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Sleep Quality and Disturbances in Children and Adolescents with Cancers: A Cross-Sectional Study

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Abstract

Background

Childhood cancer has very unpleasant side effects on patients. A common problem among patients is sleep disturbance owing to a variety of causes. This study aimed to determine the sleep quality and disturbances in children and adolescents with cancer in Yazd, Iran.

Materials and Methods

This study was a descriptive cross-sectional on 101 patients aged 4-18 years who referred to the Shahid Sadoughi hospital in Yazd, Iran, and were treated with the diagnosis of cancer. Sleep quality was assessed via the Pittsburgh Sleep Quality Index (PSQI). Data were analyzed using SPSS version 16.0 software.

Results

The mean age of the patients was 9.54 ± 3.97 years and 59.4% were girls. The mean duration of cancer was 12.82 ± 2.66 months. The mean of PSQI was 6.49 ± 3.14 (of the total score 21). Considering a cutoff point 5, (60.9%) of patients were identified as poor sleeper. The mean of sleep duration was 7.72 ± 1.68 hours and mean of sleep latency was 35.45 ± 29.73 minutes. The mean of fatigue was increased with increasing the average of sleep quality (P =0.000).

Conclusion

According to the results, more than half of children with cancer had poor sleep quality. According to frequent waking ups during the night, and sleep duration reduction, it is necessary to set time nursing care during the night to prevent frequent waking during the night.

Key Words: Adolescent, Cancer, Children, Sleep disorders.

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1- INTRODUCTION

Childhood cancers are considered a rare disease. Approximately 1-2% of cancers are diagnosed in Childhood (1). Prevalence rates range of childhood cancer have reported between 50 and 200 per million children in the world (2). Cancers that occurred in childhood have different types; and the most common of them are Leukemia, central nervous system tumors (CNS) and Lymphoma (3). A study showed that the mean age of children with cancer was nearly 9 years old; also, Leukemia and lymphoid malignancies were the most common cancers in children in Iran (4). Childhood cancer has very unpleasant side effects on patient, his family and society. Also, it considered as a concern for the health system (5). Children and adolescents with chronic disease are encountered with physical and psychological problems related to the disease and its treatment (6).

Researchers in recent years have suggested a relationship between quality of sleep and cancer (7). A good sleep provides physical restoration through anabolic functions such as protein and tissue synthesis (8). Adequate sleep has a vital role in physical and mental health. Sufficient and appropriate sleep is an essential part of a healthy lifestyle (9). A common problem among pediatric cancer is sleep disturbance owing to a variety of causes (7). Children with cancer have a variety of sleep problems such as altered sleep habits and problems initiating and maintaining sleep. The other symptoms of sleep disturbances include difficulty falling asleep, waking up and having trouble getting back to sleep, daytime sleepiness, and awaking early in the morning (10). Sleep disturbance has an increased prevalence in children and adolescents with cancer compared to children in the general population (11). Decreased sleep quality may persist for long-term in survivors of childhood cancer (12). Sleep problems may occur due to damage to the brain, brain tumors, radiation therapy, chemotherapy; and the indirect result of other causes include cancer-related fatigue, stress, pain and medications (11-13). Sleep disturbances may positively associate with cancer-related fatigue. Fatigue was one of the most common symptoms in 80% of patients with cancer (14).

Considering that sleep disturbances have a negative impact on the quality of life in cancer patients and their families; researchers need to determine the factors that reduce them. Therefore, any interventions for decreasing sleep disturbances in children and adolescents with cancer are a step toward the better life for them. So, the purpose of this study was to determine the quality of sleep in children and adolescents with cancer aged 4-18 years old.

2- MATERIALS AND METHODS

2-1. Study Design and Population

This study is a descriptive cross-sectional study. The target population was patients aged 4-18 years with definitive diagnosis of cancer who referred to the Shahid Sadoughi Hospital in Yazd, Iran. The sample size was determined to be 97 based on a confidence interval (CI) of 95% and standard deviation of 3.5 based on similar study (15), and error estimation of mean of 0.7, which was increased to 101 to account for potential missing cases.

