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Prevalence, Severity, and Correlates of Sleep-Wake Disturbances in Long-Term Breast Cancer Survivors

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Abstract

Current evidence shows that sleep-wake disturbances are a persistent problem linked to poor quality of life in women surviving breast cancer. Information regarding correlates of sleep-wake disturbances in long-term survivors is sparse. The purpose of this study was to refine knowledge regarding prevalence, severity, and correlates of sleep-wake disturbances in long-term breast cancer survivors (BCS) compared to age-matched women without breast cancer (WWC). The cross-sectional convenience sample included 246 BCS and 246 WWC who completed a quality-of-life study and were matched within +/− 5 years of age. BCS were a mean of 5.6 years beyond completion of cancer treatment (range 5.6 to 10.0 years). Based on Pittsburgh Sleep Quality Index (PSQI) scores, BCS had significantly more prevalent sleep-wake disturbances (65%) compared to WWC (55%) ($P < 0.05$). BCS also had significantly higher PSQI global scores indicating poorer sleep quality compared to WWC ($P < 0.05$). Significant correlates of prevalence of poor sleep for BCS included hot flashes, poor physical functioning, depressive symptoms and distress, and for WWC, included hot flashes, poor physical functioning, and depressive symptoms. Significant correlates ($P < 0.05$) of severity of poor sleep for BCS included presence of non-cancer co-morbidities, hot flashes, depressive symptoms, and residual effects of cancer treatment. For WWC, these included hot flashes, poor physical functioning, depressive symptoms, and impact of a life event. Knowledge of prevalence, severity, and correlates of sleep-wake disturbances provides useful information to health care providers during clinical evaluations for treatment of sleep-wake disturbances in BCS.

Keywords

Sleep-wake disturbance; sleep quality; breast cancer survivor; menopause; depression; symptom management

Introduction

Breast cancer survivors (BCS) represent a significant and growing population and the largest cancer survivor group in the United States.[1, 2] Evaluating health problems unique to these survivors will help improve their quality of life. A common problem reported by BCS is chronic

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sleep-wake disturbances, defined as perceived or actual disruptions in nighttime sleep or daytime wakefulness (e.g., insomnia).3 In various study samples, 12% to 95% of breast cancer patients were found to have problems with sleep or wakefulness using self-report measures, 4–10 polysomnography,11 or wrist actigraphy.[12] These problems also negatively impact all domains of quality of life (e.g., physical and psychological).[7, 13]

Literature indicates that the prevalence of sleep-wake disturbances in BCS is higher than in the general population (20% higher in persons without cancer) and other cancer groups (32% higher than gastrointestinal cancer), with a portion of BCS stating these disturbances started after their diagnosis of cancer.[10, 14] The importance of understanding sleep-wake disturbances in cancer populations has been highlighted by national agencies and professional societies in the United States, such as the National Institute of Aging; National Heart Lung and Blood Institute; National Institute of Neurological Disorders and Stroke; and the Oncology Nursing Society.

Although sleep-wake disturbances are a known problem in breast cancer, differences in the prevalence, severity, or correlates of disturbances between long-term BCS and age-matched women without cancer (WWC) are unclear. Because sleep-wake disturbances may increase with age alone, it is necessary to compare BCS with age-matched WWC. The salient difference between BCS and age-matched WWC is the experience and treatment of cancer.

Researchers have shown that as many as 23% to 51% of healthy women report sleep-wake disturbances;[7, 15] however, few studies have compared the two populations. One comparative study included breast cancer patients who were pre-cancer treatment, receiving treatment, or post-treatment (n=72) and WWC (n=50). The study showed no group differences in Pittsburgh Sleep Quality Index global sleep quality scores (M=6.8, 6.7 respectively) or component scores (except medication use, which was slightly greater in the cancer group).[7] In contrast, a second comparative study of BCS (n=15) and age-matched WWC (n=15) showed that BCS had worse sleep quality and higher disturbances (73% of BCS compared to 67% of WWC).[15]

The mechanisms for increased sleep-wake disturbances in breast cancer have been linked to minority status,[16] intense menopausal symptoms related to hormonal therapy,[11, 17] residual side effects from cancer treatment,[18] circadian rhythm disruptions because of cancer-related treatment,[19] more intrusive thoughts,20 greater psychological distress related to diagnosis and treatment,10 poorer sleep hygiene behaviors,9 and/or more intrusive sleep environments.[14] However, these and other possible correlates have not been evaluated in long-term breast cancer survivors with chronic sleep disturbances. Therefore, the purpose of this study was to evaluate prevalence, severity, and correlates of sleep-wake disturbances in long-term BCS (>2 years from completion of cancer treatment) compared to age-matched WWC.

