RESEARCH ARTICLE

Short Sleep Duration and Its Correlates among Cancer Survivors in Korea: the Korea National Health and Nutrition Examination Surveys

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Abstract

Background: Though a large proportion of cancer survivors are assumed to be commonly affected by sleep disturbance, few studies have focused on short sleep problems and its correlates among Korean cancer survivors. The purpose of this study was to evaluate the prevalence of short sleep in adult cancer survivors from a nationwide population-based sample and to identify risk factors for short sleep duration. Materials and Methods: Based on the fourth and fifth Korea National Health and Nutrition Examination Surveys (2007-2012), 1,045 cancer survivors and 33,929 non-cancer controls were analyzed. The prevalence of short sleep was compared between these two groups. Associations between short sleep and its correlates were evaluated using multiple logistic regression among cancer survivors: odds ratios (ORs) and 95% confidence intervals (95%CIs) were estimated after adjusting for sociodemographic factors, lifestyle factors, psychological conditions, and cancer-related factors. Results: About 8.1% of cancer survivors slept for less than 5 hours per day (6.2% men and 9.3% women), whereas this was the case for only 3.7% of non-cancer controls. Cancer survivors who had the lowest household income level showed a significantly higher likelihood for short sleep (adjusted OR 2.82, 95%CI 1.06-7.54). Self-reported poor health and depressive symptoms were found to be associated with significantly increased likelihood for short sleep in cancer survivors (adjusted OR 3.60, 95%CI 1.40-9.26 and adjusted OR 2.00, 95%CI 1.17-3.42). Gastric cancer survivors had a 3.97-fold increased risk for short sleep (95%CI 1.60-9.90). Conclusions: The prevalence of short sleep occurs at a high rate among the Korean cancer survivors, which may indicate a poorer quality of life and a higher risk of future complications in survivorship. Targeted interventions that can assist cancer survivors to cope with sleep disturbances as well as ensuring psychological stability are warranted to reduce the latent disease burden.

Keywords: Cancer survivorship - sleep disturbance - risk factors - Korea

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Introduction

Cancer is the leading cause of mortality and morbidity in Korea. With over 1.2 million prevalent cancer cases, nearly 2.5% of the Korean population (approximately 1 in 41 persons) has been treated for cancer or has survived after completion of the treatment (National Cancer Information Center, 2014). Given the gradual increase in cancer incidence and the steady improvements in survival rates, more people will live with cancer over the next decade.

A substantial number of cancer patients appear to experience various physical and emotional challenges that can provoke sleep impairment (Irwin, 2013; Garland et al., 2014). Pain is one of the most common causes that trigger sleep disruption in cancer patients (Theobald, 2004). Other cancer-related somatic symptoms (i.e., fatigue, nausea, and diarrhea), psychological distress, and depression can also interrupt the sleeping patterns in cancer patients (Garland et al., 2014). Furthermore, emerging evidence has indicated that these negative consequences accompanied with cancer diagnosis may persist during long-term survivorship: many of cancer survivors have reported symptoms of insomnia and undergone sleep disturbance more likely than the general population (Savard and Morin, 2001; Savard et al., 2001; Schultz et al., 2005; Bardwell et al., 2008; Mulrooney et al., 2008; Savard et al., 2011; Zhou and Recklitis, 2014),

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which can progress to an increased risk for morbidity and mortality.

Sleep disturbance as well as insomnia is assumed to place cancer survivors at a higher risk of future physical and mental health problems (Garland et al., 2014) but little is known among Korean cancer survivors. Considering that a large portion of cancer patients are expected to live longer in Korea, there is a need for studies exploring diverse aspects of sleep patterns in this population. Thus, in the present study, we aimed to explore the aspect of short sleep problems among adult cancer survivors derived from a nationally representative data. Specifically, we attempted to 1) estimate the prevalence of short sleep duration (less than 5 hours per day) as a substitute of insomnia; 2) compare the prevalence of short sleep between cancer survivors and non-cancer controls; and 3) identify the risk factors, regarding sociodemographic characteristics, lifestyle factors, psychological conditions, and cancer-related factors for short sleep among Korean cancer survivors.

