Sleep Medicine 109 (2023) 293–299

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Understanding sleep quality in a national cohort of young adult cancer survivors: Results from the YACPRIME study

Sheila N. Garland [a,b,*], Joshua Tulk [a], Riley Cotter [a], Eric S. Zhou [c,d], Lauren C. Daniel [e], Fiona S.M. Schulte [f], Jacqueline L. Bender [g], Karine Chalifour [h], Geoff Eaton [h]

[a] Department of Psychology, Faculty of Science, Memorial University, St. John's, Newfoundland and Labrador, Canada
[b] Discipline of Oncology, Faculty of Medicine, Memorial University, St. John's, Newfoundland and Labrador, Canada
[c] Division of Sleep Medicine, Harvard Medical School, Boston, MA, USA
[d] Psychosocial Oncology and Palliative Care, Dana-Farber Cancer Institute, Boston, MA, USA
[e] Department of Psychology and Health Sciences, Rutgers University, Camden, NJ, USA
[f] Department of Oncology, Division of Psychosocial Oncology, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada
[g] Department of Supportive Care, Princess Margaret Cancer Centre, University Health Network, 585 University Avenue, Toronto, Ontario, Canada
[h] Young Adult Cancer Canada, St. John's, Newfoundland and Labrador, Canada

ARTICLE INFO

Keywords:
Young adults
Cancer
Insomnia
Sleep quality
Sleep medication
Distress

ABSTRACT

Purpose: A cancer diagnosis in young adulthood can negatively impact sleep quality. The present study describes sleep issues in young adults (YAs) and analyzes potential demographic and clinical characteristics related to sleep quality.

Methods: Canadian YAs (n = 359) diagnosed with cancer between ages 15–39 participated in the study. Pittsburgh Sleep Quality Index (PSQI) items were examined to identify specific sleep issues that occurred 3+ times per week. Logistic regression was used to examine demographic, clinical, and symptom-related variables associated with poor sleep quality (defined as a PSQI global score >8) and sleep medication use.

Results: Participants were predominantly female (87.5%) with an average age of 32 years. Of the sample, 52% had poor sleep quality, 55.5% took >30 min to fall asleep, 32.9% slept <7 h, and 54.6% reported a habitual sleep efficiency of <85%. YAs with poor sleep quality were 5.7 times more likely to report severe distress (p=<.001), as well as 1.8 times more likely to report poorer mental (p = .03) and physical functioning (p = .05). Nearly half (44%) of YAs used sleep medication to help them sleep. YAs who reported severe psychological distress were 2.4 times more likely to use sleeping medication (p = .01), whereas those with a household income ≥$100,000/year were half as likely to use medication to help with sleep (p = .04).

Conclusion: Psychological distress is associated with worse sleep quality and sleep medication use in YA cancer survivors. Sleep quality may be a possible target for future research and intervention to promote long-term function and recovery.

1. Background

In Canada, approximately 4.1% of all cancer diagnoses annually are in young adults (YAs) between 15 and 39 years of age (about 8,200 individuals) [1]. Survival rates in this population are relatively high with over 80% of YAs living for at least 5 years after their cancer diagnosis [2], meaning there is a large population of YA survivors of cancer. Given the significant disruptions that a cancer diagnosis and subsequent treatment can have on the numerous important developmental milestones that occur in this period, there is an increased urgency to address the many physical and psychological late effects of their cancer-directed therapies [3].

Sleep quality is a multidimensional concept [4]. Poor sleep quality, disrupted, extended or insufficient sleep, problems with the initiation and maintenance of sleep, poor sleep timing, and excessive daytime sleepiness may represent a clinically diagnosable sleep disorder and are common issues among YA cancer survivors. In a sample of 2,045 YAs within 6 months of their cancer diagnosis, sleep problems were the third most prevalent patient-reported domain of concern reported by 35% of YAs, preceded only by fear and worry (57%) and understanding of

* Corresponding author. Department of Psychology, Faculty of Science, Memorial University, St. John's, Newfoundland and Labrador, Canada.
E-mail address: sheila.garland@mun.ca (S.N. Garland).

https://doi.org/10.1016/j.sleep.2023.07.017
Received 26 May 2023; Received in revised form 10 July 2023; Accepted 17 July 2023
Available online 21 July 2023

illness (48%) [5]. The presence of sleep issues in YAs increases their likelihood of experiencing other symptoms. YA cancer survivors reporting poor sleep are more likely to experience worse fatigue and mood symptoms [6,7], neurocognitive issues [8], and decrements to their physical and mental quality of life [9,10].

Despite the relevance of sleep to YA cancer survivors' quality of life, only a handful of studies have examined this issue. This research has been limited by small sample sizes [9,10], samples where YAs were diagnosed with cancer in childhood [7,8,11,12], and samples that did not include the full YA age range (i.e., restricting the upper age limit to 24) [13]. Furthermore, little is known about the management of sleep problems in cancer survivors, including the use of sleep medications. Given the importance of understanding sleep during what has been described as one of the most critical stages of development [14], the present study sought to describe the sleep typically experienced by YA cancer survivors and examine the association between sleep quality, sleep medication use, and relevant psychosocial, clinical, and cancer-related variables.

