. Participants are asked to complete 45 minutes of meditation homework six days a week and are given a homework log in order to record this for their own purposes.

Data Analysis

Descriptive statistics were used to summarize data on demographics and cancer history variables. Frequency distributions were used to investigate reported sleep quality of participant's pre and post intervention. Component and total scores on the PQSI for all participants were analyzed using repeated measures *t* tests to detect any significant changes over the course of the program.

Associations between raw scores at both pre- and postintervention on the PSQI, POMS and SOSI total scores, and the POMS fatigue subscale were assessed using Pearson product-moment correlations.

Change scores were calculated on the PSQI, POMS and SOSI total scores by subtracting the pre-scores from the post-scores for each participant. Pearson

product-moment correlations between change scores on the PSQI total and component scores, and the POMS and SOSI total scores, were used in order to measure and describe the relationship between changes in sleep quality and symptoms of stress as well as sleep quality and mood disturbance. Correlational analyses were also used to determine whether change in the fatigue subscale of the POMS was significantly related to change in the PSQI total score.

Results

Demographics

Sixty-three patients participated in this study, 49 women and 14 men. The age of the subjects ranged from 32 to 78 years (mean age, 54 years). The majority of the subjects were married (71%). The education level of the sample was relatively high with a mean of 16 years of formal education. The type of cancer diagnosis varied within this sample. The most common type of cancer was breast, comprising 59% of the sample, followed by prostate, ovarian, and Non-Hodgkins lymphoma, all at 6%.

Sleep Quality

Higher scores on the PSQI indicate more sleep disturbance. Before beginning the intervention 91% of the sample met the clinical cutoff of 5 or higher for sleep disturbance. Even more disturbing was that more than half of the sample (51%) had sleep disturbance scores of 10 and greater. Comparatively, after completing the MBSR program, only 27% of the sample was still reporting sleep disturbance scores above the score of 10 or greater (Table 1). Using a more conservative measure of 8 as a cutoff for sleep disturbance has been recommended (Carpenter & Ansrykowski, 1998). Using this cutoff score, 70% of the sample would qualify for disturbed sleep preintervention and 49% would meet this criterion postintervention. There was a significant change in overall sleep quality pre- (M = 10.27; SD = 4.58) to postintervention (M = 7.80; SD = 3.63), $t(62)$ = 4.83, $p < .001$). There was also significant improvement on all of the PSQI subscales. Mean subscale scores are presented in Figure 1. The largest improvements occurred in the areas of subjective sleep quality, sleep efficiency and duration.

Table 1. *PSQI Scores Pre and Post MBSR Intervention*

	Over 5		Over 10	
Pre	N = 57/63	90%	N = 32/63	51%
Post	N = 50/60	79%	N = 17/63	27%

Sleep Quality and Stress

Reduction in overall symptoms of stress pre- to postintervention was statistically significant, $t(62)$ = 4.81, $p < .001$. Significant improvement was also seen