Materials and Methods

Study population

This study was based on the data from the fourth and fifth Korea National Health and Nutrition Examination Survey (KNHANES IV and V, 2007-2012) by the Ministry of Health and Welfare and the Korean Centers for Disease Control and Prevention. The KNHANES is a nationally representative survey consisting of the Health Interview, the Nutrition Survey, and the Health Examination and aims at providing a description of the health and nutritional status of Koreans since 1998 (Lee et al., 2013; Kweon et al., 2014). A study protocol of the KNHANES IV and V was approved annually by the Institutional Review Board of the Korea Centers for Disease Control and Prevention (2007-02CON-04-P, 2008-04EXP-01-C, 2009-01CON-03-2C, 2010-02CON-21-C, 2011-02CON-06-, and 2012-01EXP-01-2C).

Brief information on the sampling protocol for the KNHANES is summarized as follows: using the 2005 Population Census (KNHANES IV) and 2009 Registration Population (KNHANES V) as the sampling frame, a stratified, multi-stage, clustered probability design was employed to select a representative sample of the non-institutionalized civilians aged 1 year or older in the Korean population (Song et al., 2014); a total of 13,800 sample households from 600 sample statistical units and 11,400 sample households from 576 sample statistical units were primarily selected for the KNHANES IV and V, respectively; and of the 63,301 respondents who were targeted, approximately 79.6% participated in the Survey (71.2% in 2007, 77.8% in 2008, 82.8% in 2009, 81.9% in 2010, 80.4% in 2011, and 80.0% in 2012).

Among the initial study samples for the KNHANES IV and V in the present study, a total of 34,974 participants, including 1,045 cancer survivors and 33,929 non-cancer controls, were selected as the final sample for analysis. The sample included individuals over 19 years of age with available information on history of cancer diagnosis and sleep duration.

Ascertainment of cancer diagnosis history

Information regarding history of cancer diagnosis was evaluated by the following question: "Have you ever been diagnosed with cancer or a malignancy of any kind by a doctor?" Subjects who concurred with the question were assigned as cancer survivors; respondents who denied the question were defined as non-cancer controls. Cancer controls were then further asked regarding the specific cancer type and the age at cancer diagnosis. If cancer survivors were reported to be diagnosed with multiple cancers, the first cancer diagnosis was applied to define the primary outcome. Cancer type was classified as gastric, liver, colon, breast, uterine cervical, lung, thyroid, prostate, and others. Survival time was calculated by subtracting the age at diagnosis from the current age and categorized into ≤ 5 years, 6-10 years, and > 10 years.

Sleep duration and putative risk factors

Self-reported sleep duration was ascertained by posing the open-ended question, "On average, how many hours of sleep do you get per day?" The response ranged from 0 to 20 hours, with 99.5% of the subjects' answers between 3 and 14 hours. Subjects who slept for less than 5 hours were defined as the major risk factor.

Based on the self-reported questionnaires, information on putative risk factors was acquired in respect to sociodemographic factors, lifestyle factors, and psychological conditions as follows.

Sociodemographic factors: age was categorized into 19-44, 45-64, and ≥ 65 years old. Marital status was defined as married or single, in which single included subjects who were never married, divorced, separated, or bereaved. According to the highest level of education achieved, educational attainment was categorized as middle school graduate or lower, high school graduate, and university degree or higher. The household income level, which was divided into quartiles by the KNHANES was reclassified into three groups: high (the highest quartile), middle (quartiles 2 and 3), and low (the lowest quartile).