2-2. Inclusion and Exclusion Criteria

Inclusion criteria in this study included: 1- The diagnosis of cancer in the patients with diagnostic tests done at the hospital and definitive confirmation by the physician, 2- Start the treatment process, 3- Voluntary participation in the study and 4- Aged between 4-18 years. Participants who had not responded to all questions were excluded from this study.

2-3. Study procedure

Sampling was conducted based on the convenience sampling (availability sampling) method. In this study, the researchers referred to Shahid Sadoughi Hospital in Yazd city for sampling. According to the inclusion criteria, 101 children and adolescent with cancer admitted in Shahid Sadoughi hospital non-randomly entered the study. Researchers explained the aim of the study to participants; then, completed the questionnaire by face-to-face interview with the companion patient (caregiver) of children.

2-3-1. Instrument

The data were collected by a questionnaire including three parts: demographic variables and disease-related variables, Pittsburgh sleep quality index (PSQI), and fatigue questionnaire.

Part-1: The first part of the questionnaire was related to the demographic variables and disease-related variables included gender, economic situation, type of cancer, and methods of treatment.

Part-2: Pittsburgh sleep quality index (PSQI) was used to measure the quantity and quality of sleep. PSQI was developed by researchers at the University of Pittsburgh (16). PSQI is a self-report questionnaire that assesses the sleep quality during the past month (four weeks). It contains 19 questions in 7 components included: subjective sleep quality (1 item); sleep latency, that is the amount of time that it takes to fall asleep (12 items); sleep duration (1 item); habitual sleep efficiency, that is the percentage of the actual hours of sleep divided by the hours spent in bed (3 items); sleep disturbances (9 items); use of sleeping medications (1 item); and daytime dysfunction (2 items). The score range of each question was from 0 to 3 points; so, the global score range for questionnaire was between 0 and 21 points. A PSQI score of 5 or greater indicates poor sleep quality (10). The reliability and validity of the questionnaire has been confirmed in other studies. According to Backhaus et al. study, the PSQI homogeneity was high with a Cronbach's alpha of 0.85. The overall PSQI global score correlation coefficient for test–retest reliability was 0.87 (17). In the Iranian version of the questionnaire validity was 0.86 and reliability was 0.89 (18).

Part-3: A researcher-made questionnaire was designed for collecting data about fatigue. The fatigue questionnaire had 25 questions and its reliability and validity has been confirmed. Face validity was examined using a panel of experts. In addition, researchers used Cronbach's alpha to determine the reliability of the fatigue questionnaire. Cronbach's alpha coefficient for fatigue questionnaire was 0.95.

2-4. Data analysis

Statistical analysis was performed using SPSS software (version 16.0). The analysis included: 1- Descriptive statistics (mean and standard deviation [SD]), 2- The Kolmogorov-Smirnov test was used to evaluate the distribution of quantitative variables, 3-T-test was used to compare the mean of sleep quality according to gender, 4- One-way ANOVA was conducted to evaluate the mean of sleep quality according to type of cancer and treatment method; and for evaluating the mean of fatigue based on components of Pittsburgh sleep quality index, 5- Pearson's correlation were calculated for assessment of correlation between sleep quality and fatigues and age 6- Regression was utilized to estimate the regression coefficient (B) for the associations between the independent variables and sleep quality. A p-value < 0.05 was considered significant.

2-5. Ethical Considerations

This article is the result of a research project number 4612 approved by research center of prevention and epidemiology of

non-communicable disease, Shahid Sadoughi University of Medical Sciences. This article has a license from the research ethics committees of Shahid Sadoughi University of Medical Sciences, code IR.SSU.SPH.REC.1394.114. Researchers before completing the questionnaire explained the aim of the study to participants. Participation in the study was also voluntary.