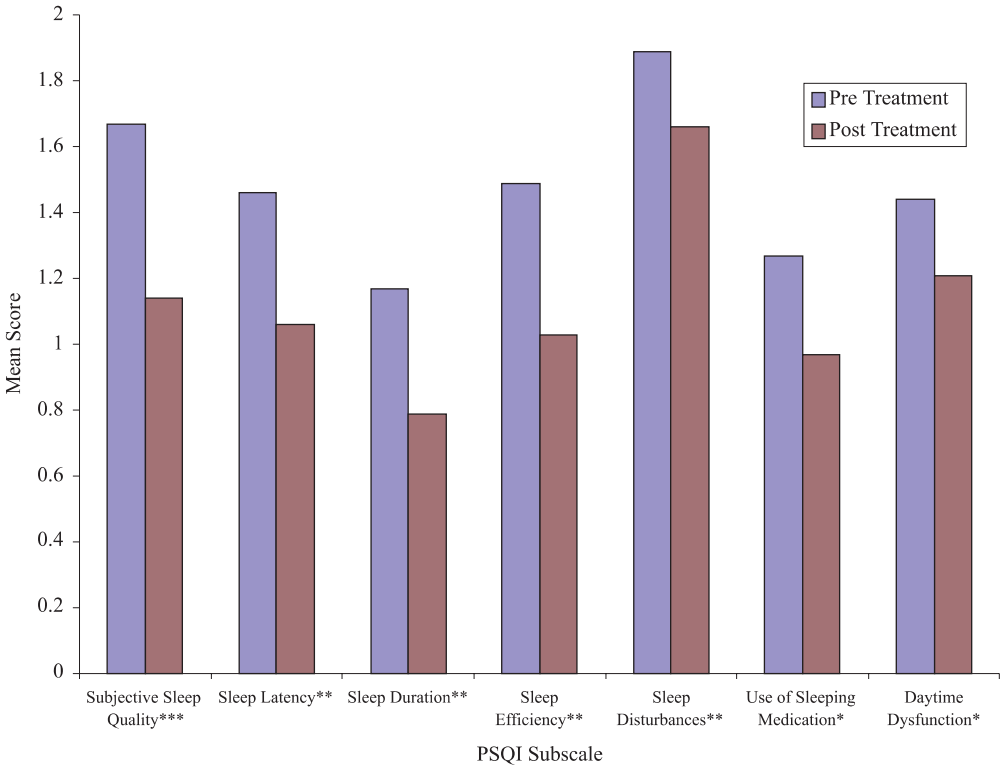

Figure 1. Improvements pre- to postintervention. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 2. *SOSI Scores: Decreases in Stress Symptoms Over Time (Pre vs. Post)*

	Preintervention		Postintervention				
	M	*SD*	*M*	*SD*	t	*df*	*p*
Peripheral manifestations	7.90	5.22	6.54	4.95	2.34	62	.023
Cardiopulmonary	9.60	7.44	8.40	7.96	1.32	62	.192
Central neurological	3.90	4.04	3.03	3.27	2.79	62	.007
Gastrointestinal	8.33	6.25	6.41	5.53	3.67	62	.001
Muscle tension	10.67	7.69	8.59	7.39	2.90	62	.007
Habitual patterns	20.68	9.71	15.60	9.00	4.56	62	.001
Depression	9.78	6.28	7.02	5.34	4.71	62	.001
Anxiety/fear	13.97	9.09	10.21	7.91	4.53	62	.001
Emotional irritability	6.94	5.79	5.18	5.32	3.60	61	.001
Cognitive disorganization	6.10	4.50	4.49	3.74	3.81	62	.001
Total score	97.99	54.33	75.38	49.16	4.81	62	.001

Note. SOSI = Symptoms of Stress Inventory.

Table 3. *Correlations*

	Preintervention			Postintervention			Pre–Post Change Scores		
N = 62	PSQI	SOSI	POMS	PSQI	SOSI	POMS	PSQI	SOSI	POMS
SOSI									
r	.458			.558			.381		
	.001						.002		
p	*N* = 63			.001			*N* = 63		
POMS									
r	.456	.836		.566	.798		.133	.717	
p	.001	.001		.001	.001		.302	.001	
Fatigue									
r	.322	.636	.778	.526	.625	.730	.124	.533	.745
p	.011	.001	.001	.001	.001	.001	.336	.001	.001

Note. PSQI = Pittsburgh Sleep Quality Index; SOSI = Symtoms of Stress Inventory; POMS = Profile of Mood States.

on several of the SOSI subscales, as presented in Table 2. There were significant correlations between raw stress scores and PSQI scores both at pre- ($r = .46, p < .001$) and post- ($r = .56$, $p < .001$) intervention (see Table 3). As predicted, there was also a moderate negative correlational relationship between a reduction in stress symptoms and an improvement in sleep quality, $r = .38$, $p < .005$, such that as stress symptoms improved, so did sleep quality (Table 3). In order to determine whether sleep quality was related more to somatic stress or psychological stress symptoms, we performed Pearson product-moment correlations between the change scores for each subscale and changes in overall sleep quality. These analyses revealed that overall sleep quality was significantly related more to decreases in somatic stress symptoms (cardiopulmonary, $r = –.45$, $p < .01$, gastrointestinal, $r = –.44$, $p < .01$, muscle tension, $r = –.37$, $p < .01$), than psychological stress symptoms (habitual patterns, $r = –.37$, $p < .01$).