2. Method

2.1. Participants

The present study utilized data collected in the Young Adults with Cancer in their Prime (YACPRIME) study. To be eligible for the study, YAs needed to be Canadian residents diagnosed with any cancer between ages 15 and 39, regardless of time since diagnosis or treatment status, and be at least 18 years of age to comply with Memorial University's Interdisciplinary Committee on Ethics in Human Research (ICEHR) policy. Of the 622 respondents, only individuals diagnosed with cancer within the 10 years prior to the survey's completion and those currently aged ≤39 years were included in the present sample (n = 474). This inclusion criterion was added since members of the sample greater than 10 years post-diagnosis were statistical outliers. Finally, 115 participants who completed the YACPRIME study but did not fully complete the PSQI were removed from analyses, resulting in a final analytic sample of 359 YA cancer survivors.

2.2. Procedure

The YACPRIME study was completed in collaboration with Young Adult Cancer Canada (YACC), a non-profit organization that cultivates a national network of young adults affected by cancer across Canada. YACC helped to recruit participants through emails, social media posts, and online advertisements. Participants were also recruited through referrals from healthcare providers. The YACPRIME study was conducted online as a one-time survey that was completed between June 2017 and March 2018 and received ethics approval from Memorial University's Interdisciplinary Committee on Ethics in Human Research (ICEHR).

2.3. Measures

2.3.1. Sleep quality

The dependent variable for the study was participants' perceived sleep quality, as measured by the Pittsburgh Sleep Quality Index (PSQI) [15]. The PSQI assesses subjective sleep quality over the month prior to completion and allows the assessor to measure a myriad of qualities contributing to overall sleep quality such as sleep efficiency (SE), sleep onset latency (SOL), sleep duration, and sleep disruptions. The PSQI global score is calculated on a scale from 0 (no difficulty in all areas) to 21 (extreme difficulty in all areas) by adding together all the participant's subscale scores. These subscales [subjective sleep quality, SOL, habitual SE, sleep duration, sleep disturbances, sleep medication use, and daytime dysfunction] are individually measured on a scale from 0 (no problem at all) to 3 (extreme difficulty). In the general population, PSQI global scores >5 indicate poor sleep quality [15], however, a cut-off of >8 has been suggested for cancer survivors [16]. The PSQI has been used in previous studies with YAs and other individuals with cancer [6,16,17].

2.3.2. Psychological distress

The Kessler Psychological Distress Scale-10 item version (K10) was used to measure participants' non-specific psychological distress in the previous month [18]. Items are rated on a 5-point Likert scale and summed to create a total score ranging from 10 to 50. Total scores <20 indicate no distress, scores from 20 to 24 suggest mild distress, 25–29 moderate distress, and scores of 30 or greater indicate severe distress [18]. The K10 has previously been used in YAs with cancer [19,20].

2.3.3. Physical and mental health-related quality of life

The Short-Form Health Survey 12 (SF-12) assessed participants' perceived physical and mental health over the four weeks prior to the survey [21]. The SF-12 is comprised of two subcomponents—the physical component score (PCS) and mental component score (MCS)—that measure physical and mental-health related concerns. This measure includes assessments of overall health and whether health-related troubles have impacted one's ability to perform daily functioning. Both measures are scored on a scale of 0-100, where PCS <50 indicates poor physical health and MCS <42 indicates poor mental health [21]. The SF-12 has been effectively used in previous studies to assess the health-related quality of life in YAs with cancer [22,23].

2.3.4. Demographic and cancer-related information

Participants self-reported demographic (i.e., age, gender, household income, relationship status, sexuality) and clinical data (i.e., time since cancer diagnosis, cancer recurrence status, and cancer treatment status) as part of the YACPRIME survey.

2.4. Data analysis

Descriptive statistics were used to describe the sample's demographic, clinical, and cancer-related characteristics. Poor global sleep quality was defined by overall PSQI scores >8, insufficient sleep duration was defined by those reporting <7 h of sleep on an average night, poor sleep efficiency was indicated in those reporting <85% sleep efficiency, and problematic sleep latency was indicated by a SOL >30 min [15,24-26]. Frequency statistics on individual items of the PSQI were used to determine the most frequent and pertinent sleep issues. Issues that had not occurred over the last month or occurred less than once per week were categorized as "not a problem." Issues that occurred two to three times a week were categorized as a "mild problem," whereas stating that the issue occurred three or more times a week was categorized as a "moderate to severe problem."

To determine the factors associated with poor sleep and medication use, independent variables (i.e., clinical, demographic, and cancer-related characteristics) were entered into univariable binomial logistic regression models. Covariates yielding associations with p values <.10 were subsequently entered into multivariable models. Multicollinearity between variables was assessed and variance inflation factors were under 4, suggesting minimal collinearity. All statistical analyses were conducted with SPSS version 27, where $p < .05$ indicated significance.

2.4.1. Missing data

Not including those who were excluded for not completing the PSQI, the percentage of missing values was 12.3%; however, those participants with missing data did not noticeably differ according to other clinical or demographic variables. Participants were allowed to skip any questions they did not want to answer and participants with missing data tended to skip the questions presented later in the survey. Little's (1988) Missing Completely at Random (MCAR) test was significant, $\chi^2(2, N = 359) = 6.6, p = .037$, and data were assumed to be missing at

random. Maximum likelihood estimation was used to create a single, complete dataset for this study. Incomplete outcome variables were imputed using the Expectation-Maximization (EM) algorithm in the Missing Values Analysis package for SPSS version 27 set to 50 iterations. Maximum likelihood-based methods were chosen for this study as they perform better than multiple imputation under the missing at random assumption [27].