3-RESULT

3-1. Descriptive feature of patients

In this study, 101 patients with cancer aged less than 18 years were participated. The mean age of the patients was 9.54 ± 3.97 years; mean duration of cancer was nearly 13 months; 60.4% of them had leukemia and 21.8% had lymphoma; 59.4% were girls and 40.6% was boys. According to the results, 77% of participants received only chemotherapy, 6% received chemotherapy and radiotherapy, 8% were treated by chemotherapy and surgery and 9% of patients were treated by all three methods (chemotherapy, radiotherapy and surgery).

3-2. Evaluation of sleep quality

The mean of The PSQI score in children with cancer was 6.49 ± 3.84 of the total score 21 Considering a cutoff point 5, 60.9% of patients were identified as poor sleeper. The mean of the PSQI components were as follows: Subjective sleep quality (1.45±0.8), Sleep efficiency (1.11±0.3), Daytime dysfunction (1.06±0.1), Sleep disturbances (1.28±0.5), Sleep duration (0.5±0.1), Sleep latency (1.56±1), and Use of sleeping medications (0.81±0.22). The score range for each of PSQI components were between 0 and 3. Therefore, sleep latency had the highest mean and sleep duration had the lowest mean. The mean of sleep duration was 7.72 ± 1.68 hours. Sleep duration was in the range of 2-12 hours in participants. In addition, 64.5% of patients slept more than 7 hours, 25.8% between 6-7 hours, 4.3% between 5-6 hours, and 5.4% less than 5 hours during the night. The mean of sleep latency was 35.45 ± 29.73 minutes. Sleep latency was in the range of 0-180 minutes. The results showed that 31.9% patients took less than 15 minutes, 36.2% between 16-30 minutes, 26.6% between 31-60 minutes and 5.3% higher than 60 minutes to fall asleep after going to bed. The percentages of the reported difficulties with sleeping 3 times per week were as follows: feeling too hot (26.7), awakening during the night or in the early morning (21.8%), feeling too cold (15.8%), having bad dreams (14.9%), waking up to urinate (9.9), having pain (5.9%), waking up due to difficulty breathing (3%), and coughing or snoring (2%). The results of sleep disturbances showed that feeling too hot, waking up in the middle of the night or early morning were the most common sleep disturbance, and coughing or snoring loudly and difficulty breathing had the lowest frequent among sleep disturbance.

With respect to daytime dysfunction, 9.8% of the patients reported that keeping up enough enthusiasm to get things done was "a very big problem", 16.3% reported that it was "somewhat of a problem". In addition, 20.4% reported had trouble staying awake 1-2 times a week and 11.8% three or more times a week while driving, eating, or socializing. With respect to sleep medications, 33.3% had taken sleep medicines during the past month. Also, 6.5% of patients rated their sleep quality as very good, 54.8 % fairly good, 25.8% fairly bad and 12.9% very bad. Mean sleep efficiency was more than 85% in 90.4% of patients.

3-3. Association between sleep quality and gender and clinical characteristics

According to the results of T-test, the mean of sleep quality was higher in girls (6.87±4.05) than boys (6±3.56). (P=0.35).
The results of ANOVA showed that the

mean of sleep quality was higher in patients with breast and ovarian cancer (11±0.00) than other types of cancer (p=0.24). The results of ANOVA also showed that patients who were treated by all three methods (chemotherapy, radiotherapy, surgery) (8.57±2.82) had the lowest mean of sleep quality than patients who received other treatments methods. (p=0.43). These differences, however, did not constitute statistical significance.

T-test results showed that the mean of sleep quality was higher in girls than boys (p=0.35). The results of ANOVA showed that the mean of sleep quality was higher in patients with bone cancer than other types of cancer (p=0.4). According to ANOVA test, patients who were treated by all three methods (chemotherapy, radiotherapy, surgery) had the lowest mean of sleep quality than patients who received other treatments methods (p=0.41) (**Table.1**). (*Please see the table in the end of paper*). In addition, the mean of sleep quality was increased with increasing age. However; researchers found no significant differences between sleep quality and age. (P =0.09, R=0.2).