The Psychobiological Model of Sleep Disturbances in BCS was the conceptual model used for this study.[21] The model postulates demographic, physiological, psychological, environmental, and behavioral factors that negatively affect sleep or wake, resulting in negative proximal and distal health-related outcomes. The major categories listed in the model were based on an extensive review of literature.[22] Variables for this study were identified from the categories within the model as possible correlates of sleep-wake disturbances in BCS.

Methods

This study analyzed data from two separate cross-sectional, descriptive, comparative, case-controlled studies that evaluated an extensive set of quality-of-life variables in BCS and WWC. Data were collected via questionnaire survey at a single point in time for both studies. Subjects completed both standardized and study-specific questionnaires. The rationale for combining data from two separate studies was threefold: (1) identical questionnaires, (2) similar inclusion

and exclusion criteria, and (3) recruitment for one study focused on African American BCS allowing increased diversity in the combined sample.

The eligibility criteria for each of the two studies were similar and included women who were at least 18 years of age; were stage I–III at diagnosis; were cancer-free at time of study enrollment; had no history of other cancers; were able to read, write, and speak English; and were at least two years but no more than 10 years post-completion of surgery, radiation, and chemotherapy. Women without cancer were recruited by acquaintance referral from BCS, self-referral, or from a cancer corporative group. These women were eligible if they had no history of breast cancer and were in good general health.

Measures

Prevalence and Severity of Self-Reported Sleep-Wake Disturbances—The main outcome of sleep-wake disturbances was assessed using a subjective questionnaire. The Pittsburgh Sleep Quality Index (PSQI)[5] items use varying response categories including Likert-type responses. Responses are based on the prior month's habits. The questionnaire is a 19-item scale that produces a global sleep quality index score based on seven component scores: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. The global sleep quality score can range from 0–21 where higher scores reflect poorer global sleep quality. Previous research has shown that global sleep scores greater than 5 are indicative of poor sleep.5 Psychometrics of the PSQI such as internal consistency reliability have been widely supported in a variety of populations, 23, 24 including non-cancer populations (n=52; α=0. 83)[5] and BCS (n=102; α=0. 80).6 Construct validity has also been shown in non-cancer populations through convergent validity (r=0. 69) and discriminant validity (r<0. 37).[6] In this study, Cronbach's alpha was 0.73 for BCS and 0.73 for WWC. PSQI global sleep scores, component scores, and PSQI global cut-off scores were used for the analyses. For the prevalence analyses, women scoring >5 were categorized as having poor sleep (more sleep-wake disturbances). For the severity analyses, global sleep quality index scores were used (higher scores = poor sleep or more sleep-wake disturbances).

Correlates—Correlates evaluated for this study were selected based on a literature review of sleep and cancer research and guided by the Psychobiological Model discussed above.

Demographic correlates. Demographic variables such as age, race, education, income, and menopausal status were collected in study-specific questionnaires.

Physiological correlates. Non-cancer co-morbidity information was obtained from a questionnaire that provided information that is often not explicit in medical records. The questionnaire consisted of 21 items addressing the presence of disease states and general health. Since this was a general medical history questionnaire, reliability and validity estimates were not available.

Physical function was measured by the RAND Physical Functioning-10 (PF-10), a valid and reliable 10-item scale that provided an assessment of overall physical function. The PF-10 is the physical functioning scale of the MOS SF-36 and one of the most commonly used measures of health-related quality of life.25, 26 Cronbach's alpha for the PF-10 has generally exceeded 0.90 in prior research studies,25 which was consistent with the current study (BCS α=0.93, WWC α=0.93). The total PF-10 score was used to evaluate the relationship between physical function and sleep for the current study.