3. Results

The average age of the sample was 32.1 (SD = 4.7) years, and predominantly female (87.5%), white (87.5%), and heterosexual (86.9%). Most participants (28.1%) were diagnosed with a hematological malignancy (e.g., leukemia, lymphoma, myeloma), followed by breast cancer (25.3%). The average time since diagnosis was 2.5 years (SD = 2.4), most of the sample was not on treatment at the time of the survey (66.3%), and the majority had not experienced a cancer recurrence (83.0%). Further, 50.8% of the sample reported moderate or severe levels of distress and over two-thirds had relatively poor mental (65.5%) and physical health (73.5%). Table 1 provides additional descriptive characteristics of the sample.

The average global score on the PSQI was 8.9 (SD = 4.0), and 52.4% of the sample reported a total score >8. However, if the less conservative PSQI cut-off of >5 was used, 78.8% would be classified as having poor sleep quality. Among respondents, 55.5% of the sample took more than 30 min to fall asleep. The sample reported an average sleep duration of around 7 h ($M = 7.2$, $SD = 1.5$); however, 32.9% of the sample slept less than 7 h and 13.9% reported sleeping 9 or more hours. Further, 54.6% of the sample reported a habitual sleep efficiency less than 85% ($M = 80.7$, $SD = 13.5$). To supplement the information provided by these sleep characteristics, PSQI subscales were analysed to indicate the most pertinent issues for the sample. As illustrated in Fig. 1, waking up too early (45.8%) and trouble falling asleep (31.7%) were among the issues most frequently classified as moderate-severe. Waking up to go to the bathroom was also reported as a moderate-to-severe problem by 44% of the sample.

Separate univariable binomial logistic regression models identified significant independent factors associated with poor sleep quality (see Table 2 for complete univariable analysis). Significant factors at the univariable level were entered into a multivariable regression model. The logistic regression model was significant ($\chi^2(17) = 81.62, p = 001$), with the included predictors explaining 28.8% of the variance in sleep quality (Nalgelkerke R^2). The Hosmer-Lemeshow test was not significant ($\chi^2(8) = 12.16, p = .144$) suggesting that the model was a good fit. The multivariable model correctly identified 67.3% of cases; sensitivity was 70.9%, and specificity was 63.1%, while the positive and negative predictive values were 68.6% and 65.6%, respectively. After adjusting for other covariates, participants who reported severe distress were at close to 6 times greater odds of experiencing poor sleep quality (adjusted odds ratio [AOR] = 5.73 [2.59,12.68], p=<.001). Likewise, participants with poor mental (AOR = 1.87 [1.05,3.34], $p = .03$) or physical health (AOR = 1.84 [1.01,3.37], $p = .05$) were almost twice as likely to experience poor sleep quality than participant with good health. At the multivariable level, education, employment status, household income, treatment status, and metastasis were no longer significantly associated with sleep quality. Sensitivity analyses revealed that using a lower cut-off for sleep quality (i.e., PSQI score >5) produces similar, but less efficient (i.e., wider confidence intervals), results compared to using a higher cut-off (i.e., PSQI score >8).

Sleep medication use was reported by 45.4% of the sample; 20.1% reported using sleeping medication three or more times per week, 11.7% used medication to help with sleep one to two times per week and 13.6% reported using medications less than once per week. Significant univariable predictors of sleep medication use were entered simultaneously into the multivariable logistic regression model (see Table 3 for complete univariable analysis). The logistic regression model was significant

Table 1
Descriptive statistics for demographic, clinical, and patient-reported outcomes of young adults diagnosed with cancer (N = 359).

Variable		N (%)
Demographic variables		
Age (years)	*M* (*SD*)	32.12 (4.7)
	20–29	93 (25.9)
	30–39	266 (74.1)
Gender	Female	314 (87.5)
	Male	45 (12.5)
Sexuality	Heterosexual	312 (86.9)
	Queer/non-heterosexual	47 (13.1)
Education	*M* (*SD*)	17.10 (3.09)
	<14 years	36 (10.0)
	14–18 years	211 (58.8)
	≥19 years	103 (28.7)
Employment status	Not working or in school	146 (40.7)
	In school	25 (7.0)
	Working	188 (52.4)
Relationship status	Single	115 (32.0)
	In a relationship[a]	244 (68.0)
Children	None	238 (66.3)
	One or more	121 (33.7)
Race/ethnicity	White	314 (87.5)
	BIPOC[b]	45 (12.5)
Household income	<$20,000	70 (19.5)
	$20,000 to <$40,000	41 (11.4)
	$40,000 to <$60,000	35 (9.7)
	$60,000 to <$80,000	46 (12.8)
	$80,000 to <$100,000	45 (12.5)
	$100,000 or more	108 (30.1)
Clinical variables		
Cancer type	Breast	91 (25.3)
	Genitourinary	47 (13.1)
	Thyroid	35 (9.7)
	Hematological	101 (28.1)
	Brain	28 (7.8)
	Gastrointestinal	25 (7.0)
	Other[c]	34 (21.8)
Cancer Stage	Stage 1	48 (13.4)
	Stage 2	108 (30.1)
	Stage 3	75 (20.9)
	Stage 4	38 (10.6)
	No stage	55 (15.3)
Time since diagnosis (years)	*M* (*SD*)	2.45 (2.4)
	<1 year	88 (24.5)
	1–2 years	73 (20.3)
	2–5 years	126 (35.1)
	≥5 years	72 (20.1)
Treatment status	Not on treatment	238 (66.3)
	On treatment	121 (33.7)
Cancer recurrence	No recurrence	298 (83.0)
	Had a cancer recurrence	61 (17.0)
Metastasis	No metastasis	284 (79.1)
	Unsure	30 (8.4%)
	Metastasis	45 (12.5)
Outcome variables		
Psychological Distress (K10)	*M* (*SD*)	24.74 (7.5)
	No distress	96 (26.7)
	Mild distress	90 (25.1)
	Moderate distress	78 (21.7)
	Severe distress	92 (25.6)
Mental health (SF-12 MHC)	*M*(*SD*)	33.83 (16.2)
	Good health	124 (34.5)
	Poor health	235 (65.5)
Physical health (SF-12 PHC)	*M*(*SD*)	37.57 (16.7)
	Good health	95 (26.5)
	Poor health	264 (73.5)