The results of regression are shown in **Table.2**. (*Please see the table in the end of paper*). The results showed that boys had lower sleep quality score than girls as much as 0.6 score (P=0.35). To compare the quality of sleep with the treatment methods, the chemotherapy was considered as the base for regression and the rest of the methods were compared with it. The results of this comparison showed that patients were treated by chemotherapy and surgery had a lower sleep quality score as much as 2.37 score than patients received only chemotherapy (P=0.09). Comparison of other treatment methods is shown in **Table.2**. To compare the quality of sleep with the type of cancer, Leukemia was considered as the base for regression and other cancers were compared with it. The results of this comparison showed that children and adolescent with lymphoma had lower sleep quality score as much as 0.88 score than patients with leukemia (P=0.34); also children and adolescent with bone cancer had higher sleep quality score than patients with leukemia as much as 0.6 score (P=0.6).

3-4. Association between sleep quality and fatigue

Comparison of the mean of fatigue and sleep quality based on T-test showed that the mean of fatigue was significantly higher in patients with poor sleep quality (61.21±16.64) than patients with good sleep quality (35.96±15.56) (P=0.000). In addition, ANOVA results showed the significant difference between the mean of fatigue and subjective sleep quality (P=0.000), daytime dysfunction (P=0.000), sleep disturbances (P=0.000), sleep latency (P=0.000) and use of sleeping medications (P=0.02) (**Table.3**). (*Please see the table in the end of paper*). The results of Pearson correlation showed that the mean of fatigue was significantly increased with increasing the mean of sleep quality (Worsening sleep quality) (P =0.000, R=0.72). According to the results of regression, with each unit increasing in fatigue score, the sleep quality score increased by 0.13 score (P=0.000) (**Table.2**).

4- DISCUSSION

The present study was conducted to evaluate the quality and quantity of sleep in children and adolescents with cancer. In this study, the mean of sleep quality in children with cancer was 6.49 ± 3.14 (of the total score 21), and according to the results, 60.9% had poor sleep quality. Barmeh ziyar et al. reported that the mean of quality of sleep score in school children was 8.51 ± 2.97 and according to the cut-off point Pittsburgh Sleep Quality Index only 18.8% had good sleep quality (19). Poor sleep may affect the treatment

process due to the relationship between sleep and immune functioning and resistance to infection (20). Considering the importance of sleep in the first years of life, one of the goals of healthy people by 2020 is to reduce the number of unhealthy sleep in children (21). Walker et al. reported that adolescents with cancer had poor sleep quality and poor hygiene behaviors during chemotherapy (22). The quality of life in children becomes worse during cancer treatment, and sleep disturbance helps to makes it worse. In Van et al. study, all children with leukemia had more sleep problems and lower quality of life than healthy children (23). According to children with cancer need proper care to improve sleep quality during hospitalization, hospital administrators must provide a suitable environment for sleeping them. In this study, the mean of sleep duration in children and teens with cancer was nearly 8 hours. The mean of nighttime sleep duration was 8.75 in hospitalized school-age children with cancer in Linder and Christian study that is similar with the current study (24).

However, the duration of nighttime sleep in children and teens with cancer in Orsey et al. study (6.6±1.3 hours) was less than our study (25). Lee et al. reported that hospitalized children with cancer may be experience a significant decrease in sleep duration (the range of 457.70–582.08 minutes compared to the range of 600 to 660 minutes for the same age group) (26). However, in Javadi et al. study, the total night sleep duration was 10.3±1.3 hours among preschool children of 6-3 years old (21). It is emphasized that sleeping less than 10 hours was associated with reduced quality of life several years later (27). Sleep durations is 11 and 12 hours for children in 3-6 years age (28), 10 hours for children in 9-12 years age (29) 7-8 hours and for children in 13-18 years age in other studies (30, 31). Therefore, duration of nighttime sleep in children with cancer in this study was lower than healthy children. In this study, most children had bedtime between 10 pm and 12pm that is similar to a study conducted in Qazvin (21), and a study that conducted on Japanese children of 2 - 3 years (32); while a study conducted among Australian children (2-3 years old) in 1990 showed that only 4.1% of children had bedtime of 10 pm or later (33). This issue may be due to change in lifestyle and modernization of society. Also, the mean of time to fall asleep was nearly 30 minutes in this study which is consistent with Linder and Christian study (24). Also, average sleep latency among hospitalized school-age children with cancer was less than 16 minutes in their study (24). Some studies also indicated difficulty initiating sleep among adolescents with leukemia (22, 34). So, children may experience many problems to fall asleep.

