International Journal of Behavioral Medicine (2018) 25:502–516
https://doi.org/10.1007/s12529-018-9715-2

Sleepless from the Get Go: Sleep Problems Prior to Initiating Cancer Treatment

Eric S. Zhou[1,2] · Karen Clark[3] · Christopher J. Recklitis[1,2] · Richard Obenchain[3] · Matthew Loscalzo[3]

Published online: 15 March 2018

Abstract

Purpose Cancer patients are likely to experience sleep problems. Understanding their perception of sleep problems is important as subjective symptom experience is associated with treatment-seeking behavior. We explored the prevalence of sleep problems and its correlates in a large sample of cancer patients at an important but understudied stage of their cancer journey: prior to initiating treatment.

Methods Cancer patients (5702) (67.5% female; 76.9% White; 23.0% Hispanic), following diagnosis and prior to initiating cancer treatment, completed an electronic screening instrument. Patients across eight different cancer diagnoses (breast, gastrointestinal, gynecological, head and neck, hematological, lung, prostate, urinary) rated their sleep problems on a five-point scale, with those reporting "severe" or "very severe" sleep problems classified as having high sleep problems.

Results Overall, 12.5% of patients reported high sleep problems. Across diagnoses, the proportion of patients reporting high sleep problems ranged from 4.3 to 13.8%, with prostate cancer patients least likely and gastrointestinal cancer patients most likely to report high sleep problems. Older age, having a partner, higher education, and higher household income were associated with a lower likelihood of experiencing sleep problems. Being female, Black, Hispanic, and reporting anxiety or depression was associated with an increased likelihood of sleep problems.

Conclusions A sizeable proportion of cancer patients experience significant problems with their sleep before any treatment has occurred. This clinical issue cannot be ignored as treatment is likely to worsen existing sleep problems. Oncology providers should routinely screen for sleep-related problems. Identifying and treating patients for sleep problems during a vulnerable period early in their cancer trajectory should be an essential component of clinical care.

Keywords Sleep problems · Sleep dysfunction · Sleep disturbances · Cancer patient · Oncology

Introduction

A cancer diagnosis can be one of the most stressful times of an individual's life [1, 2]. The pre-treatment period for a cancer patient may be one of the most psychologically difficult, as they are faced with understanding their diagnosis, making important treatment decisions, and confronting the possibility of their mortality, all within a relatively brief window of time [3–5]. These stressors may be likely to create sleep problems, which are already common in the general population. Estimates suggest that up to half of adults have a sleep complaint, with women, older adults, and those from a lower socioeconomic background more likely to struggle with their sleep [6–8], and mixed findings regarding ethnic differences [9, 10]. Chronic sleep problems are associated with a host of physical and psychosocial health outcomes including increased infection risk, pain, fatigue, depression, poorer quality of life, and mortality [11–15] in a population already at increased risk for co-morbidities.

Beyond the absence or presence of a symptom, it is also important to understand the patient's perception of how much of a problem that particular symptom may be. The experience of a problem is an important predictor of whether they will seek medical treatment to address that symptom [16]. This is notable in the context of sleep-related issues because they are often overlooked by both patients and medical providers, viewed as a

✉ Eric S. Zhou
eric_zhou@dfci.harvard.edu

[1] Perini Family Survivors' Center, Dana-Farber Cancer Institute, Boston, MA, USA

[2] Pediatrics, Harvard Medical School, Boston, MA, USA

[3] Supportive Care Medicine, City of Hope National Medical Center, Duarte, CA, USA

"normal" response to a recent cancer diagnosis and merely a temporary issue [17]. Consequently, sleep disorders are consistently under-diagnosed in the oncology setting [18, 19]. Without routine screening and diagnosis, patients are not provided with the opportunity to receive evidence-based interventions for their poor sleep [20], resulting in ongoing sleep problems that can persist through active therapy [21–25] and well into cancer survivorship [14, 26–28].

Our understanding of sleep in the context of cancer is limited by several key factors. First, less than 10% of sleep disorders research in cancer populations has been conducted during the critical phase prior to treatment initiation [29], with work suggesting that this period may be the highest risk phase for sleep problems [30]. Next, limited research in cancer patients has specifically inquired about how much of a problem patients are experiencing with their sleep. Finally, though the prevalence of sleep problems varies across cancer diagnoses [25, 31], the preponderance of research has been conducted among breast cancer patients. There is a need to improve our understanding of sleep in other patient groups [29]. To address these important limitations of our current literature, we sought to improve our insight into the prevalence and correlates of sleep problems following cancer diagnosis and prior to treatment initiation. To the best of our knowledge, this study sample is one of the largest in which sleep problems among cancer patients have been studied. Participants in this sample are diverse with respect to demographics and have been diagnosed with eight of the most commonly diagnosed cancers in adults.

Methods

During a routine clinical visit prior to starting treatment, patients were asked to complete a biopsychosocial problem-related screening instrument on a touch-screen device (*SupportScreen*) [32] that is part of standard of clinical outpatient care. Data collected from this instrument were examined for this cross-sectional study of 5702 adult cancer patients at a National Cancer Institute designated comprehensive cancer center in the USA between 2009 and 2016. For inclusion into the study, participants were a minimum age of 18, had not yet received active cancer therapy, were outpatient status, and were able to complete the survey in English, Spanish, or Chinese. Patients were identified in the hematological malignancy, gastrointestinal cancer, head/neck cancer, prostate cancer, gynecologic cancer, lung cancer, urinary cancer, or prostate cancer clinics. This study was approved by the City of Hope Institutional Review Board.

Sample

In the sample, there were more females than males (68.2%), with the majority between the ages of 40–64 years (56.7%). Though 77.0% of the sample was White, there was minority representation with 5.6% Blacks and 17.3% Asians. Most participants identified as non-Hispanic (77.0%), were married (64.2%), and had at least some college education (71.8%). A substantial proportion (44.0%) of our sample reported having a household income of less than $40,000/year.

Measures

The 53-item *You*, *Your Family*, *and the City of Hope are a Team* screening instrument was developed based upon patient and family input, a comprehensive review of the scientific literature, and clinical experience. Further information about measure development and validation has been previously published [33–37]. Patients are prompted to report ratings on a five-point scale from 1 (Not a problem) to 5 (Very severe problem) in response to the question "How much of a problem is this for you?" regarding a range of common physical, practical, social, psychological, nutritional, physical rehabilitation, and spiritual problems encountered by patients with cancer. Specifically for this study, patient responses to the question How much of a problem is this for you? for three items were examined: (1) "sleeping," (2) "feeling anxious or fearful," (3) "feeling down or depressed." Patients who indicated that a symptom was either a "severe" or "very severe" problem were classified as having "high problems," and those who reported "not a problem," or a "mild" or "moderate" problem were classified as having "non-high problems." This classification mirrors the clinical setting where the screening tool is utilized. A medical provider (e.g., physician, nurse, social worker etc.) is automatically notified if a patient reports either severe or very severe for a specific item so that they may be triaged. Demographic characteristics were obtained from the survey and the patient's electronic medical record.