Physiological cancer-related variables were measured using two instruments and were applicable only to the BCS group. First, a generic questionnaire was used to abstract medical

record information from participant charts by trained study staff (dates of diagnosis, cancer treatment, and staging information). Second, the Symptom Experience Report (SER) has been used in prior research to assess the presence and severity of various symptoms and was used to measure residual and/or current side effects of cancer treatment.[27, 28] A modified version of the SER evaluated presence of 12 symptoms such as lymphedema (e.g. arm swollen) and neurological symptoms (e.g., numbness) that can occur after cancer treatment. Participants indicated if each symptom had occurred in the previous week. For this study, positive responses to individual items/symptoms were summed to obtain a total number of symptoms per subject. Cronbach's alpha for the Symptom Checklist was 0.88 for this sample of BCS.

Menopausal symptoms were measured using single-item responses from a general checklist for menstrual and gynecological history. Information regarding last menstrual period and prevalence of hot flashes was obtained for BCS and WWC and was used to evaluate hot flash frequency.

Psychological correlates. Depressive symptoms were assessed using the Center for Epidemiologic Studies-Depression Scale (CES-D), a 20-item self-report instrument assessing the presence and severity of depressive symptoms occurring over the past week.29 Potential scores range from 0–60. Scores >16 indicate high depressive symptoms, but are not a diagnosis of clinical depression.30 Cronbach's alpha coefficients of >0.85 for the CESD have been reported in both cancer and non-cancer populations,31 which is slightly higher than in the current study (BCS α=0.76, WWC α=0.83). For this study, total scores were used to evaluate the relationship between depressive symptoms and sleep-wake disturbances.

Psychological distress related to cancer was evaluated using two questionnaires. First, cancer-related distress was measured using the Concerns about Recurrence Scale (CARS),32 a two-part instrument developed for BCS. The first part of the CARS consists of 4 items that assess overall concerns of recurrence using Likert-type responses with a total score range from 4–24. Cronbach's alpha for part one total scores has ranged from 0.87 to 0.94 in prior studies,32 which is comparable to what was found in the current study (α=0.89). Since the subscales of second part can be considered separate variables, only the part one total score was evaluated in the current study to reduce the number of overall variables evaluated to ensure adequate power was achieved.

The second measure of distress, the Impact of Events Scale (IES), is a 15-item Likert-type questionnaire used to measure frequency of intrusive and avoidant thoughts about breast cancer for BCS or, for WWC a stressful life event over the previous week.[33] The scale allows for a total score ranging from 0–75 or evaluation of separate subscales for intrusion and avoidance. The IES total scores were evaluated in both BCS and WWC to determine the relationship between a stressful life event (breast cancer in the BCS, recent event in the WWC) and as a correlate of sleep-wake disturbances. Cronbach's alpha for the total scale for non-cancer female subjects has been reported as 0.91.34 For this study, alpha was 0.92 for BCS and 0.94 for WWC for the total scale.

Environmental correlates. Sleep environment was assessed in two ways. First, information regarding sleep environment was assessed using item 19 on the PSQI which addresses the presence of a bed partner or roommate.[5] Although this was a narrow view of sleep environment, the larger studies did not include a comprehensive questionnaire regarding specific environmental issues or sleep hygiene. Second, the presence of children in the home was determined by a single item question that asks if children are living with the participant at the present time. This provided information regarding child-rearing, which can create a disrupted sleep environment. Sleep hygiene was not assessed because the parent studies did not include a validated questionnaire addressing this variable.

Procedures

Studies were reviewed and approved by the university institutional review board and cancer center scientific review committee. Both studies used similar local recruitment strategies for BCS and WWC. BCS were recruited in-person in local cancer clinics or via telephone by trained research assistants. Clinics were chosen based on availability of participants for the geographic location. Telephone contacts were referred by recruiters or physicians. WWC were recruited using referrals from BCS or self-referrals. One of the two parent studies used regional referrals from institutions affiliated with the Eastern Cooperative Oncology Group (ECOG) and a southeastern university for both BCS and WWC. For ECOG referrals, the parent study received approval from over 50 investigational review boards for recruitment. The ECOG Statistical Office identified names of potential participants from a computerized database, contacted potential participants, obtained verbal consent by BCS and WWC to be contacted by the parent study, then forwarded names to the parent study investigators. Parent study investigators then contacted referred BCS and WWC to confirm eligibility and obtain written consent.