[a] Includes common law, married, and in a committed relationship; single includes divorces, widowed, and single.
[b] BIPOC=Black, indigenous, or a person of color.
[c] Other cancer types includes skin, head & neck, and other rare cancers not covered by other categories.

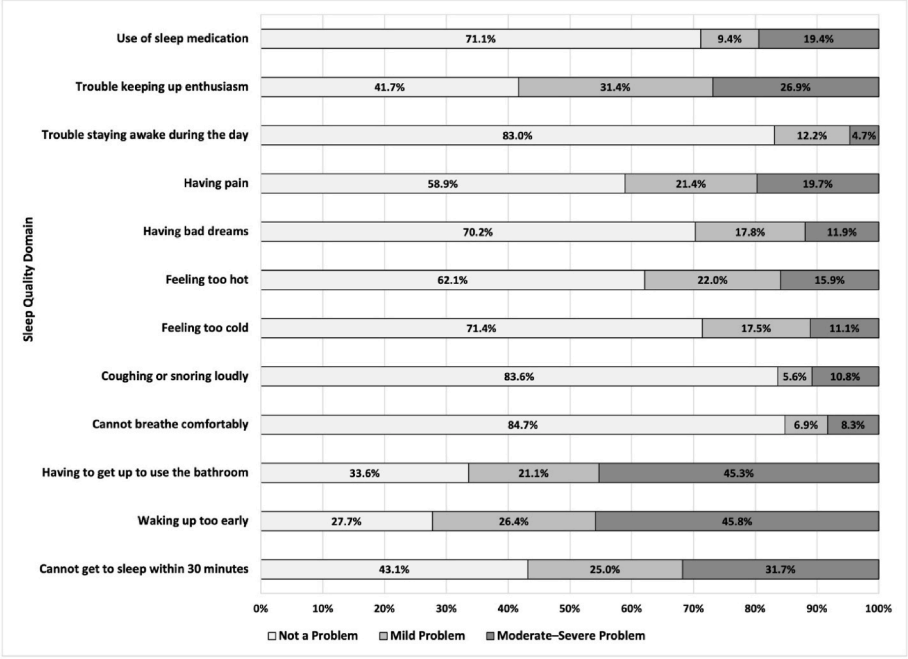

Fig. 1. Presence of Specific Sleep Issues Among Respondents according to Individual PSQI Items
Note. "Not a problem" indicates that a participant reported that the issue did not occur at all in the last month, "mild problem" indicates that the problem occurred less than once a week or once to twice a week, and "moderate-severe problem" states that the problem occurred three or more times a week.

($\chi^2(13) = 30.51$, $p = .004$) and these predictors explained 11.3% of the variance in sleep medication use. The Hosmer and Lemeshow test was not significant ($\chi^2(8) = 10.49$,$p = .232$), suggesting the model was a good fit. The regression model correctly predicted 61.7% of cases; sensitivity was 44.7%, specificity was 75.1%, the positive predictive value was 58.6%, and negative predictive value was 63.3%. At the multivariable level, participants who used sleep medication were more likely to report severe psychological distress (AOR = 2.43 [1.22,4.86], p=.01). Conversely, participants with personal incomes of ≥$100,000 annually were less likely to report sleep medication use (AOR = 0.49 [0.25,0.96], $p = .04$. Health-related quality of life, treatment, and disease status were no longer associated with medication use at the multivariable level.

4. Discussion

The development and solidification of sleep habits in young adulthood may influence health throughout adulthood. This study is the first to describe and examine the association between sleep quality, sleep medication use, and relevant psychosocial, clinical, and cancer-related variables in a large sample of YA cancer survivors and addresses the limitations of previous research by using the full AYA age range. More than half of YA cancer survivors in our sample reported clinically significant issues concerning their sleep. When examining their symptom presentation, more than half of the sample took longer than 30 min to fall asleep and had poor sleep efficiency, and close to one-third slept fewer than 7 h. These domains when assessed together are suggestive of insomnia disorder. Insomnia in cancer survivors has been associated with increased risk of developing infections [28,29]; cognitive impairments [30] and mood disturbances [31]; increased severity of pain and fatigue [32]; and reduced quality of life [33,34]. Some cancer survivors have reported being more overwhelmed by insomnia and resulting sequelae than from cancer treatment itself [35].