Data Analysis

The frequency with which patients reported sleep problems on the five-point scale was tabulated first across all cancer diagnoses and then separately for each specific cancer diagnosis. A chi-square test of independence was calculated comparing the proportions of patients endorsing high and non-high problems for each cancer diagnosis. Next, chi-square tests of independence were conducted comparing patients endorsing high or non-high sleep problems with each demographic (age, gender, race, ethnicity, marital status, education level, and household income) and psychological (single-item

report of problems with anxiety and with depression) variable, with odds ratios calculated via logistic regression. Finally, we conducted an exploratory analysis to understand the overall associations between sleep and all possible covariates with a single comprehensive logistic regression model including all demographic and psychological variables. Missing data was handled using list-wise deletion for all analyses. For all analyses, the Statistical Package of Social Sciences (SPSS) 22.0 was used, using a two-tailed p value $\leq .05$ to designate statistical significance.

Results

Of 5702 cancer patients, 713 (12.5%) reported that they were experiencing high problems with sleep (Table 1). The range for patients indicating high problems with sleep was between 4.6 and 13.8%, with independence tests demonstrating that prostate cancer patients were least likely to report high problems (4.6%; $p < .001$) compared to all other diagnoses. Among the remaining seven cancer diagnoses, between 11.3 and 13.8% of patients reported having high problems; differences between these diagnoses were not statistically significant. In the whole sample, independence tests identified statistically significant associations between demographic (age, gender, race, ethnicity, marital status, education level, and household income) and health-related (single-item report of problems with anxiety and with depression) correlates of sleep problems (Table 2). Covariates positively associated with high sleep problems in the overall sample included being female (OR = 1.30; $p < .01$), Black (OR = 1.86; $p < .001$), Hispanic (OR = 1.56; $p < .001$), and reporting high problems associated with anxiety (OR = 6.25; $p < .001$) and depression (OR = 9.09; $p < .001$). Further, women were more likely to report experiencing high problems associated with anxiety (OR = 1.59; $p < .001$) and depression (OR = 1.92; $p < .001$). Similarly, being 65 years of age or older (OR = 0.65; $p < .001$), married/partnered (OR = 0.78; $p < .01$), having some college education (OR = 0.62; $p < .001$) or an advanced degree (OR = 0.43; $p < .001$), and having an income of $40,000–100,000/year (OR = 0.40; $p < .01$) or greater than $100,000/year (OR = 0.64; $p < .001$) were associated with a lower likelihood of reporting high problems with sleep. A logistical regression model with all potential covariates revealed that education, household income, anxiety, and depression remained significantly associated with sleep problems even after adjusting for other variables (Table 3).

A detailed view of the tests of independence between demographic and health covariates of high/non-high sleep problems separately by individual diagnosis can be seen in the Tables 4, 5, 6, 7, 8, 9, 10, and 11.

Table 1 Patient responses to "*How much of a problem is this for you? Sleeping*" by site of cancer diagnosis ($N = 5702$)

	Cancer diagnosis								
	All cancer diagnoses (N = 5702)	Hematological ($n = 416$)	Gastrointestinal ($n = 801$)	Head/neck ($n = 344$)	Prostate ($n = 469$)	Gynecologic ($n = 648$)	Lung ($n = 524$)	Urinary ($n = 332$)	Breast ($n = 2168$)
Not a problem	35.9%	33.8%	35.7%	40.4%	50.6%	33.2%	31.9%	33.6%	33.8%
Mild problem	26.1%	28.3%	26.0%	26.5%	24.6%	27.8%	26.0%	22.7%	26.0%
Moderate problem	25.6%	24.4%	24.4%	21.8%	20.5%	26.5%	29.2%	30.0%	26.7%
Severe problem	9.1%	10.4%	9.9%	8.1%	2.6%	9.8%	7.5%	11.2%	10.1%
Very severe problem	3.4%	3.1%	3.9%	3.2%	1.7%	2.8%	5.4%	2.4%	3.4%

Table 2 Demographic and psychological characteristics for all cancer patients by high/non-high sleep problems ($N = 5702$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	5667			.00	
18–39	391	49 (12.5%)	342 (87.5%)		Ref
40–64	3216	461 (14.3%)	2755(85.7%)		1.32
≥ 65	2060	199 (9.7%)	1861 (90.3%)		0.65***
Gender	5587			.00	
Male	1779	188 (10.6%)	1591 (89.4%)		Ref
Female	3808	513 (13.5%)	3295 (86.5%)		1.30**
Race	4917			.00	
White	3788	454 (12.0%)	3334 (88.0%)		Ref
Black	276	56 (20.3%)	220 (79.7%)		1.86***
Asian	853	86 (10.1%)	767 (89.9%)		0.85
Ethnicity	5134			.00	
Non-Hispanic	3954	447 (11.3%)	3507 (88.7%)		Ref
Hispanic	1180	196 (16.6%)	984 (83.4%)		1.56***
Marital status	5283			.00	
Not Married (single/widowed/divorced)	1921	277 (14.4%)	1644 (85.6%)		Ref
Married/life partner	3392	389 (11.6%)	2973 (88.4%)		0.78**
Education	5457			.00	
≤ High school diploma	1538	248 (16.1%)	1290 (83.9%)		Ref
Some college or 4-year degree	2892	349 (12.1%)	2543 (87.9%)		0.62***
> 4-year degree	1027	80 (7.8%)	947 (92.2%)		0.43***
Annual household income	4132			.00	
< $40,000	1818	297 (16.3%)	1521 (83.7%)		Ref
$40,000–$100,000	1362	151 (11.1%)	1211 (88.9%)		0.40**
> $100,000	952	518 (12.5%)	3614 (87.5%)		0.64***
Anxiety	5537			.00	
Low problem	5023	484 (9.6%)	4939 (90.4%)		Ref
High problem	514	209 (40.7%)	305 (59.3%)		6.25***
Depression	2310			.00	
Low problem	2116	206 (9.7%)	1910 (90.3%)		Ref
High problem	194	96 (49.5%)	98 (50.5%)		9.09***

*$p < .05$; **$p < .01$; ***$p < .001$

In summary, statistically significant differences were seen between high/non-high sleep problems and age only for those diagnosed with head/neck and breast cancer. For gender, females diagnosed with hematological malignancy were statistically more likely to report high problems with sleep, but not in other cancer diagnoses that affect both genders. Blacks consistently reported high sleep problems compared with Whites, with statistically significant differences seen in all diagnoses, with the exception of hematological malignancy and lung cancer. Hispanics diagnosed with hematological malignancy, gynecologic cancer, and breast cancer were more likely to report high sleep problems. Being married or having a life partner was associated with a statistically significantly lower likelihood of reporting high problems for those diagnosed with gastrointestinal cancer and head/neck cancer only. Statistically significant relationships between higher education and a lower rate of high sleep problems were only seen in those with a gastrointestinal, lung, urinary, and breast cancer diagnoses. A higher household income was associated with lower rates of high problems in those with a gastrointestinal, head/neck, gynecologic, urinary, and breast cancer diagnosis. Finally, in every individual cancer diagnosis, patients reporting high problems with anxiety or depression were more likely to also report high problems with their sleep.