Sleep Quality and Mood Disturbance

Reduction in mood disturbance was statistically significant after MBSR participation, $t(63) = 5.28$, $p < .001$. There was also a demonstrated improvement on all of the POMS subscales. Mean POMS subscale scores are presented in Table 4.

Significant associations were found between levels of mood disturbance and overall sleep quality scores at both pre- ($r = .46$, $p < .001$) and post- ($r = .56$, $p < .001$) intervention, as was found with the stress scores. This is not surprising as there was a very significant relationship between changes in mood disturbance and symptoms of stress ($r = .72$, $p < .001$), indicating a high degree of covariance.

Despite significant improvement in overall mood disturbance, a significant correlational relationship between improved sleep quality and reduced mood disturbance change scores was not found.

Sleep Quality and Fatigue

Fatigue scores were measured by a POMS subscale. The change in fatigue scores was statistically significant, $t(62) = 3.74$, $p < .001$. Significant relationships were found between fatigue and sleep at both pre- ($r = .32$, $p < .05$) and post- ($r = .53$, $p < .001$) intervention. However, a statistically significant relationship was

Table 4. *POMS Scores: Decreases in Mood Disturbance Over Time (Pre vs. Post)*

	Preintervention		Postintervention				
	M	*SD*	*M*	*SD*	t	*df*	*p*
Anxiety	9.03	7.89	4.61	6.56	5.51	60	.001
Depression	15.34	12.04	10.52	9.73	3.96	61	.001
Anger	11.48	8.78	6.42	6.69	5.44	61	.001
Vigor	12.84	5.96	14.48	6.47	–2.48	61	.016
Fatigue	11.98	7.13	9.29	6.79	3.74	61	.001
Confusion	6.72	5.75	3.60	4.97	4.80	61	.001
Total mood disturbance	41.13	40.13	20.10	33.23	5.28	61	.001

Note. POMS = Profile of Mood States.

not found between improvements in fatigue and sleep, but a significant relationship was found between changes in symptoms of stress and fatigue ($r = .53$, $p < .001$), as well as changes in mood disturbance and fatigue ($r = –.39$, $p < .01$). Therefore, as patients became less tired, they also became less stressed and moody.

Discussion

These results confirm and strengthen the findings of past research indicating that participation in a mindfulness-based stress reduction program can have positive benefits for sleep quality, stress symptoms, mood disturbance, and fatigue levels (Carlson et al., 2001; Speca et al., 2000; Shapiro et al., 2003). This research brings to light some new considerations, particularly the extent of sleep difficulties present in cancer patients. This study found somewhat higher rates of sleep disturbance (90%) compared to other studies' results of 30–50% (Savard et al., 2001), 44% (Engstrom et al., 1999), and 40% (Carlson et al., 2003). The differing results may be in large part due to the type of measurement instrument; regardless, this is clearly a severe problem for cancer patients. Using the recommended more conservative cutoff, sleep disturbance rates drop to 70% and our results look more similar to previously reported rates of 63% (Koopman et al., 2002), still disturbingly high.

In terms of our specific hypotheses, participants did report a statistically significant improvement in their sleep quality after participation in the MBSR program. The sleep disturbance experienced by participants was reduced by 11% in the entire sample when using a cutoff of 5 and by 24% when using a cutoff score of 10, as demonstrated in Table 2. Of greater importance is the dramatic improvement in the subjective sleep quality that participants reported, indicating that the participants felt their sleep had improved and was of superior quality than it had been prior to MBSR participation. It has been suggested that subjective sleep complaints are longer lasting and more relentless than what can be assessed with more objective sleep quality assessment measures (Shapiro et al., 2003). This implies that how patients feel they sleep may be the most important aspect of their sleep quality. Other research (Savard et al., 1999) adds credibility to the importance of subjective sleep quality as a factor influencing quality of life and overall health. It was discovered that higher satisfaction with sleep duration was associated with increased circulating levels of helper T cells (an important immune parameter) in the blood.

Furthermore, results of the present study demonstrated that participants were experiencing longer and more efficient sleep. Participants initially reported sleeping approximately 6 hours per night. After program completion, participants reported sleeping approximately 7 hours per night—a clinically significant increase of about one hour per night. Previous research has reported that fewer hours of sleep were significantly associated with more depressive symptoms, frustration, short temper, generally poor mood (Koopman et al., 2002), and increased mortality (Savard et al., 2001). This is consistent with the current findings that participants reported improved sleep duration, as well as less depression and emotional irritability.