Eligible and willing BCS and WWC who signed consents were given a questionnaire packet in person or through the mail. When completed questionnaires were received by study team members, they were visually checked for completeness and logged into a secured computerized database. If there were missing responses, participants were called to determine if this was purposeful or an oversight. After this initial data check, all questionnaires for both studies were electronically scanned by the biostatisticians into a secure computerized database.

Data Analysis

Data analyses were performed using the Statistical Package for the Social Sciences (SPSS) (v. 15.0, SPSS Inc., Chicago, IL). Demographic variables were evaluated using descriptive and frequency statistics. Group demographics were compared using independent *t*-tests and Chi-square and considered significant if $P < 0.05$. If group differences arose, these variables were controlled for during subsequent analyses. Because of the large number of possible correlates evaluated, power analyses were calculated to ensure the sample size was adequate to detect significance.[35]

The sample size was based on power analyses to detect significant correlates of prevalence (logistic regression) and severity (multiple regression) of sleep-wake disturbances in BCS and WWC. For logistic regression, we assumed the rarer outcome would be 35% of BCS with good sleep quality (i.e., 35% with PSQI global scores < 5).[15] To detect significant correlates with logistic regression ($P<0.05$), there needed to be at least five observations per parameter for the rarer outcome for the final regression model.[36] Therefore, if the sample consisted of 242 in each group, 35% of the BCS ($n=88$) and 50% of WWC ($n=125$) would be expected to be good sleepers, which supported the analysis of up to 17 possible variables in each group. Based on the sample needed to perform the logistic regression, there was more than adequate power for the multiple regression, which would require 10 participants per variable.[35] The study evaluated 17 BCS variables and 14 WWC variables as possible correlates, which would require at least 170 BCS and 140 WWC. Based on the largest sample needed to obtain adequate power, a sample of at least 242 women in each group was sought from the two larger studies.

A pool of 520 BCS and 252 WWC were identified from the two studies. Only subjects who submitted completed questionnaires were considered for this analysis. Although the larger studies did not recruit based on age-match potential, the researchers of the secondary analysis matched on age. A total of 246 BCS were matched within +/−5 years of age with 246 WWC ($n=492$). Of the BCS, 148 were recruited by telephone, local clinic referrals, or self-referrals

and 98 from regional institutions. For the WWC, individual recruitment information was not available but the majority were from local BCS referrals or self-referrals.

Prevalence and Severity—After comparing demographic variables between BCS and WWC, it was apparent that some differences existed that needed to be controlled in subsequent analyses. To compare prevalence of poor sleep quality in BCS and WWC, PSQI global cut-off scores were dichotomized (i.e., ≤ 5 vs. > 5).[5] A logistic regression was used to control for differences in demographic characteristics between BCS and WWC. Percentages of women who scored above the established cut-off (indicates poor sleep quality) were reported. To compare severity of poor sleep quality between BCS and WWC, PSQI global sleep scores were evaluated using analysis of covariance in order to control for differences in demographics.

Correlates of Prevalence and Severity—To select physiological, psychological, and environmental correlates to be used in the logistic regression to identify correlates for prevalence of sleep-wake disturbances in BCS and WWC, selected variables were placed into categorical groups based on frequencies. Chi-square analyses were then performed between each variable and the outcome of sleep to determine if each variable was significantly related to the prevalence of sleep-wake disturbances (e.g., income level was compared to PSQI cut-off score (yes, no)). Variables that were significant at $P \leq 0.25$ were entered into the final regression models.

Physiological, psychological, and environmental variables used in the multiple regression to identify correlates of severity of sleep quality in BCS and WWC were selected as follows. Pearson correlations or *t*-tests were performed comparing each variable and PSQI global sleep scores (e.g., age was compared to global sleep quality). Relationships were considered significant and entered into the regression models with *P*-values ≤ 0.25 and $r>|0.2|$. The assumptions of non-collinearity, absence of outliers, normality, linearity, homoscedasticity of residuals, and independence of errors were evaluated prior to the analysis of the regression models showing no violations that would negatively impact results.

Since this was an exploratory analysis of possible correlates for prevalence and severity of sleep-wake disturbances, *P*-values and r-values set for inclusion into the final regression models were broad in order to allow for a comprehensive set of variables to be evaluated.[37] In the final regressions, correlates were considered significant at $P < 0.05$.