Consistent with other research, nocturnal urination was a common experience that negatively impacted the sleep quality of 44% of respondents [34]. In a sample of 1026 mixed-site older aged ($M_{age} = 58$) cancer patients, 77% reported problems with having to go to the bathroom in the middle of the night. In our sample, this may a consequence of spending more time in a lighter sleep stage when one is more likely to be aware of pressure in the bladder, whereas age-related changes may have been a factor in the sample of older cancer survivors. Notably, one-fifth of the sample were also regularly taking a medication to aid with sleep. In comparison, estimates suggest that 8.4% adults in the United States took sleep medication in the last 30 days either every day or most days to help them fall or stay asleep [36]. Sleep medication use has been associated with reduced life expectancy [37]. On average, the life expectancy of individuals who used sleeping pills was 5.3 years shorter for men and 5.7 years shorter for women. As such, using sleep medications in early adulthood may have significant longer-term health ramifications for YA cancer survivors.

Health-related factors showed the greatest association with sleep quality when considered with other relevant variables. The strongest association was found between psychological distress and poor sleep quality where those who reported severe levels of distress were close to 6 times more likely to report poor sleep quality. Distress levels were also the strongest factors associated with insomnia symptoms in YA cancer survivors during the COVID-19 pandemic in the months of January and February 2021 [38]. Prior research has identified that YA cancer survivors who are unemployed, in school, have high body image dissatisfaction, fear of cancer recurrence, and poor social support may be more likely to experience distress [20].

Insomnia and poor sleep quality has historically been thought of as a consequence of psychological distress; however, prospective research demonstrates that insomnia severity, particularly difficulties falling asleep, predicts first onset of major depressive disorder [39]. Major depressive disorder is the leading cause of disability worldwide [40] and the prevalence of depression in people diagnosed with cancer is even higher [41]. A diagnosis of cancer can provoke the occurrence of depression during the first 2 years after diagnosis [42]. Even when depression is successfully treated, persistent insomnia symptoms can influence the likelihood of a depressive relapse [43]. Sleep disturbance has a unique prospective role in occurrence, recurrence, and persistence of depression. This finding is pertinent considering the strength and bidirectionality of the relationship [44]. Improving sleep quality is

Table 2
Factors associated with poor sleep quality in young adults diagnosed with cancer.

		Univariable Logistic Regression		Multivariable Logistic Regression	
		Odds ratio [95% CI]	*p*	Adjusted odds ratio [95% CI]	*p*
Age	20–29 years (ref)	1			
	30–39 years	1.48 [0.92,2.37]	.11		
Gender	Female (ref)	1			
	Male	0.77 [0.41,1.44]	.41		
Education	<14 years (ref)	1		1	
	14–18 years	0.54 [0.25,1.15]	.11	0.77 [0.31,1.92]	.57
	≥19 years	0.33 [0.15,0.74]	**.01**	0.50 [0.19,1.33]	.16
Employment Status	Not working or in school (ref)	1		1	
	In school	0.68 [0.29,1.61]	.39	0.83 [0.30,2.29]	.72
	Working	0.39 [0.25,0.61]	**<.001**	0.65 [0.36,1.14]	.13
Relationship Status	Single (ref)	1			
	In a relationship	0.87 [0.56,1.35]	.53		
Number of Children	None (ref)	1			
	One or more children	1.14 [0.74,1.77]	.56		
Household Income	<$20,000 (ref)	1		1	
	$20,000 to <$40,000	0.96 [0.44,2.09]	.92	0.74 [0.29,1.86]	.52
	$40,000 to <$60,000	1.13 [0.49,2.57]	.78	1.08 [0.41,2.88]	.88
	$60,000 to <$80,000	1.17 [0.55,2.49]	.69	1.99 [0.80,4.99]	.14
	$80,000 to <$100,000	1.24 [0.57,2.66]	.59	1.66 [0.66,4.19]	.29
	$100,000 or more	0.48 [0.26,0.88]	**.02**	0.68 [0.32,1.43]	.31
Time Since Diagnosis	<1 year (ref)	1			
	1–2 years	1.09 [0.58,2.04]	.79		
	2–5 years	0.69 [0.40,1.20]	.19		
	≥5 years	0.72 [0.39,1.34]	.30		
Cancer Stage	Stage 1 (ref)	1			
	Stage 2	1.10 [0.55,2.18]	.79		
	Stage 3	0.92 [0.44,1.90]	.81		
	Stage 4	0.62 [0.26,1.45]	.27		
	No stage	0.88 [0.40,1.91]	.74		
Treatment Status	Not on treatment (ref)	1		1	
	On treatment	1.71 [1.10,2.67]	**.02**	1.53 [0.86,2.72]	.14
Cancer recurrence	No recurrence (ref)	1			
	Had a recurrence	1.18 [0.68,2.05]	.56		
Metastasis	No metastasis (ref)	1		1	
	Unsure	2.40 [1.06,5.42]	**.04**	1.54 [0.55,4.35]	.41
	Metastasis	1.54 [0.81,2.93]	.18	0.84 [0.38,1.90]	.68
Distress	No distress (ref)	1		1	
	Mild distress (K10 20–24)	1.84 [1.01,3.35]	**.05**	1.51 [0.76,3.01]	.24
	Moderate distress (K10 25–29)	2.57 [1.38,4.77]	**.003**	1.40 [0.65,3.01]	.39
	Severe (K10 ≥30)	9.71 [4.91,19.17]	**<.001**	5.73 [2.59,12.68]	**<.001**
Mental Health	Good health (ref; SF12MHC ≥43)	1		1	
	Poor health (SF12MHC ≤42)	2.46 [1.57,3.84]	**<.001**	1.87 [1.05,3.34]	**.03**
Physical Health	Good health (ref; SF12PHC ≥51)	1		1	
	Poor health (SF12PHC ≤50)	2.22 [1.38,3.60]	**.001**	1.84 [1.01,3.37]	**.05**

Note: Bold indicates statistical significance.

particularly relevant because of its potential to improve physical and mental health-related correlates.