Lifestyle factors: smoking status was defined as current smokers who had smoked ≥ 5 packs (100 cigarettes) during their lifetime and still smoked *vs* non-current smokers including those who had never smoked across a lifespan and quitters. In the same vein, alcohol consumption was classified into current drinkers who drank at least once a month during the previous year and non-current drinkers. Regular exercisers were defined as those who engaged in either vigorous or moderate physical activities for at least 10 minutes at a time per week; and others were referred to non-exercisers.

Psychological conditions: self-rated health status was evaluated by using a five-point response scale, very good, good, fair, poor, and very poor. The five response choices were summarized into three categories: good (very good and good), fair, and poor (poor and very poor). Depressive symptom was elicited by the following question, "Has there ever been two consecutive weeks or longer when you suffered from feeling down, depressed, or hopeless?" Binary response categories were given as yes or no.

Statistical analysis

In accordance with the KNAHNES adopted to a complex multi-stage clustered probability sampling design, all analyses were conducted by using survey weightings in estimating the statistical results. Based on the survey procedures available through SAS version 9.3 (SAS Institute, Cary, North Carolina), statistics were properly weighted to produce unbiased national estimates (Choi et al., 2013). Using the chi-squared test for categorical variables, estimated proportion and standard errors were calculated in order to compare the baseline characteristics between cancer survivors and non-cancer controls. Prevalence of short sleep was estimated and compared between cancer survivors and non-cancer controls. The adjusted proportion of short sleep was presented according to each cancer type (i.e., gastric, liver, colon, breast, uterine cervical, lung, thyroid, prostate, and others) and non-cancer controls.

To identify the risk factors associated with the presence of short sleep among cancer survivors, multivariate logistic regression analyses were performed in phase. Along with 5-9 hours of sleep as the comparison group, the odds ratios (ORs) and 95% confidence intervals (95%CIs) were calculated after accounting for sex and age (model 1) and sex, age, sociodemographic characteristics (i.e., marital status, educational attainment, and household income level), lifestyle factors (i.e., smoking status, alcohol consumption, and physical exercise), psychological conditions (i.e., self-rated health status and depressive symptom), and cancer-related factors (i.e., cancer type and survival time) (model 2).

Results

The baseline characteristics of the study population, cancer survivors and non-cancer controls, are summarized in Table 1. In this representative study population, approximately 2.2% of the Korean adult population were reported to be cancer survivors. The mean ages of the cancer survivors were significantly higher than those of non-cancer controls ($p<0.001$). Cancer survivors were more likely to be women, less educated, have a lower household income, non-current smokers or drinkers, and show poorer psychological conditions compared to non-cancer controls ($p<0.001$). Among cancer survivors, the most common cancer type was gastric cancer (19.6%), followed by uterine cervix (14.8%), breast (14.6%), and colon (10.4%); and the mean survival time was 7.7±0.3 years.

Estimated proportions of short sleep duration were 8.1% among cancer survivors and 3.7% among non-cancer controls; and the difference exhibited a statistical significance ($p<0.001$). The prevalence of short sleep was significantly higher in cancer survivors regardless of sex ($p<0.001$ for each sex) but the overall prevalence were more likely to be higher among women compared to men (Figure1). Prevalence of short sleep appeared to differ from cancer-specific types: lung cancer survivors presented the highest prevalence of short sleep, followed by gastric cancer, uterine cervix, colon, liver, and breast. Interestingly, non-cancer controls were at the bottom of the prevalence, exhibiting the lowest prevalence of short sleep compared to cancer survivors with any kind of cancer type (Figure 2).

Risk factors associated with the presence of short sleep among cancer survivors are shown in Table 2.