Table 3 Logistic regression model incorporating all potential covariates ($n = 1339$)

	n high sleep problem (%)	*n* non-high sleep problem (%)	Odds ratio
Age			
18–39	13 (7.9%)	70 (6.0%)	Ref
40–64	113 (68.5%)	679 (57.8%)	0.77
≥ 65	39 (23.6%)	425 (36.2%)	0.50
Gender			
Male	47 (28.5%)	451 (38.4%)	Ref
Female	118 (71.5%)	723 (61.6%)	1.06
Race			
White	131 (79.4%)	955 (81.3%)	Ref
Black	18 (10.9%)	70 (6.0%)	1.41
Asian	16 (9.7%)	149 (12.7%)	0.60
Ethnicity			
Non-Hispanic	119 (72.1%)	905 (77.1%)	Ref
Hispanic	46 (27.9%)	269 (22.9%)	0.66
Marital status			
Not married (single/widowed/divorced)	74 (44.8%)	403 (34.3%)	Ref
Married/life partner	91 (55.2%)	771 (65.7%)	1.08
Education			
≤ High school diploma	64 (38.8%)	336 (28.6%)	Ref
Some college or 4-year degree	88 (53.3%)	598 (50.9%)	1.01
> 4-year degree	13 (7.9%)	240 (20.4%)	0.43*
Annual household income			
< $40,000	107 (64.8%)	497 (42.3%)	Ref
$40,000–$100,000	38 (23.0%)	389 (33.1%)	0.66
> $100,000	20 (12.1%)	288 (24.5%)	0.48*
Anxiety			
Low problem	115 (69.7%)	1109 (94.5%)	Ref
High problem	50 (30.3%)	65 (5.5%)	2.92***
Depression			
Low problem	118 (71.5%)	1130 (96.3%)	Ref
High problem	47 (28.5%)	44 (3.7%)	4.63***

*$p < .05$; **$p < .01$; ***$p < .001$

Discussion

The prevalence of experiencing sleep problems prior to initiating active cancer treatment is considerable across multiple diagnoses. These patients have not started to receive the intensive therapies designed to treat their cancer, yet are already reporting that they are experiencing problems with their sleep. Even though issues with sleep are associated with many health consequences, they are commonly overlooked by healthcare clinicians in the oncology setting [18, 19], and both patients and providers are not aware that highly effective interventions tailored for cancer patients exist (e.g., cognitive-behavioral therapy for insomnia) [20, 38]. However, when compared to the general population, there is some cause for optimism. There has been increasing interest in studying sleep in oncology populations, and because cancer patients are actively engaged within a healthcare system, there is an increased chance that they may receive a sleep evaluation and treatment for their sleep problems. Our findings demonstrate that there are important demographic (age, gender, race, ethnicity, marital status, education level, and household income) and health-related (anxiety and depression) factors which can help to guide clinicians and researchers in identifying those at greatest risk for reporting sleep problems. Furthermore, our logistical regression model suggests that those with co-morbid concerns about anxiety and depression are at particular risk for sleep problems, even after controlling

Table 4 Demographic and psychological characteristics for patients with hematological malignancy by high/non-high sleep problem ($n = 409$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	409			.61	
18–39	82	14 (17.1%)	68 (82.9%)		Ref
40–64	203	26 (12.8%)	177 (87.2%)		0.71
≥ 65	124	16 (12.9%)	108 (87.1%)		0.72
Gender	400			.69	
Male	199	25 (12.6%)	174 (87.4%)		Ref
Female	201	28 (13.9%)	173 (86.1%)		1.13**
Race	369			.15	
White	296	41 (13.9%)	255 (78.9%)		Ref
Black	20	0 (0.0%)	20 (100.0%)		0.00
Asian	53	5 (10.9%)	48 (90.6%)		0.65
Ethnicity	379			.01	
Non-Hispanic	298	32 (10.7%)	266 (89.3%)		Ref
Hispanic	81	18 (22.2%)	63 (77.8%)		2.38**
Marital status	381			.32	
Not married (single/widowed/divorced)	141	16 (11.3%)	125 (88.7%)		Ref
Married/life partner	240	36 (15.0%)	204 (85.0%)		1.38
Education	396			.42	
≤ High school diploma	73	9 (12.3%)	64 (87.7%)		Ref
Some college or 4-year degree	215	33 (15.3%)	185 (84.7%)		1.29
> 4-year degree	108	11 (10.2%)	97 (89.8%)		0.81
Annual household income	294			.19	
< $40,000	109	19 (17.4%)	90 (82.6%)		Ref
$40,000–$100,000	88	10 (11.4%)	78 (88.6%)		0.61
> $100,000	97	9 (9.3%)	88 (90.7%)		0.48
Anxiety	386			.00	
Low problem	369	47 (12.7%)	322 (87.3%)		Ref
High problem	17	7 (41.2%)	10 (58.8%)		4.80**
Depression	108			.01	
Low problem	104	10 (9.6%)	94 (90.4%)		Ref
High problem	4	2 (50.0%)	2 (50.0%)		9.40*

*$p < .05$; **$p < .01$; ***$p < .001$

for demographic variables. Patients who are experiencing significant sleep problems may be more receptive to referrals to evidence-based treatment, which can have a positive health impact for patients at risk for decrements to their health and quality of life as a result of their upcoming cancer therapy.

A direct comparison of our findings with other samples is made difficult by virtue of the different definitions for sleep disruption used in various studies, which ranged from questions about overall sleep quality to those who met diagnostic criteria for insomnia disorder [17, 31, 39]. In our study, had we classified patients in our sample with "moderate" sleep problems as having high sleep problems, the proportions in our findings would have differed. Our decision to categorize patients reporting severe or very severe sleep problems as having high sleep problems was because those with more severe insomnia impairments are more likely to seek treatment [40]. There is a known discrepancy between the presence of a sleep problem (e.g., frequent night awakenings) and a patient's perception that their sleep is a problem—prior literature has demonstrated that over 20% of adults who were experiencing insomnia symptoms still reported that they were satisfied with their sleep [41]. The subjective nature of sleep disturbances (i.e., it is possible that some patients simply "got used to" living with a sleep problem and no longer consider their poor sleep a significant issue) may help to explain

Table 5 Demographic and psychological characteristics for patients with gastrointestinal cancer by high/non-high sleep problem ($n = 795$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	795			.18	
18–39	33	7 (21.2%)	26 (78.8%)		Ref
40–64	410	62 (15.1%)	348 (84.9%)		0.66
≥ 65	352	41 (11.6%)	311 (88.4%)		0.49
Gender	790			.44	
Male	393	51 (13.0%)	342 (87.0%)		Ref
Female	397	59 (14.9%)	338 (85.1%)		1.17
Race	678			.02	
White	479	67 (14.0%)	412 (86.0%)		Ref
Black	25	18 (28.0%)	18 (72.0%)		2.39*
Asian	174	16 (9.2%)	158 (90.8%)		0.62
Ethnicity	721			.35	
Non-Hispanic	544	71 (13.1%)	473 (86.9%)		Ref
Hispanic	177	28 (15.8%)	149 (84.2%)		1.25
Marital status	761			.17	
Not Married (single/widowed/divorced)	243	49 (20.2%)	194 (79.8%)		Ref
Married/life partner	518	58 (11.2%)	490 (88.8%)		0.50**
Education	771				
≤ High school diploma	275	46 (16.7%)	229 (83.3%)	.00	Ref
Some college or 4-year degree	375	50 (13.3%)	325 (86.7%)		0.77
> 4-year degree	121	12 (9.9%)	109 (90.1%)		0.55*
Annual household income	586				
< $40,000	295	61 (20.7%)	243 (79.3%)	.00	Ref
$40,000–$100,000	188	22 (11.7%)	166 (88.3%)		0.51*
> $100,000	103	6 (5.8%)	97 (94.2%)		0.24**
Anxiety	778			.00	
Low Problem	711	79 (11.1%)	632 (88.9%)		Ref
High Problem	67	30 (44.8%)	37 (55.2%)		6.49***
Depression	315			.00	
Low Problem	280	39 (13.9%)	241 (86.1%)		Ref
High Problem	35	15 (42.9%)	20 (57.1%)		4.64***

*$p < .05$; **$p < .01$; ***$p < .001$

why cancer patients are unlikely to discuss sleep issues with their oncologists [14] and why increasing the awareness among patients about common sleep disorders and their health consequences could be an important focus for future interventions.