Some studies have shown that sleep problems remain in survivors of cancer. In Daniel et al. study cancer survivors reported taking 31.75 min to fall asleep and sleeping for 7.72 hours. They suggested that sleep problems may persist even after cancer treatment (20). According to Van et al. study, a high dose of radiotherapy in childhood is associated with changes in the sleep and waking system (35). Setoyama et al. reported that patients with cancer had longer sleep onset latency, earlier bedtime and poor self-evaluated sleep quality during hospitalization than the short time they stayed at home (36). Inability to fall asleep may be caused due to physical psychological distress, pain, spending the night in the hospital and environmental factors. In addition, no significant difference was found between sleep duration and gender. A systematic review conducted by Olson indicated that no differences existed between males and females in difficulty initiating sleep. So, sleep restriction, sleep hygiene education,

medication for pain control, sedative hypnotics, and melatonin can help to improve sleep onset (37). Nearly, 30% of the participants in this study reported that they had daytime sleepiness more than once a week. Daytime dysfunction can effect on child's ability such as exercising, completing homework, watching television, working with the computer, staying awake during school, and engaging in social activities. Sleep disturbance is a chronic problem in cancer patients and persists until after treatment (38). In the present study, the most common sleep disturbances in children with cancer was the feeling too hot during sleep and waking up in the middle of night or early morning. According to Orsey et al. study, the sleep pattern of children with cancer is unnatural compared to healthy children; waking up in the middle of the night and reduction in sleep efficiency were common problems (25).

In the study of Zupanec et al., the prevalence of sleep disturbances in children with cancer was 87 % (39). In the study of Rosen and Brand, 60% of children with cancer had problems due to excessive drowsiness during the day, 40% due to breathing difficulties during sleep and 24% due to insomnia (40). Olson reported that difficulty initiating sleep, fragmented sleep, disordered breathing, parasomnias, napping, excessive daytime sleepiness (EDS), fatigue, and sleep disturbance unspecified were the most frequently reported disturbances in adolescent with cancer (37). In Chen et al. studies, the risk of developing sleep disturbances was significantly 2.72- fold higher in cancer patients than the general population (38). Anderson et al. indicated that 62% of patients with cancer had the moderate to severe sleep disturbances; this rate was two to three times higher than the general population (41). Sleep disturbances in children and adolescent with cancer not only decrease their quality of life, but also create problems for their families. The incidence of sleep disturbances in the parents of children with cancer was 48% in Zupanec et al. study (39). Orsey et al. reported that hospitalization was associated with increased night-time waking in most studies (37). Sleep disturbances in hospitalized children with cancer is likely a combination of cancer treatment, related medications, or the hospital environment (26). In the study of Linder and Christian the environment (sound and light levels) had the greatest influence on sleep minutes. In their study, Nighttime sound levels in the patients' rooms were 10 dB greater than the standard value reported by World Health Organization (WHO) for patients' rooms in hospital (24).

The level of sound also increase with staff entries and exits into the patient's room. Receiving nursing care during the night (such as receiving medication, controlling vital signs, changing the serum, requiring urine drainage), nausea and vomiting, and even hearing the groin of other patients are the causes of waking up frequently during the night. Leukemia is one of the most common types of childhood cancer. One of the major methods for the treatment of leukemia is chemotherapy with high dose dexamethasone and vincristine that have an effect on sleep quality. This drug increases the number of waking up in the middle of the night and the duration of nap during the day (35). In addition, napping during the day might reduce the sleep duration during night.