Table 1. Baseline Characteristics of Cancer Survivors and Non-cancer Controls

	Total population Estimated proportion % (SE)		
	Cancer survivors (N=1,045)	Non-cancer controls (N=33,929)	P
Sociodemographic factors			
Sex			<0.001
Men	37.7 (1.9)	49.6 (0.3)	
Women	62.3 (1.9)	50.4 (0.3)	
Age (years), mean ± SD	59.5±0.5	44.6±0.2	<0.001
19-44	12.2 (1.5)	53.1 (0.5)	
45-64	48.1 (1.9)	33.8 (0.4)	
≥ 65	39.7 (1.9)	13.1 (0.3)	
Marital status			0.049
Married	77.5 (1.6)	74.1 (0.5)	
Unmarried	22.5 (1.6)	25.9 (0.5)	
Educational attainment			<0.001
≤ Middle school graduate	55.3 (1.9)	29.0 (0.5)	
High school graduate	27.0 (1.8)	39.7 (0.4)	
≥ University degree	17.7 (1.6)	31.3 (0.5)	
Household income level			<0.001
Lowest quartile	28.6 (1.8)	15.8 (0.4)	
Medium (Q2+Q3)	46.4 (2.1)	55.5 (0.6)	
Highest quartile	25.0 (1.9)	28.7 (0.6)	
Lifestyle and psychological factors			
Smoking status			<0.001
Never or former smokers	90.0 (1.2)	71.9 (0.3)	
Current smokers	10.0 (1.2)	28.1 (0.3)	
Alcohol consumption			<0.001
Never or former drinkers	68.7 (1.9)	41.1 (0.4)	
Current drinkers	31.3 (1.9)	58.9 (0.4)	
Physical exercise			0.001
Regular exercisers	45.6 (1.9)	51.8 (0.5)	
Non-exercisers	54.4 (1.9)	48.2 (0.5)	
Self-rated health status			<0.001
Good	24.0 (1.6)	37.8 (0.4)	
Fair	34.7 (1.9)	43.8 (0.5)	
Poor	41.3 (1.8)	18.4 (0.3)	
Depressive symptom			<0.001
No	78.9 (1.6)	86.5 (0.2)	
Yes	21.1 (1.6)	13.5 (0.2)	
Cancer-related factors			
Cancer type			
Gastric	19.6 (1.5)		
Liver	4.1 (0.8)		
Colon	10.4 (1.2)		
Breast	14.6 (1.4)		
Uterine cervical	14.8 (1.4)		
Lung	2.3 (0.5)		
Thyroid	4.7 (0.8)		
Prostate	3.0 (0.6)		
Others	26.7 (1.8)		
Time since diagnosis, mean ± SD	7.7±0.3		
≤ 5 years	51.7 (1.9)		
6~10 years	22.4 (1.6)		
> 10 years	25.9 (1.7)		

After accounting for sex and age effect, the odds of being short sleepers significantly increased with female gender, elderly, lower educational attainment and household income, lack of exercise, self-rated poor health status, depressive symptom, and specific cancer type (i.e., lung and gastric). When all putative risk factors were accounted for, cancer survivors who had the lowest household income level were almost three-times more likely to being short sleepers (adjusted OR 2.82, 95%CI 1.06-7.54). The association between short sleep in cancer survivors and psychological factors remained statistically significant even after adjusting for all residual effects of covariates: self-reported poor health and depressive symptom were found to be at significantly increased likelihood for short sleep (adjusted OR 3.60, 95%CI 1.40-9.26; and adjusted OR 2.00, 95%CI 1.17-3.42, respectively). Moreover,

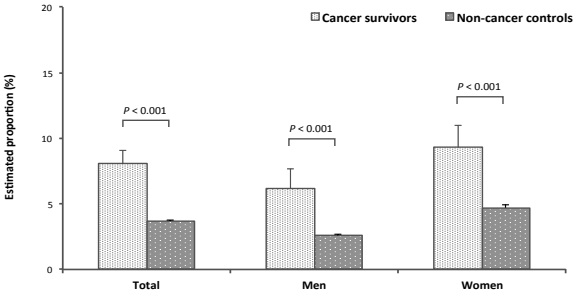

Figure 1. Estimated Proportion of Short Sleep Duration among Cancer Survivors *vs* Non-cancer Controls