The results also confirmed the second hypothesis: reductions in sleep disturbance were significantly correlated with reductions in symptoms of stress. It is of note that improvements in sleep were more related to a reduction in somatic stress symptoms than psychological stress symptoms. This may be a result of activating the physiological relaxation response in meditation participants. The MBSR program may also have improved sleep by reducing the amount of recurrent cognitive distortions and negative or ruminative thoughts. Other studies have also found stress-related intrusive thoughts were associated with poorer sleep quality and suppressed immunity (Hall et al., 1998). More research examining the particular mechanisms by which cancer-related stress can influence sleep quality and how the practice of mindfulness can provide a vehicle to reduce stress and improve sleep is warranted.

The participants reported a significant improvement in their mood after participation in the MBSR program, particularly in the areas of anxiety, depression, hostil-

ity, and confusion. Inconsistent with the third hypothesis, this was not significantly correlated with the reported sleep improvement, although higher levels of mood disturbance were associated with worse sleep at both time points. Improvements in mood were correlated with decreases in stress, however, which may suggest that a pathway for MBSR action on sleep is moderated through stress reduction, rather than improved mood. More sophisticated prospective designs would help to further clarify these associations.

One particular subscale of interest in the POMS was the fatigue subscale. Participants did report an improvement in their fatigue levels after the intervention. Again, absolute fatigue levels were related to sleep quality, particularly postintervention, but improvements in sleep were not associated with improved fatigue, as would have been predicted by the third hypothesis. It may be possible that the fatigue subscale on the POMS is not a particularly sensitive measure of fatigue. Associations may have been found had other scales such as the Brief Fatigue Inventory (Mendoza et al., 1999), or the Functional Assessment of Cancer Therapy (FACT)-Fatigue (Yellen, Cella, Webster, Blendowski, & Kaplan, 1997) subscale been utilized. Another explanation may be that improvements in fatigue were associated with the exercise component of the program (yoga), and not as closely with sleep quality. This is consistent with research showing activity to be an effective treatment for fatigue. It has been found that exercise reduced fatigue levels in women with breast cancer (Schwartz, 2000) and that moderate exercise improved quality of life in cancer survivors (Courneya et al., 2003). Future research should investigate the extent that yoga exercises alone produce beneficial outcomes in terms of fatigue levels.

This study has several methodological limitations that preclude definitive conclusions. Most noteworthy, a control group was not included. Thus, it is not possible to know that the improvements reported in sleep quality are greater than those that may have been seen over time in similar cancer patients not practicing mindfulness meditation. Although we consider this unlikely (due to the rapid improvements and the heterogeneous nature of the sample in terms of time since diagnosis and treatment status), because of the limitations in study design we cannot assume causality. This omission is due to the exploratory nature of this research, as this study is one of the first to look at sleep quality and meditation using a validated measure. Future studies should include a control group, preferably randomized. One potential alternate explanation for the achieved results may be due to maturation of the research participants, in that their sleep may have improved naturally over time. Another potential explanatory mechanism is that the participants were highly distressed at the start of the program, hence their willingness to try complementary treatment. This may have inflated their preintervention scores and made it more likely that these extreme scores would moderate naturally over time (regression toward the mean). Furthermore, because this treatment was multi-modal it is difficult to ascertain which of the components, or combination thereof, may be responsible for the greatest amount of demonstrated change. The lack of a specific measure to assess fatigue can also be seen as a methodological limitation. Future studies should include a measure designed to assess fatigue levels in a cancer population. Finally, there was no follow up assessment included, so it is uncertain whether the improvements gained will be maintained over time.

With these limitations in mind, we can suggest that mindfulness meditation and participation in the MBSR program may have positive influences on the sleep quality of practitioners. The heterogeneity of the present sample strengthens the MBSR program's applicability to both genders, a diversity of cancer types and stages, and to a range of ages. The present study reinforces previous research suggesting that sleep disturbance in cancer patients is a serious problem and presents mindfulness meditation as a potential nonpharmacological treatment for sleep disturbance in this population.

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