Of note, there were several factors that were not associated with sleep quality in the sample, despite previous research suggesting relevant associations. Namely, gender, sexual orientation, and race/ethnicity were not associated with sleep quality [45,46]. In the present study, males, queer people, and those with racial and ethnic identities other than white were underrepresented by the sample, meaning it is possible that differences in sleep quality across these demographic variables may have been undetectable or understated. Future research should pay specific attention to various factors associated with sleep in under-represented groups to better understand the sleep experiences of these YAs with cancer. Further, we did not find an association between any cancer-related variables and sleep quality. This finding is consistent with other research suggesting that factors such as time since diagnosis, treatment status, and recurrence status are not as relevant to sleep quality as are the physical and mental health effects of a cancer experience [47]. However, the current study did not include analysis of specific clinical characteristics such as different treatment types (e.g., hormonal therapy), which have previously been associated with poor sleep [32]. Further research is needed to better understand the nuances in sleep among YAs with cancer based on cancer and treatment-related characteristics.

There are existing guidelines in Canada and the United States for the prevention, screening, assessment, and treatment of sleep disturbances in adults with cancer [48,49]. Despite these guidelines, actual practice falls far short with estimates suggesting that less than 50% of patients treated in National Comprehensive Cancer Network (NCCN) designated cancer centers receive optimal insomnia-related care screening and few clinicians providing survivorship care were well-prepared to conduct a

Table 3
Factors associated with sleep medication use in young adults diagnosed with cancer.

		Univariable Logistic Regression		Multivariable Logistic Regression	
		Odds ratio [95% CI]	*p*	Adjusted odds ratio [95% CI]	*p*
Age	20–29 years (ref)	1			
	30–39 years	1.244 [0.77,2.01]	.37		
Gender	Female (ref)	1			
	Male	0.84 [0.44,1.59]	.59		
Education	<14 years (ref)	1			
	14–18 years	1.04 [0.51,2.13]	.91		
	≥19 years	1.12 [0.52,2.44]	.76		
Employment Status	Not working or in school (ref)	1			
	In school	0.83 [0.35,1.95]	.67		
	Working	0.70 [0.45,1.09]	.11		
Relationship Status	Single (ref)	1			
	In a relationship	0.71 [0.45,1.10]	.13		
Number of Children	None (ref)	1			
	One or more children	0.78 [0.50,1.21]	.27		
Household Income	<$20,000 (ref)	1		1	
	$20,000 to <$40,000	0.73 [0.34,1.58]	.42	0.63 [0.28,1.44]	.27
	$40,000 to <$60,000	0.44 [0.19,1.02]	**.06**	0.42 [0.17, 1.03]	.06
	$60,000 to <$80,000	1.00 [0.48,2.12]	.99	1.23 [0.55,2.73]	.62
	$80,000 to <$100,000	0.67 [0.32,1.43]	.30	0.69 [0.31,1.55]	.37
	$100,000 or more	0.46 [0.25,0.85]	**.01**	0.49 [0.25.0.96]	**.04**
Time Since Diagnosis	<1 year (ref)	1			
	1–2 years	1.46 [0.78,2.74]	.24		
	2–5 years	1.40 [0.80,2.43]	.24		
	≥5 years	1.07 [0.57,2.03]	.83		
Cancer Stage	Stage 1 (ref)	1			
	Stage 2	1.37 [0.68,2.73]	.38		
	Stage 3	1.08 [0.51,2.25]	.85		
	Stage 4	1.53 [0.65, 3.61]	.34		
	No stage	1.18 [0.54,2.60]	.68		
Treatment Status	Not on treatment (ref)	1		1	
	On treatment	1.66 [1.07, 2.59]	**.02**	1.59 [0.96, 2.65]	.07
Cancer recurrence	No recurrence (ref)	1			
	Had a recurrence	1.30 [0.75, 2.26]	.35		
Metastasis	No metastasis (ref)	1		1	
	Unsure	1.08 [0.50, 2.30]	.85	0.78 [0.33,1.85]	.58
	Metastasis	1.93 [1.02,3.64]	**.04**	1.50 [0.73,3.07]	.27
Distress	No distress (ref)	1		1	
	Mild distress (K10 20–24)	1.68 [0.92,3.07]	**.09**	1.45 [0.75,2.79]	.27
	Moderate distress (K10 25–29)	1.70 [0.91,3.17]	**.09**	1.37 [0.67,2.81]	.39
	Severe (K10 ≥30)	3.13 [1.72,5.69]	**<.001**	2.43 [1.22,4.86]	**.01**
Mental Health	Good health (ref; SF12MHC ≥43)	1		1	
	Poor health (SF12MHC ≤42)	1.52 [0.97,2.37]	.07	1.14 [0.67,1.95]	.63
Physical Health	Good health (ref; SF12PHC ≥51)	1		1	
	Poor health (SF12PHC ≤50)	1.77 [1.09,2.89]	**.02**	1.37 [0.79,2.35]	.26

Note: Bold indicates statistical significance.

proper sleep evaluation [50]. Insomnia was most commonly treated with sleep hygiene, or pharmacotherapy, rather than the recommended first line intervention, cognitive-behavioral therapy [51]. Programs specific to YA cancer survivors have been developed and have evidence of efficacy [52], but further support/research is needed to implement these effectively into survivorship care. Given that most YAs will live longer following their cancer diagnosis than preceding it, the results of this study should serve as a call to action for cancer centers to better address the sleep and psychosocial needs of YA cancer survivors.