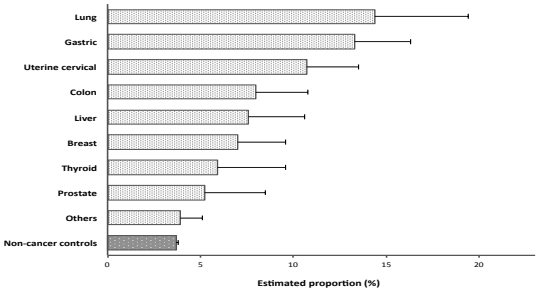

Figure 2. Estimated Proportion of Short Sleep Duration according to the Cancer-specific Types

Table 2. Factors Associated with Short Sleep Duration among Cancer Survivors

		Estimated proportion % (SE)	OR (95%CI)[a]	OR (95%CI)[b]
Sociodemographic factors				
Sex	Men	6.9 (1.7)	1 (reference)	1 (reference)
	Women	10.0 (1.4)	1.82 (1.00-3.32)	1.19 (0.52-2.67)
Age (years)	19-44	2.6 (1.6)	1 (reference)	1 (reference)
	45-64	6.7 (1.5)	2.73 (0.71-10.5)	2.00 (0.42-9.37)
	≥ 65	13.3 (1.9)	6.39 (1.75-23.3)	3.25 (0.69-15.2)
Marital status	Married	6.9 (1.0)	1 (reference)	1 (reference)
	Unmarried	14.4 (2.8)	1.61 (0.91-2.87)	1.44 (0.78-2.66)
Educational attainment	≤ Middle school graduate	13.2 (1.8)	3.12 (1.21-8.05)	2.53 (0.88-7.26)
	High school graduate	4.0 (1.4)	1.19 (0.40-3.51)	1.14 (0.33-3.97)
	≥ University degree	2.9 (1.2)	1 (reference)	1 (reference)
Household income level	Lowest quartile	16.7 (2.8)	5.64 (2.05-15.5)	2.82 (1.06-7.54)
	Medium (Q2+Q3)	7.1 (1.3)	2.80 (1.13-6.93)	2.19 (0.83-5.73)
	Highest quartile	2.6 (1.1)	1 (reference)	1 (reference)
Lifestyle and psychological factors				
Smoking status	Never or former smokers	9.6 (1.3)	1 (reference)	1 (reference)
	Current smokers	9.3 (5.0)	1.19 (0.36-3.89)	0.64 (0.25-1.63)
Alcohol consumption	Never or former drinkers	10.2 (1.3)	1 (reference)	1 (reference)
	Current drinkers	5.9 (1.8)	0.73 (0.38-1.41)	0.83 (0.44-1.58)
Physical exercise	Regular exercisers	5.7 (1.2)	1 (reference)	1 (reference)
	Non-exercisers	11.5 (1.7)	1.77 (1.05-2.96)	1.53 (0.91-2.56)
Self-rated health status	Good	2.4 (1.0)	1 (reference)	1 (reference)
	Fair	9.1 (1.9)	3.27 (1.32-8.08)	3.54 (1.31-9.56)
	Poor	12.7 (1.9)	4.05 (1.79-9.18)	3.60 (1.40-9.26)
Depressive symptom	No	6.7 (1.1)	1 (reference)	1 (reference)
	Yes	15.7 (3.0)	2.34 (1.36-4.02)	2.00 (1.17-3.42)
Oncological factors				
Cancer type	Gastric	14.3 (3.4)	3.84 (1.60-9.19)	3.97 (1.60-9.90)
	Liver	8.6 (4.9)	3.23 (0.68-15.3)	3.32 (0.70-15.8)
	Colon	8.9 (3.1)	2.12 (0.78-5.78)	1.98 (0.69-5.65)
	Breast	7.5 (2.7)	1.41 (0.52-3.82)	1.73 (0.61-4.90)
	Uterine cervical	11.5 (3.1)	2.28 (0.93-5.54)	2.64 (0.97-7.20)
	Lung	15.6 (8.6)	4.56 (1.02-20.5)	5.79 (0.92-36.5)
	Thyroid	5.4 (3.5)	1.20 (0.22-6.55)	1.32 (0.28-6.32)
	Prostate	6.0 (4.6)	1.43 (0.28-7.31)	2.20 (0.43-11.3)
	Others	4.3 (1.2)	1 (reference)	1 (reference)
Time since diagnosis,	≤ 5 years	7.5 (1.4)	1 (reference)	1 (reference)
	6~10 years	11.0 (2.6)	1.39 (0.68-2.83)	1.30 (0.67-2.51)
	> 10 years	9.5 (2.2)	0.97 (0.49-1.91)	0.88 (0.45-1.71)