Consistent with insomnia prevalence in the general population [42], perceptions of high sleep problems in our sample were more common in women. Within the general population, the risk ratio for female versus male insomnia prevalence is 1.41 [42], which is similar to our finding that women were 1.40 times more likely to report high problems with their sleep. It has been previously suggested that the increased likelihood of sleep problems in women may be the result of factors including the increased prevalence of psychiatric disorders (specifically depression and anxiety) in women [43, 44] and the higher probability that women will report somatic symptoms such as sleep disturbances [45, 46]. Our findings support these hypotheses: women were more likely to perceive experiencing high problems associated with anxiety and depression. Further, the strongest correlates of sleep problems in our sample were the report of either anxiety or depressive problems, across demographic groups, which is consistent with the general population [47]. This is a commonly seen symptom cluster within oncology populations [24], and sleep/anxiety/depression can serve to exacerbate or cause one another [48]. The high rate of sleep problems in women

Table 6 Demographic and psychological characteristics for patients with head and neck cancer by high/non-high sleep problem (n = 344)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	344			.00	
18–39	25	7 (28.0%)	18 (72.0%)		Ref
40–64	184	27 (14.7%)	157 (85.3%)		0.44
≥ 65	135	5 (3.7%)	130 (96.3%)		0.10***
Gender	341			.67	
Male	246	27 (11.0%)	219 (89.0%)		Ref
Female	95	12 (12.6%)	83 (87.4%)		1.17
Race	312			.08	
White	255	25 (9.8%)	230 (90.2%)		Ref
Black	9	3 (33.3%)	6 (66.7%)		4.60*
Asian	48	6 (12.5%)	42 (87.5%)		1.31
Ethnicity	316			.13	
Non-Hispanic	273	29 (10.6%)	244 (89.4%)		Ref
Hispanic	43	8 (18.6%)	35 (81.4%)		1.92
Marital status	309			.06	
Not married (single/widowed/divorced)	104	16 (15.4%)	88 (84.6%)		Ref
Married/ life partner	205	17 (8.3%)	188 (91.7%)		0.50*
Education	332			.85	
≤ High school diploma	96	12 (12.5%)	84 (87.5%)		Ref
Some college or 4-year degree	167	18 (10.8%)	149 (89.2%)		0.85
> 4-year degree	69	9 (13.0%)	60 (87.0%)		1.05
Annual household income	257			.00	
< $40,000	112	21 (18.8%)	91 (81.3%)		Ref
$40,000–$100,000	83	3 (3.6%)	80 (96.4%)		0.16**
> $100,000	62	3 (4.8%)	59 (95.2%)		0.22*
Anxiety	328			.00	
Low problem	284	22 (7.7%)	262 (92.3%)		Ref
High problem	44	15 (34.1%)	29 (65.9%)		6.16***
Depression	83			.00	
Low problem	73	5 (6.8%)	68 (93.2%)		Ref
High problem	10	5 (50.0%)	5 (50.0%)		13.60**

*$p < .05$; **$p < .01$; ***$p < .001$

before they have received any cancer therapy is particularly concerning as cancer treatments can cause women to experience menopausal symptoms (e.g., hot flashes) [49] which can further impair sleep [50].

The results we present on race and ethnicity are consistent with current knowledge from the general population: Blacks and Hispanics experience poorer sleep than other racial groups [51–56], while Asians are less likely to experience sleep issues [57, 58]. Our understanding of why some minority populations sleep worse than others is limited and requires further research [59]. These results emphasize the need to discuss sleep-related issues with Black and Hispanic cancer patients in the clinical setting, as they are likely to be experiencing sleep problems.

Overall reductions in role demands (e.g., employment, childrearing, etc.) and the associated decrease in general stress may help to explain our novel findings with respect to the association between age, race, and ethnicity; marital status; education level; and household income with sleep problems. First, the prevalence of sleep problems by age groups in our sample differs from what is generally seen in the general population. Epidemiological studies have suggested that the likelihood of sleep disorders, such as insomnia, is associated with increasing age [60, 61]. In our sample, the lowest rates of sleep problems were reported by those 65 years of age and older, while the middle-aged patients (40–64 years) reported the highest rates of sleep problems. Other studies have identified a similar peak around the fourth decade of

Table 7 Demographic and psychological characteristics for patients with prostate cancer by high/non-high sleep problem ($n = 468$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	468			.27	
18–39	2	0 (0.0%)	2 (100.0%)		N/A
40–64	178	11 (6.2%)	167 (93.8%)		
≥ 65	288	9 (3.1%)	279 (96.9%)		
Gender	N/A				
Male					
Female					
Race	411			.00	
White	348	7 (2.0%)	341 (98.0%)		Ref
Black	28	5 (17.9%)	23 (82.1%)		10.59***
Asian	35	2 (5.7%)	33 (94.3%)		2.95
Ethnicity	417			.28	
Non-Hispanic	348	11 (3.2%)	337 (96.8%)		Ref
Hispanic	69	4 (5.8%)	65 (94.2%)		1.89
Marital status	435			.67	
Not Married (single/widowed/divorced)	80	4 (5.0%)	76 (95.0%)		Ref
Married/ life partner	355	14 (3.9%)	341 (96.1%)		0.78
Education	458			.39	
≤ High school diploma	61	4 (6.6%)	57 (93.4%)		Ref
Some college or 4-year degree	247	12 (4.9%)	235 (95.1%)		0.73
> 4- year degree	150	4 (2.7%)	146 (97.3%)		0.39
Annual household income	339			.70	
< $40,000	63	2 (3.2%)	61 (96.8%)		Ref
$40,000–$100,000	133	7 (5.3%)	126 (94.7%)		1.69
> $100,000	143	5 (3.5%)	138 (96.5%		1.11
Anxiety	464			.00	
Low problem	444	15 (3.4%)	429 (96.6%)		Ref
High problem	20	5 (25.0%)	15 (75.0%)		9.53***
Depression	302			.00	
Low problem	295	10 (3.4%)	285 (96.6%)		Ref
High problem	7	3 (42.9%)	4 (57.1%)		21.38***

*$p < .05$; **$p < .01$; ***$p < .001$

life [62], possibly because this period of life is one in which many adults have the heaviest employment workload coupled with their lowest levels of job satisfaction [63, 64]. In the present study, these issues are compounded by the disruption that cancer is likely to create, further increasing the likelihood of sleep problems. Moreover, it is possible that while older individuals may experience more sleep disorders, they may simply be less bothered by these issues. Second, prior work examining the relationship between marital status with sleep has been inconsistent, with evidence that being single [64] or being married [40] can be associated with better sleep. In our patients, being married/having a life partner was a potential protective factor against sleep problems. As noted before, the presence of someone to share in responsibilities may help to reduce overall stress; stress is directly associated with an increased probability of experiencing sleep problems [65], and individuals who have shared daytime obligations may consequently have increased opportunity to catch up on their sleep and experience less subjective concern about their sleep. Finally, we have replicated work conducted in the general population which showed that individuals with a higher level of education or with higher incomes were less likely to experience insomnia or to report subjective impairment due to their insomnia [66–69], and this is the case even when controlling for other demographic and psychological variables. As