Results

Sample characteristics for the BCS and WWC and cancer disease and treatment for the BCS are shown in Table 1. Significantly more BCS were Caucasian and post-menopausal compared to WWC ($P < 0.05$).

Mean scores on questionnaires for each group are listed in Table 2. BCS had significantly higher mean CES-D scores compared to WWC ($P < 0.05$) reflecting more depressive symptoms. However, WWC had higher impact of a life event reflected by higher mean scores for the IES ($P < 0.05$), controlling for group differences in race and menopausal status.

Prevalence and Severity

Results showed BCS (65%) had significantly more prevalent sleep-wake disturbances (based on PSQI cut-off scores) compared to WWC (55%) when controlling for group differences in race and menopausal status ($P < 0.05$). In addition, BCS had significantly more severe sleep-wake disturbances as evidenced by higher mean global sleep scores, worse sleep quality, longer sleep latency, shorter sleep duration, greater number of disturbances, and more daytime dysfunction ($P < 0.05$ for all variables) compared to WWC controlling for race and menopausal

status (Table 3). Use of sleep medications and sleep efficiency were not significantly different between groups.

Correlates of Prevalence

Significant correlates of prevalence of sleep-wake disturbances (e.g., PSQI cut-off scores > 5) for BCS included minority race, presence of hot flashes, poor physical functioning, and more depressive symptoms ($P < 0.05$). For WWBC, significant correlates included presence of hot flashes, poor physical functioning, and more depressive symptoms ($P < 0.05$) (Table 4). Thus, although BCS had a higher prevalence of sleep-wake disturbances, the only unique correlate was minority racial status.

Correlates of Severity

Significant correlates of severity of sleep-wake disturbances for BCS ($P < 0.05$) included presence of co-morbid conditions, hot flashes, residual effects of cancer, and depressive symptoms ($r^2 = 0.37$). For WWC, significant correlates ($P < 0.05$) included hot flashes, level of physical functioning, depressive symptoms, and impact of a recent life event ($r^2 = 0.31$) (Table 5). The unique correlates for BCS include having a higher number of co-morbid conditions and residual effects of cancer.

Discussion

Prevalence and Severity

This study showed that sleep disturbances were significantly more common and more severe among long-term BCS (65%) compared to age-matched WWC (55%). The prevalence rate in this study was within the range of prior BCS studies that included questions about sleep. These studies found a wide range of 19–90%[7, 10, 13–17, 38] of BCS who complained of poor sleep or insomnia compared to 67% of WWC.[15] Three of the BCS studies with lower prevalence rates had with smaller sample sizes and used sleep measures that differed from this current study.[10, 14, 16] The two studies with higher prevalence rates of 73%[15] and 90%[13] used the PSQI or a single-item assessment of sleep in BCS, but again were limited by small sample sizes.[15] In addition, one study focused only on BCS and WWC with hot flashes who lacked racial diversity, [13] which may have influenced PSQI scores. The current study provided a more representative sample of BCS and WWC.

In the current study, the severity of sleep wake disturbances for BCS (M=7.26) was within the range reported in prior BCS studies (range=6.8 to 7.3).[6, 7, 9, 15] However, the current study found the severity of sleep-wake disturbances in WWC (M=5.8) was lower compared to previously reported means (n=50, M=6.7)[7](n=15, M=6.9).[15] These data suggest that BCS experience more severe sleep-wake disturbances than WWC. The current study shows that prevalence and severity of sleep-wake disturbances are problematic even for long-term survivors. Sleep disturbances appear to be a problem for BCS well into survivorship.

Correlates

Correlates of prevalence and severity of sleep-wake disturbances in BCS were slightly different from those in age-matched WWC. Previous studies found that (a) being female; (b) demographic or disease characteristics such as having breast cancer, currently taking endocrine therapy for breast cancer, race, age, socioeconomic factors, education, marital status; or (c) menopausal status (singly or in combination) can contribute to sleep-wake disturbances.[18, 39–47] Although this study found that being a BCS and minority status were significantly related to sleep disturbances, no other demographic variables were significantly related to prevalence or severity of sleep-wake disturbances. Interestingly, although previous studies

found that age contributes to sleep disturbances in non-cancer populations, 43, [48] age was not a significant variable in this study. The age range for BCS and WWC in this study was 27–80 years of age. Based on prior studies, it was expected that younger BCS and WWC might sleep better compared to older BCS and WWC. However, when evaluated with other variables, age did not predict prevalence or severity of poor sleep, suggesting that poor sleep was problematic across ages in both BCS and WWC.