[a]Adjusted P values by sex and age; [b]Adjusted P values by sex, age, marital status, educational attainment, household income level, smoking status, alcohol consumption, physical exercise, self-rated health status, depressive symptom, cancer type and time since first cancer diagnosis

gastric cancer survivors were found to have a 3.97-fold increase in their adjusted odds of short sleep (95%CI 1.60-9.90; Table 2).

Discussion

In the present study, we explored the aspect of sleep among Korean cancer survivors and evaluated which of the putative risk factors constituted important correlates in the presence of short sleep, using a nationally representative survey data. Our findings confirm that short sleep in cancer survivors occurs at a high rate, with a prevalence that is more than twice as much as the general population (8.1% *vs* 3.7%), allowing the assumption that cancer survivors are more likely to be at higher risk of future health problems in consequence of sleep disturbance compared to the general population. Furthermore, several conditions lower socioeconomic status, poor psychological conditions, and specific cancer types appear to exacerbate sleep problems among cancer survivors.

Evidence has indicated that sleep complaints primarily characterized by sleep disturbance and insomnia frequently occur among cancer survivors (Savard et al., 2011; Irwin, 2013; Irwin et al., 2013; Garland et al., 2014); yet is these problems are often overlooked in post-treatment care for cancer survivors (Ancoli-Israel, 2009). Though the prevalence ranges vary depending on the study characteristics, cancer survivors have consistently reported higher rates of sleep problems compared than the general population (Savard and Morin, 2001; Savard et al., 2001; Schultz et al., 2005; Bardwell et al., 2008; Mulrooney et al., 2008; Savard et al., 2011; Zhou and Recklitis, 2014), which parallel with our findings. Notwithstanding the limits of knowledge on the exact mechanism across the cancer trajectory, cancer-related sleep problems covering difficulties initiating or maintaining sleep, dissatisfaction with sleep quality, and/or short sleep duration appear to begin with cancer diagnosis, inducing emotional challenges (i.e., anxiety and distress), and are easily exacerbated during cancer treatments such as chemotherapy, which continue through cancer survivorship (Palesh et al., 2012; Garland et al., 2014). Biologically, these negative consequences are assumed to underlie the inflammatory mechanism: a negative feedback loop where substantial increases in proinflammatory cytokine activity induced by cancer treatments can lead to sleep problems, which in turn may feedback to alter immune profiles, activating chronic inflammatory processes among cancer survivors, and finally progress to long-term sleep disturbance throughout the survivorship (Lee et al., 2004; Miller et al., 2008; Irwin et al., 2013). Further investigations concerning both sleep modalities and biology dynamics in longitudinal follow-up studies will help to clarify the hidden mechanism behind cancer-related sleep problems in Korean cancer survivors.