Table 8 Demographic and psychological characteristics for patients with gynecologic cancer by high/non-high sleep problem ($n = 645$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	645			.46	
18–39	69	7 (10.1%)	62 (89.9%)		Ref
40–64	381	53 (13.9%)	328 (86.1%)		1.43
≥ 65	195	21 (10.8%)	174 (89.2%)		1.07
Gender	N/A				
Male					
Female					
Race	545			.21	
White	439	47 (10.7%)	392 (89.3%)		Ref
Black	28	6 (21.4%)	22 (78.6%)		2.28*
Asian	78	10 (12.8)	68 (87.2%)		1.23
Ethnicity	572			.01	
Non-Hispanic	429	43 (10.0%)	386 (90.0%)		Ref
Hispanic	142	29 (20.3%)	114 (79.7%)		2.28**
Marital status	585			.73	
Not married (single/widowed/divorced)	242	28 (11.6%)	214 (88.4%)		Ref
Married/life partner	343	43 (12.5%)	300 (87.5%)		1.10
Education	635			.52	
≤ High school diploma	183	27 (14.8%)	156 (85.2%)		Ref
Some college or 4-year degree	327	41 (12.5%)	286 (87.5%)		0.83
> 4- year degree	125	13 (10.4%)	112 (89.6%)		0.67
Annual household income	485			.11	
< $40,000	222	37 (16.7%)	185 (83.3%)		Ref
$40,000–$100,000	171	16 (9.4%)	155 (90.6%)		0.52*
> $100,000	92	13 (14.1%)	79 (85.9%)		0.82
Anxiety	632			.00	
Low problem	564	52 (9.2%)	512 (90.8%)		Ref
High problem	68	26 (38.2%)	42 (61.8%)		6.10***
Depression	143			.00	
Low problem	128	11 (8.6%)	117 (91.4%)		Ref
High problem	15	7 (46.7%)	8 (53.3%)		9.31***

*$p < .05$; **$p < .01$; ***$p < .001$

external intervention for these socioeconomic factors are challenging, it will be important to ensure that patients from a lower socioeconomic background are consistently screened for potential sleep problems.

Rates of sleep problems were fairly comparable across cancer diagnoses, with the exception of those with prostate cancer (Tables 4, 5, 6, 7, 8, 9, 10, and 11). Older age and male gender in our sample were associated with a reduced likelihood of sleep problems. Moreover, the prostate cancer patients in our sample were more likely to be married, educated, and have a higher income, all factors that were associated with less sleep problems. Despite the lower prevalence of sleep problems among prostate cancer patients, it is important for clinicians to remember that simply because the patient does not report a sleep problem does not mean that the symptom will not have detrimental health consequences. Further, we note that some of the statistically significant correlates of sleep problems were unique across individual cancer diagnoses. Therefore, providers should consider the disease group they treat to determine what correlates may be relevant for them to consider during clinical care.

We recognize that the results of our study are limited by several factors. First, our sample is from a single center and the screening measure used for this study was designed to be a practical tool to be used as part of routine clinical care. Therefore, our findings may not be generalizable to all cancer patients. Also, the cross-sectional nature of the study precludes causal conclusions from being made

Table 9 Demographic and psychological characteristics for patients with lung cancer by high/non-high sleep problem ($n = 520$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	520			.42	
18–39	9	0 (0.0%)	9 (100.0%)		N/A
40–64	226	32 (14.2%)	194 (85.8%)		
≥ 65	285	35 (12.3%)	250 (87.7%)		
Gender	514			.10	
Male	236	37 (15.7%)	199 (84.3%)		Ref
Female	278	30 (10.8%)	248 (89.2%)		0.65
Race	464			.60	
White	335	41 (12.2%)	294 (87.8%)		Ref
Black	22	4 (18.2%)	18 (81.8%)		1.59
Asian	107	16 (15.0%)	91 (85.0%)		1.26
Ethnicity	469			.37	
Non-Hispanic	405	53 (13.1%)	352 (86.9%)		Ref
Hispanic	64	11 (17.2%)	53 (82.8%)		1.38
Marital status	491			.50	
Not married (single/widowed/divorced)	164	19 (11.6%)	145 (88.4%)		Ref
Married/ life partner	327	45 (13.8%)	282 (86.2%)		1.22
Education	504			.01	
≤ High school diploma	162	27 (16.7%)	135 (83.3%)		Ref
Some college or 4-year degree	264	35 (13.3%)	229 (86.7%)		0.76
> 4-year degree	78	2 (2.6%)	76 (97.4%)		0.13**
Annual household income	385			.23	
< $40,000	178	22 (12.4%)	156 (87.6%)		Ref
$40,000–$100,000	131	19 (14.5%)	112 (85.5%)		1.20
> $100,000	76	5 (6.6%)	71 (93.4%)		0.50
Anxiety	509			.00	
Low problem	472	51 (10.8%)	421 (89.2%)		Ref
High problem	37	14 (37.8%)	23 (62.2%)		5.03***
Depression	170			.00	
Low problem	157	15 (9.6%)	142 (90.4%)		Ref
High problem	13	5 (38.5%)	8 (61.5%)		5.92**

*$p < .05$; **$p < .01$; ***$p < .001$

and does not capture the fluctuating nature of sleep over time. In future research, it will be valuable to explore the directionality of the relationships between sleep problems with anxiety and depression. Next, our work asked a unique, single, subjective item to describe sleep-related problems that has not been used in a prior research study. A more comprehensive evaluation of sleep, including an understanding of whether participants were endorsing clinical disorder or simply a subjective concern about their sleep, will be important as this would allow for a richer understanding of the sleep problems and also potentially allow for statistical comparisons with other chronic illness populations and the general population. However, we note that a single question about a cancer patient's subjective sleep experience can be an important predictor of outcomes as it has been associated with their overall survival [70]. Further, it is acknowledged that different analytic approaches to categorizing sleep problems in our sample could have been taken (e.g., comparing those who reported not a problem/mild problem vs. moderate problem/severe problem/very severe problem or comparing those reporting not a problem/mild problem vs. moderate problem vs. severe problem/very severe problem). We believe that our dichotomization approach provides valuable information about the extent of truly significant sleep problems in cancer patients, underscoring the importance of sleep assessment and treatment during clinical care.