An unexpected and interesting finding from this study was that minority BCS but not WWC were at higher risk for sleep-wake disturbances. In non-cancer samples, it has been reported that minorities have greater sleep disturbances, worse sleep quality, and higher incidence of sleep apnea.[49] Only one prior study reported that 49% of the African-American BCS had sleep problems, based on a single-item question. [16] However, no prior sleep studies in BCS looked at race as a correlate of sleep-wake disturbances; therefore, this study provides evidence that minority BCS should be considered at higher risk for sleep-wake disturbances.

Specific physiological correlates for BCS were found only for severity of sleep-wake disturbances. Results showed that BCS with more co-morbid conditions and more residual effects of cancer had more severe sleep-wake disturbances. In terms of co-morbid conditions, no previous studies were found that reported similar results. For cancer-related side effects, studies show that effects of treatment typically subside over time; however, some BCS experience residual effects that continue to negatively affect quality of life.[50]

Physiological correlates not specific to BCS (hot flashes and physical functioning) have been previously reported to affect sleep. For example, it is known that women with hot flashes report poor sleep.11, 51 BCS tend to have more severe and distressing hot flashes than WWC52, 53 related to the use of endocrine therapy for breast cancer; however, the majority of BCS in this study were not taking or had not taken endocrine therapy for breast cancer (67%), suggesting that hot flashes are a physiological problem that should be examined regardless of hormone treatment when assessing sleep for both BCS and WWC.

In addition, the level of physical activity has been shown to decrease during breast cancer treatment and into survivorship, contributing to sleep disturbances.[54] Physical activity is important for maintenance of overall health. Although physical activity is not synonymous with physical functioning, altered functioning can lead to decreased activity. This study found that lower physical functioning significantly contributed to prevalence but not severity in BCS and to both prevalence and severity in WWC. Determining the reasons for lowered functioning (e.g., arthritic pain) will be helpful in future studies in order to maintain adequate physical activity during survivorship to promote sleep.

Psychological factors such as distress or depression are related to increased sleep disturbances. [15, 19, 55–57] It has been reported that BCS can experience distress related to cancer or fear of cancer recurrence.[20, 58, 59] Only depressive symptoms were significant correlates of prevalence and severity in both BCS and WWC in this study. Although BCS had moderate levels of concern about recurrence and distress related to cancer, these concerns did not significantly contribute to sleep-wake disturbances. The latter could be attributed to other psychological problems such as depressive symptoms, which are highly related to sleep-wake disturbances both in cancer and non-cancer populations.[15, 60–63]

Sleep environment factors such as excessive light, noise, presence of a restless sleep partner, and child-rearing have been shown to negatively affect sleep.64, 65 Although most BCS were at an age when children are no longer living at home, this study found a majority of the women had children (56%) (ages not reported) at home. In addition, having a companion or bed partner with disrupted sleep can also contribute to the woman's disrupted sleep.66, 67 Results showed neither having a bed partner nor children living in the home was associated with poor sleep or

sleep disturbances in BCS or WWC. However, environmental factors included in the analyses were evaluated using only one item questions and did not address factors such as noise, light, and sleep habits of the bed partner (restless sleeper).

Limitations

There were some limitations to this study. Because this was a convenience sample, the subjects may not have been representative of all BCS with and without sleep-wake disturbances. In addition, since the number of BCS in this sample that had not taken endocrine therapy as part of their treatment was so high, findings might not be representative of the larger BCS population. Also, the questionnaire was answered at a single time point, which limits our knowledge of how sleep-wake disturbances change over time. However, a strength is that women were recruited for quality-of-life studies, which is likely to draw both good and poor sleepers. In addition, some variables could not be evaluated, such as other biological factors, sleep hygiene behaviors, detailed sleep environment factors, and social factors. Factors such as thyroid function, genetic polymorphisms, sleep hygiene, and additional sleep environment factors could be important to evaluate to fully understand this problem.