Decreased sleep quantity arising in cancer survivors appears to be aggravated by psychological distress. In the present study, psychological factors such as self-rated poor health and depressive symptoms that are considered to be symptomatic dimensions of depression were selected as significant risk factors for short sleep in cancer survivors. Furthermore, the lowest household income showed a significant association with short sleep; this finding, presumed to be linked with psychological distress due to financial burden (Andrykowski et al., 2013; Sharp et al., 2013; Fathollahzade et al., 2015), could be explained in respect to depression. Sleep disturbance and depression have been reported to frequently co-occur in symptom clusters related to cancer side effects (Irwin, 2013; Garland et al., 2014) and share the same biologic mechanism as the previously mentioned inflammatory response pathway (Irwin et al., 2013). Given that sleep disturbance and depression interrelate with each other in a synergetic and/or independent manner, it is presumed that cancer survivors are exposed to a greater adverse potential of reduced quality of life and increased risk for morbid outcomes. Interventions that take into consideration coping strategies on psychological distress are necessary to reduce the burden of sleep disturbance amongst cancer survivors.

Specific cancer types, such as gastric and lung, can lead to a decrease in sleep quantity. Lung and gastric cancer survivors presented the highest prevalence of short sleep; and the association remained statistically significant even after accounting for age and sex effects. When all putative risk factors were accounted for, gastric cancer survivors were only found to have a 3.97-fold increase in their adjusted risk of short sleep. Understanding of the link between gastric cancer and decreased sleep quantity remains unknown for the most part but, given the association between gastrointestinal disturbances and sleep disorders (Maneerattanaporn and Chey, 2009; Ali et al., 2013), the plausibility of our findings can be strongly supported. There is a need for studies exploring sleep physiology and associated mechanisms among gastric cancer survivors. Lung cancer survivors also showed close to a 6-fold increased likelihood for short sleep using fully adjusted model at a marginally significant level. The results are consistent with the previous studies reporting that lung cancer patients and survivors had the highest prevalence of sleep problems including insomnia (Davidson et al., 2002; Baker et al., 2005; Akyuz et al., 2013); and this can possibly be explained by comorbid conditions such as pulmonary diseases and respiratory distress components frequently reported among lung cancer survivors (Sarna and Brecht, 1997; Sarna et al., 2002).

The present study was a large-scale, cross-sectional study based on a nationally representative data but several study limitations should be taken into account. First, the nature of the cross-sectional design precludes us from determining the causal relationship of short sleep duration with putative risk factors and speculating about chronological changes of sleep patterns in post-cancer trajectories. Moreover, the effect of temporal ambiguity was not taken into account. Second, cancer diagnosis as well as all other variables was ascertained based on self-reported information; thus, we are not free from misclassification and/or recall bias. Third, collection of information on sleep was not through objective methods such as actigraphic monitoring or the Pittsburgh Sleep Quality Index. Additionally, sleep duration was

evaluated by using a single-item assessment and other components related to sleep parameters was not taken into consideration. Finally, we could not consider cancer treatments and/or pharmaceutical status in our analyses due to the lack of information on clinical records. In spite of these limitations, this study explored the aspect of short sleep problems among adult cancer survivors derived from a nationally representative data, thereby estimating the magnitude of sleep problems among the Korean cancer survivors. Furthermore, the putative risk factors affecting short sleep duration were fully accounted for in the multivariate models and this approach allowed us to identify the significant correlates of short sleep among adult cancer survivors.

In the present study, we confirmed that the prevalence of short sleep occurs at a high rate among the Korean cancer survivors, which indicate a poorer quality of life and a higher risk of future complications in survivorship. Given that many cancer survivors may not recognize their sleep problems and easily overlook its importance, the real proportion of cancer survivors who suffer from sleep disturbances is probably greater than expected. Targeted interventions that can assist cancer survivors to cope with sleep disturbances as well as maintaining psychological stability is warranted to reduce the latent disease burden. Furthermore, clinicians should pay attention to cancer-related sleep problems during and after patients' cancer treatment and prepare appropriate interventions for risk modification.

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