CRediT authorship contribution statement

Sheila N. Garland: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition, All authors have read and agreed to the published version of the manuscript. **Joshua Tulk:** Methodology, Validation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Visualization, All authors have read and agreed to the published version of the manuscript. **Riley Cotter:** Methodology, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, All authors have read and agreed to the published version of the manuscript. **Eric S. Zhou:** Formal analysis, Writing – original draft, Writing – review & editing, All authors have read and agreed to the published version of the manuscript. **Lauren C. Daniel:** Formal analysis, Writing – original draft, Writing – review & editing, All authors have read and agreed to the published version of the manuscript. **Fiona S.M. Schulte:** Writing – review & editing, All authors have read and agreed to the published version of the manuscript. **Jacqueline L. Bender:** Writing – review & editing, All authors have read and agreed to the published version of the manuscript. **Karine Chalifour:** Investigation, Resources, Writing – review & editing, Funding acquisition, All authors have read and agreed to the published version of the manuscript. **Geoff Eaton:** Investigation, Resources, Writing – review & editing, Funding acquisition, All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

Eric S. Zhou has received grant funding from Jazz Pharmaceuticals and Harmony Biosciences, and consulting fees from MindUP and Samsung for work unrelated to the content of this manuscript.

Acknowledgments

This study was supported by a patient-oriented research grant from the Newfoundland and Labrador Support for People and Person Oriented Research and Trials (NL SUPPORT) unit. Dr. Sheila Garland is supported by a Canadian Cancer Society Emerging Scholar Award (Survivorship) (grant #707146). Eric S. Zhou was supported by a Clinician Scientist Development Grant (CSDG-21-080-01 – CTPS) from the American Cancer Society.