Table 10 Demographic and psychological characteristics for patients with urinary cancer by high/non-high sleep problem ($n = 329$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	329			.05	
18–39	6	0 (0.0%)	6 (100.0%)		N/A
40–64	145	27 (18.6%)	118 (81.4%)		
≥ 65	178	18 (10.1%)	160 (89.9%)		
Gender	326			.14	
Male	246	30 (12.2%)	216 (87.8%)		Ref
Female	80	15 (18.8%)	65 (81.2%)		1.66
Race	301			.12	
White	256	36 (14.1%)	220 (85.9%)		Ref
Black	12	4 (33.3%)	8 (66.7%)		3.06*
Asian	33	3 (9.1%)	30 (90.9%)		0.61
Ethnicity	301			.41	
Non-Hispanic	251	34 (13.5%)	217 (86.5%)		Ref
Hispanic	50	9 (18.0%)	41 (82.0%)		1.40
Marital status	318			.23	
Not married (single/widowed/divorced)	82	14 (17.1%)	68 (82.9%)		Ref
Married/life partner	236	28 (11.9%)	208 (88.1%)		0.65
Education	319			.06	
≤High school diploma	87	17 (19.5%)	70 (80.5%)		Ref
Some college or 4-year degree	177	23 (13.0%)	154 (87.0%)		0.62
> 4-year degree	55	3 (5.5%)	52 (94.5%)		0.24*
Annual household income	241			.14	
< $40,000	77	15 (19.5%)	62 (80.5%)		Ref
$40,000–$100,000	98	11 (11.2%)	87 (88.8%)		0.52
> $100,000	66	6 (9.1%)	60 (90.9%)		0.41*
Anxiety	328			.00	
Low problem	302	30 (9.9%)	272 (90.1%)		Ref
High problem	26	14 (53.8%)	12 (46.2%)		10.58***
Depression	168			.00	
Low problem	154	15 (9.7%)	139 (90.3%)		Ref
High problem	14	9 (64.3%)	5 (35.7%)		16.68***

*$p < .05$; **$p < .01$; ***$p < .001$

Additionally, as multiple statistical tests were performed during our analyses, we recognize the increased probability of committing a type I error. Finally, we did not have the capability of collecting data on cancer-specific variables such as stage of disease or co-morbid health conditions and these may have impacted the patients' sleep.

Despite these limitations, we believe that our work adds value to our understanding of sleep in cancer patients. Our findings clearly demonstrate that a considerable proportion of patients are already experiencing sleep problems before any cancer therapy has been initiated. Active cancer treatment and its associated side effects (e.g., pain, fatigue etc.) can worsen their sleep, making it critical to recognize sleep problems as early as possible. We have identified a number of key variables that clinicians should consider when meeting with their patients. Not screening for sleep problems during routine oncology appointments is a missed opportunity to help patients with issues that are infrequently discussed in medical settings [14, 19, 71–73]. The National Comprehensive Cancer Network has published guidelines for the care of cancer survivors that outlines an effective screening and referral process for providers [74], and these findings serve as a strong reminder that sleep function should be evaluated at every oncology visit.

Table 11 Demographic and psychological characteristics for patients with breast cancer by high/non-high sleep problem ($n = 2157$)

	No.	*n* high sleep problem (%)	*n* non-high sleep problem (%)	Statistical significance	Odds ratio
Age	2157			.01	
18–39	165	14 (8.5%)	151 (91.5%)		Ref
40–64	1489	223 (15.0%)	1266 (85.0%)		1.90*
≥ 65	503	54 (10.7%)	449 (89.3%)		1.30
Gender	N/A				
Male					
Female					
Race	1837			.00	
White	1380	190 (13.8%)	1190 (86.2%)		Ref
Black	132	27 (20.5%)	105 (79.5%)		1.61*
Asian	325	28 (11.4%)	297 (91.4%)		0.59*
Ethnicity	1959			.03	
Non-Hispanic	1406	174 (12.4%)	1232 (87.6%)		Ref
Hispanic	553	89 (16.1%)	464 (83.9%)		1.36*
Marital status	2003			.17	
Not married (single/widowed/divorced)	865	131 (15.1%)	734 (84.9%)		Ref
Married/ life partner	1138	148 (13.0%)	990 (87.0%)		0.84
Education	2042			.00	
≤ High school diploma	601	106 (17.6%)	495 (82.4%)		Ref
Some college or 4-year degree	1120	137 (12.2%)	983 (87.8%)		0.65**
> 4-year degree	321	26 (8.1%)	295 (91.9%)		0.41***
Annual household income	1545			.00	
< $40,000	762	120 (15.7%)	642 (84.3%)		Ref
$40,000–$100,000	470	63 (13.4%)	407 (86.6%)		0.83
> $100,000	313	23 (7.3%)	290 (92.7%)		0.42***
Anxiety	2112			.00	
Low problem	1877	188 (10.0%)	1689 (90.0%)		Ref
High problem	235	98 (41.7%)	137 (58.3%)		6.43***
Depression	1021			.00	
Low problem	925	101 (10.9%)	824 (89.1%)		Ref
High problem	96	50 (52.1%)	46 (47.9%)		8.87***

*$p < .05$; **$p < .01$; ***$p < .001$

Funding This research was supported by internal funding at the City of Hope Comprehensive Cancer Center.

Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare that they have no conflict of interest.

Financial Disclosures *SupportScreen* is a licensed product of the City of Hope.

References

1. Linden W, Vodermaier A, Mackenzie R, Greig D. Anxiety and depression after cancer diagnosis: prevalence rates by cancer type, gender, and age. J Affect Disord. 2012;141(2–3):343–51. https://doi.org/10.1016/j.jad.2012.03.025.
2. van't Spijker A, Trijsburg RW, Duivenvoorden HJ. Psychological sequelae of cancer diagnosis: a meta-analytical review of 58 studies after 1980. Psychosom Med. 1997;59(3):280–93.
3. Carter BJ. Long-term survivors of breast cancer. A qualitative descriptive study. Cancer Nurs. 1993;16(5):354–61.
4. Cimprich B. Pretreatment symptom distress in women newly diagnosed with breast cancer. Cancer Nurs. 1999;22(3):185–94.