Future studies should also consider accessing perimenopausal status to further clarify how menopause status impacts sleep-wake disturbances in BCS compared to WWC. Although we controlled for significant group differences in menopausal status (pre- vs. post-) in the regression models, we are unsure if some women who were categorized as pre-menopausal were actually perimenopausal. The Stages of Reproductive Aging Workshop (STRAW) criteria for staging menopausal women are only applicable to WWC and not appropriate for BCS. Since sleep problems have been documented to be more bothersome during the perimenopausal period in WWC,[48] it will be important to more carefully assess menopausal status in our next study.

Conclusion

This study provided new information regarding correlates and severity of sleep-wake disturbances in long-term BCS compared to age-matched WWC. Overall, the results from this study suggest that there are unique factors associated with sleep-wake disturbances in BCS compared to WWC. Results provide a basis for recommendations for health care providers (oncology and primary health care) to further assess sleep-wake disturbances in BCS, even those who are well into survivorship. In addition, since BCS had unique factors that predicted both prevalence and severity of poor sleep, future research should focus on further identifying correlates of sleep-wake disturbances and formulating targeted interventions for BCS. In addition, longitudinal studies are needed, using structural equation modeling or path analysis to validate pathways in this model and determine if correlates are consistent over time.

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Table 1

Comparison of Demographic and Health Characteristics of BCS and WWC

	BCS (*n*=246)	**WWC (*n*=246)**	
	Mean (SD)	**Mean (SD)**	***P***
Age (yrs)	48.21 (8.50)	48.26 (10.39)	0.94
Body Mass Index	29.48 (6.49)	28.26 (6.21)	0.45
	% (*n*)	% (*n*)	*P*
Level of education			
High school or less	26 (64)	23 (57)	0.09
College or trade	59 (144)	54 (132)	
Graduate	15 (38)	23 (57)	
Race			
Caucasian	76 (186)	63 (156)	< 0.01
Minority	24 (60)	37 (90)	
Ethnicity			
Hispanic or Latino	2 (4)	4 (9)	0.13
Not Hispanic or Latino	98 (242)	96 (237)	
Marital status			
Married/living with partner	73 (180)	62 (153)	0.07
Divorced or widowed	12 (29)	13 (31)	
Single or other	15 (37)	25 (62)	
Household income in $ (SES)			
≤15,000 per year	11 (27)	15 (37)	0.18
15,001–30,000 per year	13 (32)	8 (20)	
30,001–50,000 per year	15 (37)	22 (54)	
50,001–100,000 per year	36 (89)	32 (79)	
≥ 100,001 per year	25 (61)	23 (56)	
Employment status			
Working full-time	52 (128)	48 (118)	0.07
Working part-time	21 (52)	16 (39)	
Unemployed	18 (44)	23 (57)	
Retired	8 (21)	10 (25)	
Student	1 (1)	3 (7)	

Reporting non-BC co-morbidities

	BCS (*n*=246)	**WWC (*n*=246)**	
	Mean (SD)	**Mean (SD)**	***P***
None	3 (7)	7 (18)	0.09
1 condition	43 (106)	44 (108)	
2–3 conditions	35 (87)	33 (80)	
>4 conditions	19 (46)	16 (40)	
Menopausal status			
Pre-menopausal	30 (73)	47 (115)	<0.01
Post-menopausal	70 (173)	53 (131)	

Breast Cancer Disease and Treatment Information

	BCS (*n*=246)
	Mean (SD)
Time since diagnosis (years)	5.62 (2.03)
	% (*n*)
Surgery	
Lumpectomy	42 (102)
Mastectomy	59 (144)
Chemotherapy	
Received some chemotherapy	89 (211)
Received no chemotherapy	11 (35)
Use of endocrine therapy	
Never taken	67 (331)
Current use	9 (43)
Past use	24 (118)

Table 2

Differences in Standardized Questionnaires Between BCS and WWC

Scale	BCS Mean (SD)	WWC Mean (SD)	*P*
PSQI Global Score	7.31 (3.80)	5.80 (3.45)	<0.01
Physical functioning (PF-10)	2.55 (0.51)	2.62 (0.49)	0.15
Symptom experience report[a]	3.74 (3.62)		
Concerns about recurrence (CARS)[a]	12.15 (5.51)		
Center for Epidemiological Studies	11.53 (9.60)	9.00 (9.20)	<0.01
Depression Scale (CES-D)			
Impact of Events Scale (IES)	1.50 (1.23)	1.86 (1.36)	<0.01

[a]Relevant to BCS only.