The findings of this study showed a significant association between sleep quality and fatigue. According to the regression results, fatigue was higher in patients with poor sleep quality. In addition, the mean of fatigue in children and adolescent with cancer increased by increasing in sleep disturbances, the amount of sleep medication and sleep latency. The mean of fatigue was

significantly higher in patients with more daytime dysfunction than other patients. Fatigue score also increased with getting worse of subjective sleep quality. In Zupanec et al. study, the mean of fatigue had a significant positive correlation with sleep disturbance.

According to their study, sleep disturbances could increase fatigue intensity. Fatigue also correlated with sleep quality in their study (39). In orsey et al. study, Fatigue correlated with self-reported sleep quality (25). This shows the importance of the nursing interventions in reducing sleep disturbance in patients with cancer. In Mulrooney et al. study, exposure to radiotherapy was the only predictor of fatigue in patients with cancer (12). Moreover, in Erickson et al. study, the severity of fatigue and sleep disturbance increased after chemotherapy (42). Cancer and tumors are a cause of fatigue. Tumors help to create fatigue with production of cytokines, pain and neuron vod Ukraine factors (neurodegenerative) (43). Cancer treatment improves these factors, but these treatments help to increase sleep disturbance and fatigue through disrupting in cytokine secretion (44, 45). Olson reported that sleep problems and fatigue often occurred together. According to their result, inadequate sleep may increase fatigue and maybe fatigue may result in difficulty initiating or maintaining sleep.

So, directionality of this relationship is unclear (37). Fatigue in cancer patients is a multifactorial problem. It may be due to biological mechanisms and psychological / behavioral effects such as stress and depression (20). Immobility during cancer treatment may also increase weakness and fatigue(46). Some strategies such as sleeping, eating, self-care (i.e. aromatherapy, hot baths), favorite activities (i.e. seeing and talking to friends and family), and medication to improve sleep quantity and quality, and engaging in a purposeful and enjoyable activity can be effective to improve fatigue in cancer patients.

4-1. Limitations of the study

The limitation of the present study is relying on parent's reports in completing the questionnaire. Future studies can use diagnostic tests to measure the quality and quantity of sleep.

5- CONCLUSIONS

More than half of the children with cancer in this study had poor sleep quality. They experience many problems related to sleep, such as longer sleep onset latency, reduction in duration of nighttime sleep, frequent nighttime waking, daytime dysfunction and fatigue. Duration of nighttime sleep in children with cancer in this study was lower than standard duration of sleep in healthy children. In this study, sleep quality in patients getting worse by increasing fatigue score, of course, this is a two-way relationship. Fatigue also may be caused by poor quality of sleep.

Given the presence of sleep disturbances, frequent waking ups during the night, and sleep duration reduction, it is necessary to set time nursing care during the night to prevent frequent waking during the night. It is also possible to increase the sleep duration during the night by entertaining the child throughout the day and preventing from long naps during the day. According to the increase in survival rates of cancer, screening for the diagnosis and prevention of sleep problems seems useful. To better investigate the sleep problems of patients with cancer, researchers must use objective measures such as polysomnography (PSG) and actigraphy. Researchers need to do more studies to investigate the effects of radiation and chemotherapy on cancer patients' sleep problems. In addition, future studies

should examine the causal relationship between fatigue and sleep.

6- AUTHORS CONTRIBUTIONS

Mahdieh Momayyezi and Dr Mohammad Momayyezi conceptualized and designed the study, drafted the initial manuscript, designed the data collection instruments, and approved the final manuscript as submitted.

Dr Hossein Fallahzadeh carried out the initial analyses, reviewed and revised the manuscript, and approved the final manuscript as submitted.
Ms Fatemeh Farzaneh coordinated and supervised data collection, critically reviewed the manuscript, and approved the final manuscript as submitted.

7- CONFLICT OF INTEREST: None.