5. Dickerson SS, Alqaissi N, Underhill M, Lally RM. Surviving the wait: defining support while awaiting breast cancer surgery. J Adv Nurs. 2011;67(7):1468–79.
6. Foley DJ, Monjan AA, Brown SL, Simonsick EM, Wallace RB, Blazer DG. Sleep complaints among elderly persons: an epidemiologic study of three communities. Sleep. 1995;18(6):425–32.
7. Arber S, Bote M, Meadows R. Gender and socio-economic patterning of self-reported sleep problems in Britain. Soc Sci Med. 2009;68(2):281–9.
8. Patel NP, Grandner MA, Xie D, Branas CC, Gooneratne N. "Sleep disparity" in the population: poor sleep quality is strongly associated with poverty and ethnicity. BMC Public Health. 2010;10:475.
9. Grandner MA, Patel NP, Gehrman PR, Xie D, Sha D, Weaver T, et al. Who gets the best sleep? Ethnic and socioeconomic factors related to sleep complaints. Sleep Med. 2010;11(5):470–8. https://doi.org/10.1016/j.sleep.2009.10.006.
10. Jean-Louis G, Magai CM, Cohen CI, Zizi F, von Gizycki H, DiPalma J, et al. Ethnic differences in self-reported sleep problems in older adults. Sleep. 2001;24(8):926–33.
11. Ruel S, Savard J, Ivers H. Insomnia and self-reported infections in cancer patients: an 18-month longitudinal study. Health Psychol. 2015;34(10):983–91. https://doi.org/10.1037/hea0000181.
12. Stepanski EJ, Walker MS, Schwartzberg LS, Blakely LJ, Ong JC, Houts AC. The relation of trouble sleeping, depressed mood, pain, and fatigue in patients with cancer. J Clin Sleep Med. 2009;5(2):132–6.
13. Irwin MR. Depression and insomnia in cancer: prevalence, risk factors, and effects on cancer outcomes. Curr Psychiatry Rep. 2013;15(11):404. https://doi.org/10.1007/s11920-013-0404-1.
14. Zhou ES, Recklitis CJ. Insomnia in adult survivors of childhood cancer: a report from project reach. Support Care Cancer. 2014;22(11):3061–9. https://doi.org/10.1007/s00520-014-2316-y.
15. Trudel-Fitzgerald C, Zhou ES, Poole EM, Zhang X, Michels KB, Eliassen AH, et al. Sleep and survival among women with breast cancer: 30 years of follow-up within the nurses' health study. Br J Cancer. 2017;116:1239–46.
16. Irwin DE, Milsom I, Kopp Z, Abrams P, Group ES. Symptom bother and health care–seeking behavior among individuals with overactive bladder. Eur Urol. 2008;53(5):1029–39.
17. Savard J, Morin CM. Insomnia in the context of cancer: a review of a neglected problem. J Clin Oncol. 2001;19(3):895–908. https://doi.org/10.1200/JCO.2001.19.3.895.
18. Dahiya S, Ahluwalia MS, Walia HK. Sleep disturbances in cancer patients: underrecognized and undertreated. Cleve Clin J Med. 2013;80(11):722–32. https://doi.org/10.3949/ccjm.80a.12170.
19. Zhou ES, Partridge AH, Syrjala KL, Michaud AL, Recklitis CJ. Evaluation and treatment of insomnia in adult cancer survivorship programs. J Cancer Surviv. 2017;11(1):74–9. https://doi.org/10.1007/s11764-016-0564-1.
20. Garland SN, Johnson JA, Savard J, et al. Sleeping well with cancer: a systematic review of cognitive behavioral therapy for insomnia in cancer patients. Neuropsychiatr Dis Treat. 2014;10:1113–24. https://doi.org/10.2147/NDT.S47790.
21. Chen ML, Yu CT, Yang CH. Sleep disturbances and quality of life in lung cancer patients undergoing chemotherapy. Lung Cancer. 2008;62(3):391–400. https://doi.org/10.1016/j.lungcan.2008.03.016.
22. Dean GE, Abu Sabbah E, Yingrengreung S, Ziegler P, Chen H, Steinbrenner LM, et al. Sleeping with the enemy: sleep and quality of life in patients with lung cancer. Cancer Nurs. 2015;38(1):60–70. https://doi.org/10.1097/NCC.0000000000000128.
23. Yu S-Y, Nho J-H. Influence of sleep disturbance and depression on quality of life in ovarian cancer patients during chemotherapy. Asian Oncol Nurs. 2015;15(4):203–10.
24. Redeker NS, Lev EL, Ruggiero J. Insomnia, fatigue, anxiety, depression, and quality of life of cancer patients undergoing chemotherapy. Sch Inq Nurs Pract. 2000;14(4):275–90. discussion 91-8
25. Palesh OG, Roscoe JA, Mustian KM, Roth T, Savard J, Ancoli-Israel S, et al. Prevalence, demographics, and psychological associations of sleep disruption in patients with cancer: University of Rochester cancer center-community clinical oncology program. J Clin Oncol. 2010;28(2):292–8. https://doi.org/10.1200/JCO.2009.22.5011.
26. Zhou ES, Manley PE, Marcus KJ, Recklitis CJ. Medical and psychosocial correlates of insomnia symptoms in adult survivors of pediatric brain tumors. J Pediatr Psychol. 2016;41(6):623–30. https://doi.org/10.1093/jpepsy/jsv071.
27. Gooneratne NS, Dean GE, Rogers AE, Nkwuo JE, Coyne JC, Kaiser LR. Sleep and quality of life in long-term lung cancer survivors. Lung Cancer. 2007;58(3):403–10. https://doi.org/10.1016/j.lungcan.2007.07.011.
28. Otte JL, Carpenter JS, Russell KM, Bigatti S, Champion VL. Prevalence, severity, and correlates of sleep-wake disturbances in long-term breast cancer survivors. J Pain Symptom Manag. 2010;39(3):535–47. https://doi.org/10.1016/j.jpainsymman.2009.07.004.
29. Otte JL, Carpenter JS, Manchanda S, Rand KL, Skaar TC, Weaver M, et al. Systematic review of sleep disorders in cancer patients: can the prevalence of sleep disorders be ascertained? Cancer Med. 2015;4(2):183–200. https://doi.org/10.1002/cam4.356.
30. Savard J, Ivers H, Villa J, Caplette-Gingras A, Morin CM. Natural course of insomnia comorbid with cancer: an 18-month longitudinal study. J Clin Oncol. 2011;29(26):3580–6. https://doi.org/10.1200/JCO.2010.33.2247.
31. Davidson JR, MacLean AW, Brundage MD, Schulze K. Sleep disturbance in cancer patients. Soc Sci Med. 2002;54(9):1309–21.
32. Loscalzo M, Clark K, Dillehunt J, Rinehart R, Strowbridge R, Smith D. SupportScreen: a model for improving patient outcomes. J Natl Compr Cancer Netw. 2010;8(4):496–504.
33. Zabora JR, Loscalzo MJ, Weber J, editors. Managing complications in cancer: identifying and responding to the patient's perspective. Semin Oncol Nurs. 2003;19(2):1–9.
34. Loscalzo MJ, Clark KL. Problem-related distress in cancer patients drives requests for help: a prospective study. Oncology. 2007;21(9):1133–8.
35. Clark K, Bardwell WA, Arsenault T, DeTeresa R, Loscalzo M. Implementing touch-screen technology to enhance recognition of distress. Psychooncology. 2009;18(8):822–30. https://doi.org/10.1002/pon.1509.
36. Lowery AE, Greenberg MA, Foster SL, Clark K, Casden DR, Loscalzo M, et al. Validation of a needs-based biopsychosocial distress instrument for cancer patients. Psychooncology. 2012;21(10):1099–106. https://doi.org/10.1002/pon.2008.
37. Miller MF, Buzaglo JS, Clark KL, Loscalzo MJ, Kennedy V, Taylor J, et al. Demonstrating the psychometric properties of a problem-related distress screener in a community sample of 319 cancer survivors. Psychooncology. 2013;22(6):1249–57. https://doi.org/10.1002/pon.3124.
38. Zhou ES, Partridge AH, Recklitis CJ. A pilot trial of brief group cognitive-behavioral treatment for insomnia in an adult cancer survivorship program. Psychooncology. 2017;26(6):843–8. https://doi.org/10.1002/pon.4096.
39. Savard J, Savard M-H. Insomnia and cancer: prevalence, nature, and nonpharmacologic treatment. Sleep Med Clin. 2013;8(3):373–87.
40. Morin CM, LeBlanc M, Daley M, Gregoire JP, Merette C. Epidemiology of insomnia: prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. Sleep Med. 2006;7(2):123–30. https://doi.org/10.1016/j.sleep.2005.08.008.