References

[1] Canadian Cancer Society. *Canadian Cancer Statistics*: a 2022 special report on cancer prevalence. 2022. Toronto, ON.
[2] Fernandez C, et al. Principles and recommendations for the provision of healthcare in Canada to adolescent and young adult-aged cancer patients and survivors. J Adolesc Young Adult Oncol 2011;1(1):53–9.
[3] Oeffinger KC, et al. Chronic health conditions in adult survivors of childhood cancer. N Engl J Med 2006;355(15):1572–82.
[4] Buysse DJ. Sleep health: can we define it? Does it matter? Sleep 2014;37(1):9–17.
[5] Smrke A, et al. Distinct features of psychosocial distress of adolescents and young adults with cancer compared to adults at diagnosis: patient-reported domains of concern. J Adolesc Young Adult Oncol 2020;9(4):540–5.
[6] Daniel L, et al. Relationship between sleep problems and psychological outcomes in adolescent and young adult cancer survivors and controls. Support Care Cancer 2016;24(2):539–46.
[7] Mulrooney DA, et al. Fatigue and sleep disturbance in adult survivors of childhood cancer: a report from the childhood cancer survivor study (CCSS). Sleep 2008;31(2):271–81.
[8] Clanton NR, et al. Fatigue, vitality, sleep, and neurocognitive functioning in adult survivors of childhood cancer: a report from the Childhood Cancer Survivor Study. Cancer 2011;117(11):2559–68.
[9] Zhou ES, Recklitis CJ. Insomnia in adult survivors of childhood cancer: a report from project REACH. Support Care Cancer 2014;22(11):3061–9.
[10] Zhou ES, et al. Medical and psychosocial correlates of insomnia symptoms in adult survivors of pediatric brain tumors. J Pediatr Psychol 2016;41(6):623–30.
[11] Peersmann SHM, et al. Prevalence of sleep disorders, risk factors and sleep treatment needs of adolescents and young adult childhood cancer patients in follow-up after treatment. Cancers 2022;14(4).
[12] Peersmann SHM, et al. Insomnia symptoms and daytime fatigue Co-occurrence in adolescent and young adult childhood cancer patients in follow-up after treatment: prevalence and associated risk factors. Cancers 2022;14(14).
[13] Fortmann J, et al. Sleep quality among teenagers and young adults with cancer. Cancer Nurs 2021;44(1):13–9.
[14] Wood D, et al. Emerging adulthood as a critical stage in the life course. In: Handbook of life course health development. Cham: Springer; 2018. p. 123–43.
[15] Buysse DJ, et al. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatr Res 1989;28(2):193–213.
[16] Carpenter JS, Andrykowski MA. Psychometric evaluation of the Pittsburgh sleep quality Index. J Psychosom Res 1998;45(1):5–13.
[17] Beck SL, et al. Psychometric evaluation of the Pittsburgh sleep quality Index in cancer patients. J Pain Symptom Manag 2004;27(2):140–8.
[18] Andrews G, Slade T. Interpreting scores on the kessler psychological distress scale (K10). Aust N Z J Publ Health 2001;25(6):494–7.
[19] McCarthy MC, et al. Psychological distress and posttraumatic stress symptoms in adolescents and young adults with cancer and their parents. J Adolesc Young Adult Oncol 2016;5(4):322–9.
[20] Lane B, et al. Prevalence and factors associated with high levels of distress in young adult cancer survivors compared to matched peers. Support Care Cancer 2021;29(5):2653–62.
[21] E WJ, M K, D KS. A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. Med Care 1996;34(3):220–33.
[22] Harju E, et al. Health-related quality of life in adolescent and young adult cancer survivors. Support Care Cancer 2018;26(9):3099–110.
[23] Smith AW, et al. Health-related quality of life of adolescent and young adult patients with cancer in the United States: the Adolescent and Young Adult Health Outcomes and Patient Experience study. J Clin Oncol 2013;31(17):2136–45.
[24] Schutte-Rodin S, et al. Clinical guideline for the evaluation and management of chronic insomnia in adults. J Clin Sleep Med 2008;4(5):487–504.
[25] Spielman AJ, Saskin P, Thorpy MJ. Treatment of chronic insomnia by restriction of time in bed. Sleep 1987;10(1):45–56.
[26] Watson NF, et al. Recommended amount of sleep for a healthy adult: a joint consensus statement of the American academy of sleep medicine and sleep research society. Sleep 2015;38(6):843–4.
[27] Shin T, Davison ML, Long JD. Maximum likelihood versus multiple imputation for missing data in small longitudinal samples with nonnormality. Psychol Methods 2017;22(3):426–49.
[28] 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.
[29] Ruel S, et al. Insomnia, immunity, and infections in cancer patients: results from a longitudinal study. Health Psychol 2020;39(5):358–69.
[30] Liou KT, et al. The relationship between insomnia and cognitive impairment in breast cancer survivors. JNCI Cancer Spectr 2019;3(3):pkz041.
[31] Singer J, Carpenter KM. Trajectories of cancer-specific stress in cancer patients: a latent growth mixture analysis. J Behav Med 2023;46(4):689–98.
[32] Boldyrev L, et al. Sleepless and spent in survivorship: fatigue and insomnia in breast cancer survivors. Am Surg 2022;88(11):2730–6.
[33] Ross TL, et al. Insomnia and its association with quality of life in women with ovarian cancer. Gynecol Oncol 2020;158(3):760–8.
[34] Hofmeister D, et al. The association between sleep problems and general quality of life in cancer patients and in the general population. Front Psychol 2022;13:960029.
[35] Fleming L, Gillespie S, Espie CA. The development and impact of insomnia on cancer survivors: a qualitative analysis. Psycho Oncol 2010;19(9):991–6.
[36] Reuben C, Elgaddal N, Black LI. Sleep medication use in adults aged 18 and over: United States. NCHS Data Brief 2023;(462):1–8. 2020.
[37] Sun Y, Tsai MK, Wen CP. Association of sleep duration and sleeping pill use with mortality and life expectancy: a cohort study of 484,916 adults. Sleep Health; 2023.
[38] Tulk J, et al. Prevalence and factors associated with insomnia symptoms in adolescents and young adults with cancer during the COVID-19 pandemic. Sleep Health 2022;8(4):410–6.
[39] Blanken TF, et al. Network outcome analysis identifies difficulty initiating sleep as a primary target for prevention of depression: a 6-year prospective study. Sleep 2020;43(5).
[40] World Health Organization. Depression and other common mental disorders: global health estimates. 2017.
[41] Irwin MR. Depression and insomnia in cancer: prevalence, risk factors, and effects on cancer outcomes. Curr Psychiatr Rep 2013;15(11):404.
[42] Polsky D, et al. Long-term risk for depressive symptoms after a medical diagnosis. Arch Intern Med 2005;165(11):1260–6.
[43] Boland EM, et al. Is sleep disturbance linked to short- and long-term outcomes following treatments for recurrent depression? J Affect Disord 2020;262:323–32.
[44] Zee PC, Turek FW. Sleep and health: everywhere and in both directions. Arch Intern Med 2006;166(16):1686–8.
[45] Sa J, et al. Sex and racial/ethnic differences in sleep quality and its relationship with body weight status among US college students. J Am Coll Health 2020;68(7):704–11.
[46] Butler ES, McGlinchey E, Juster RP. Sexual and gender minority sleep: a narrative review and suggestions for future research. J Sleep Res 2020;29(1):e12928.
[47] Schulte T, et al. Assessment of sleep problems with the insomnia severity Index (ISI) and the sleep item of the patient health questionnaire (PHQ-9) in cancer patients. Support Care Cancer 2021;29(12):7377–84.
[48] Howell D, et al. A pan-Canadian practice guideline and algorithm: screening, assessment, and supportive care of adults with cancer-related fatigue. Curr Oncol 2013;20(3):e233–46.
[49] National Comprehensive Cancer Network. Survivorship (Version 1.2023). 2023 April 29, https://www.nccn.org/professionals/physician_gls/pdf/survivorship.pdf; 2023.
[50] Zhou ES, et al. Evaluation and treatment of insomnia in adult cancer survivorship programs. J Cancer Surviv 2017;11(1):74–9.
[51] Qaseem A, et al. Management of chronic insomnia disorder in adults: a clinical practice guideline from the American college of physicians. Ann Intern Med 2016;165(2):125–33.
[52] Zhou ES, Recklitis CJ. Internet-delivered insomnia intervention improves sleep and quality of life for adolescent and young adult cancer survivors. Pediatr Blood Cancer 2020;67(9):e28506.