Table 3

Analysis of Covariance Testing Differences in PSQI Sleep Scores Between BCS and WWC

Variable	Adjusted Mean (BCS)	Adjusted Mean (WWC)	F	*P*
Global sleep score[a]	7.26	5.85	17.87	<0.01
Sleep quality[a]	1.20	0.85	25.24	<0.01
Sleep latency[a]	1.39	1.00	14.69	<0.01
Sleep duration[b]	0.98	0.84	4.65	0.03
Sleep disturbance[a]	1.50	1.31	11.21	<0.01
Sleep medication[c]	0.65	0.61	0.15	0.70
Daytime dysfunction[d]	0.96	0.70	16.9	<0.01
Sleep efficiency[a]	0.59	0.57	0.09	0.77

[a] Controlling for race and menopausal status.

[b] Controlling for race.

[c] Controlling for menopausal status.

[d] No control variables, ANOVA performed.

Table 4

Logistic Regression for Correlates of the Prevalence of Sleep-Wake Disturbances in BCS and WWC

Variable		BC	95% CI		WWC	95% CI	
		OR	Lower	Upper	OR	Lower	Upper
Race (Minority)[1]		3.14[a]	1.26	7.83	0.50	0.23	1.06
Post-menopausal[2]		1.67	0.84	3.33	0.79	0.40	1.57
Low income[3]		1.49	0.70	3.20	0.72	0.33	1.61
Two or more co-morbidities[4]		0.91	0.18	4.69	2.27	0.65	7.89
Hot flashes[5]		2.68[a]	1.41	5.00	2.18*	1.16	4.09
Poor physical functioning[6]		2.5[a]	1.12	5.86	3.61*	1.72	7.58
Symptom experience report[b]							
# symptoms=0–5		1.43	0.61	3.33			
# symptoms=6 and above		1.30	0.52	3.26			
High depressive symptoms[7]		4.62[a]	1.91	11.78	6.92*	2.48	19.28
High impact of a life event							
Mean score=1–2		2.06	0.52	8.11	2.74	0.77	9.74
			0.48	16.10		0.93	3.68
Mean score=3 or more		2.77			3.99		
Having bed partner[8]		1.56	0.70	3.46	0.71	0.33	1.53
Children in the home[9]		0.59	0.32	1.11	1.85	0.93	3.68
	χ^2	62.24			61.73		
	P	<0.00			<0.00		

The table represents two logistic regression analyses: one for BCS and one for WWC.

[1]Referent Caucasian,

[2]Referent pre-menopausal,

[3]Referent income over $50,000/yr,

[4]Referent 1 comorbidity or less,

[5]Referent no hot flashes,

[6] Referent PF-10 scores 26–30,

[7] Referent no depressive symptoms,

[8] Referent no bed partner,

[9] Referent no children in the home

[a] $P < 0.05$.

[b] BCS only.

Table 5

Multiple Regression for Correlates of Severity of Sleep-Wake Disturbances in BCS and in WWC

		BCS	WWC
Variable		**β**[a]	**β**
Race		0.11	−0.09
Income		−0.06	−0.05
Menopausal status		0.04	−0.01
Co-morbid conditions		0.13[c]	0.05
Hormone modulator[b]		−0.07	
Hot flashes		0.24[c]	0.14[c]
Physical functioning		−0.10	−0.15[c]
Residual effects of cancer[b]		0.14[c]	
Concerns about recurrence[b]		0.10	
Depressive symptoms		0.23[c]	0.20[c]
Impact of life event		−0.02	0.14[c]
Having bed partner		0.01	−0.06
Children in the home		−0.01	0.00
Model	F	10.46[d]	10.74[d]
	R^2	0.37	0.31

The table represents two multiple regression analyses: one for BCS and one for WWC.

[a] β is the standardized regression coefficient.

[b] BCS only.

[c] $P < 0.05$.

[d] $P < 0.01$.