41. Ohayon MM, Caulet M, Priest RG, Guilleminault C. DSM-IV and ICSD-90 insomnia symptoms and sleep dissatisfaction. Br J Psychiatry. 1997;171(4):382–8.
42. Zhang B, Wing YK. Sex differences in insomnia: a meta-analysis. Sleep. 2006;29(1):85–93.
43. McLean CP, Asnaani A, Litz BT, Hofmann SG. Gender differences in anxiety disorders: prevalence, course of illness, comorbidity and burden of illness. J Psychiatr Res. 2011;45(8):1027–35. https://doi.org/10.1016/j.jpsychires.2011.03.006.
44. Kuehner C. Gender differences in unipolar depression: an update of epidemiological findings and possible explanations. Acta Psychiatr Scand. 2003;108(3):163–74.
45. Barsky AJ, Peekna HM, Borus JF. Somatic symptom reporting in women and men. J Gen Intern Med. 2001;16(4):266–75.
46. Khan AA, Gardner CO, Prescott CA, Kendler KS. Gender differences in the symptoms of major depression in opposite-sex dizygotic twin pairs. Am J Psychiatry. 2002;159(8):1427–9. https://doi.org/10.1176/appi.ajp.159.8.1427.
47. Johnson EO, Roth T, Breslau N. The association of insomnia with anxiety disorders and depression: exploration of the direction of risk. J Psychiatr Res. 2006;40(8):700–8. https://doi.org/10.1016/j.jpsychires.2006.07.008.
48. Taylor DJ, Lichstein KL, Durrence HH, Reidel BW, Bush AJ. Epidemiology of insomnia, depression, and anxiety. Sleep. 2005;28(11):1457–64.
49. Goodwin PJ, Ennis M, Pritchard KI, Trudeau M, Hood N. Risk of menopause during the first year after breast cancer diagnosis. J Clin Oncol. 1999;17(8):2365–70. https://doi.org/10.1200/JCO.1999.17.8.2365.
50. Savard J, Davidson JR, Ivers H, Quesnel C, Rioux D, Dupéré V, et al. The association between nocturnal hot flashes and sleep in breast cancer survivors. J Pain Symptom Manag. 2004;27(6):513–22.
51. Durrence HH, Lichstein KL. The sleep of African Americans: a comparative review. Behav Sleep Med. 2006;4(1):29–44. https://doi.org/10.1207/s15402010bsm0401_3.
52. Ruiter ME, Decoster J, Jacobs L, Lichstein KL. Normal sleep in African-Americans and Caucasian-Americans: a meta-analysis. Sleep Med. 2011;12(3):209–14. https://doi.org/10.1016/j.sleep.2010.12.010.
53. Mezick EJ, Matthews KA, Hall M, Strollo PJ Jr, Buysse DJ, Kamarck TW, et al. Influence of race and socioeconomic status on sleep: Pittsburgh sleepscore project. Psychosom Med. 2008;70(4):410–6. https://doi.org/10.1097/PSY.0b013e31816fdf21.
54. Hall MH, Matthews KA, Kravitz HM, Gold EB, Buysse DJ, Bromberger JT, et al. Race and financial strain are independent correlates of sleep in midlife women: the SWAN sleep study. Sleep. 2009;32(1):73–82.
55. Karacan I, Thornby JI, Anch M, Holzer CE, Warheit GJ, Schwab JJ, et al. Prevalence of sleep disturbance in a primarily urban Florida county. Soc Sci Med. 1976;10(5):239–44.
56. Pigeon WR, Heffner K, Duberstein P, Fiscella K, Moynihan J, Chapman BP. Elevated sleep disturbance among blacks in an urban family medicine practice. J Am Board Fam Pract. 2011;24(2):161–8.
57. Gold EB, Sternfeld B, Kelsey JL, Brown C, Mouton C, Reame N, et al. Relation of demographic and lifestyle factors to symptoms in a multi-racial/ethnic population of women 40-55 years of age. Am J Epidemiol. 2000;152(5):463–73.
58. Chen X, Wang R, Zee P, Lutsey PL, Javaheri S, Alcántara C, et al. Racial/ethnic differences in sleep disturbances: the multi-ethnic study of atherosclerosis (MESA). Sleep. 2015;38(6):877–88. https://doi.org/10.5665/sleep.4732.
59. Loredo JS, Soler X, Bardwell W, Ancoli-Israel S, Dimsdale JE, Palinkas LA. Sleep health in US Hispanic population. Sleep. 2010;33(7):962–7.
60. Morphy H, Dunn KM, Lewis M, Boardman HF, Croft PR. Epidemiology of insomnia: a longitudinal study in a UK population. Sleep. 2007;30(3):274–80.
61. Ohayon MM, Smirne S. Prevalence and consequences of insomnia disorders in the general population of Italy. Sleep Med. 2002;3(2):115–20.
62. Hohagen F, Kappler C, Schramm E, Riemann D, Weyerer S, Berger M. Sleep onset insomnia, sleep maintaining insomnia and insomnia with early morning awakening—temporal stability of subtypes in a longitudinal study on general practice attenders. Sleep. 1994;17(6):551–4.
63. Lavie P. Sleep habits and sleep disturbances in industrial workers in Israel: main findings and some characteristics of workers complaining of excessive daytime sleepiness. Sleep. 1980;4(2):147–58.
64. Leger D, Guilleminault C, Dreyfus JP, Delahaye C, Paillard M. Prevalence of insomnia in a survey of 12,778 adults in France. J Sleep Res. 2000;9(1):35–42.
65. Hall M, Buysse DJ, Nowell PD, Nofzinger EA, Houck P, Reynolds CF III, et al. Symptoms of stress and depression as correlates of sleep in primary insomnia. Psychosom Med. 2000;62(2):227–30.
66. Cho YW, Shin WC, Yun CH, Hong SB, Kim J, Earley CJ. Epidemiology of insomnia in korean adults: prevalence and associated factors. J Clin Neurol. 2009;5(1):20–3. https://doi.org/10.3988/jcn.2009.5.1.20.
67. Gellis LA, Lichstein KL, Scarinci IC, Durrence HH, Taylor DJ, Bush AJ, et al. Socioeconomic status and insomnia. J Abnorm Psychol. 2005;114(1):111–8. https://doi.org/10.1037/0021-843X.114.1.111.
68. Cairney J, Arnold R. Social class, health and aging: socioeconomic determinants of self-reported morbidity among the noninstitutionalized elderly in Canada. Can J Public Health. 1995;87(3):199–203.
69. Sutton DA, Moldofsky H, Badley EM. Insomnia and health problems in Canadians. Sleep. 2001;24(6):665–70.
70. Innominato PF, Spiegel D, Ulusakarya A, Giacchetti S, Bjarnason GA, Lévi F, et al. Subjective sleep and overall survival in chemotherapy-naïve patients with metastatic colorectal cancer. Sleep Med. 2015;16(3):391–8. https://doi.org/10.1016/j.sleep.2014.10.022.
71. Johnson EO. Sleep in america: 1999. Results from the National Sleep. Foundations. 1999;
72. Morin CM, LeBlanc M, Belanger L, Ivers H, Merette C, Savard J. Prevalence of insomnia and its treatment in canada. Can J Psychiatr. 2011;56(9):540–8. https://doi.org/10.1177/070674371105600905.
73. Brinkman TM, Zhang N, Recklitis CJ, Kimberg C, Zeltzer LK, Muriel AC, et al. Suicide ideation and associated mortality in adult survivors of childhood cancer. Cancer. 2013;120(2):271–7. https://doi.org/10.1002/cncr.28385.
74. National Comprehensive Cancer Network. NCCN clinical practice guidelines in oncology: survivorship. 2015.