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Table-1: Mean of components of Pittsburgh sleep quality index (PSQI) based on gender and clinical characteristics

Variable		PSQI Total score	PSQI Subjective quality	PSQI latency	PSQI duration	PSQI efficiency	PSQI disturbance	PSQI medications	PSQI dysfunctions
Gender	Girl (n=60, 59.4 %)	6.87±4.05	1.4±0.81	1.72±0.9	061±0.21	1.26±0.75	1.32±0.59	0.88±0.2	1.18±0.19
	Boy (n=41, 40.6 %)	6±3.56	1.51±0.79	1.03±0.7	0.34±0.18	1.02±0.16	1.27±0.5	0.82±0.24	1±0.1
P-value		0.35	0.53	0.07	0.1	0.05	0.79	0.95	0.17
Treatment method	Chemotherapy (n=77, 77 %)	6.34±3.8	1.4±0.8	1.55±0.78	0.4±0.13	1.15±0.55	1.27±0.58	0.91±0.38	1.1±0.1
	Chemotherapy and Surgery (n=9, 9 %)	6.16±2.7	1.75±0.7	1.42±0.78	0.5±0.2	1±0	1.28±0.48	0.37±0.21	1.31±0.17
	Chemotherapy and Radiotherapy (n=6, 6%)	5.1±2.6	1.5±0.2	1.26±1	0.5±0.22	1.5±0.22	1.4±0.54	0±0	1.22±0.1
	Chemotherapy, Radiotherapy and Surgery (n=8, 8 %)	8.83±2.9	1.5±0.5	2±1.1	0.7±0.31	1.25±0.7	1.33±0.51	1.12±0.43	1.4±0.28
P-value		0.41	0.7	0.32	0.84	0.45	0.97	0.25	0.4
Type of cancer	Leukemia (n=61, 60.4 %)	6.8±4.2	1.41±0.8	1.56±0.84	0.56±0.2	0.21±0.3	1.26±0.6	1±0.18	1.23±0.21
	Lymphatic (n=22, 21.8 %)	5.42±3.4	1.27±0.7	1.36±1.09	0.4±0.15	1.04±0.12	1.31±0.67	0.59±0.2	0.8±0.09
	Bone (n=13, 12.8 %)	7.9±4.4	1.5±0.9	1.81±1.07	0.63±0.21	1.36±0.47	1.18±0.4	0.91±0.41	1.58±0.19
	Other (n=5, 5 %)	6.5±3.47	1.6±0.7	1.62±1.1	0.46±0.18	1.13±0.25	1.33±0.48	0.8±0.1	1.1±0.1
P-value		0.14	0.56	0.57	0.7	0.51	0.87	0.73	0.002

Table-2: Multiple linear regression results to examine the relationship between sleep quality and independent variables

Variables	B	P-value
Fatigue	0.13	0.000
Gender		
Boy	-0.66	0.35
Treatment method		
Chemotherapy, Radiotherapy and Surgery	-0.04	0.97
Chemotherapy and Surgery	-02.37	0.09
Chemotherapy and Radiotherapy	-0.76	0.58
Type of cancer		
Lymphatic	-0.88	0.34
Bone	0.6	0.6
Other	-0.68	0.44

B: Second type error in statistics.

Table-3: Mean of fatigue based on components of Pittsburgh sleep quality index (PSQI)

Sleep quality parameters		Mean	Standard deviation	P-value
Subjective sleep quality*	Very good	24.33	17.11	0.000
	Fairly good	47.19	16.69	
	Fairly bad	59.7	12.27	
	Very bad	72.83	15.83	
Sleep efficiency*	> 85%	51.45	18.97	0.31
	75-84%	67.6	5.41	
	65-74%	62	0	
	>65%	51.66	36.77	
Daytime dysfunction*	Never	44	20.2	0.000
	< 1 times per week	47	13.03	
	1-2 times per week	62	15.16	
	>3 times per week	74	12.68	
Sleep disturbances*	0	31.5	16.26	0.000
	1-9	46	17.18	
	10-18	64.85	17.32	
	19-27	85.5	4.9	
Sleep duration (hours)*	>7	50.41	18.08	0.37
	6-7	54.45	21.34	
	5-6	58.25	11.78	
	<5	64.2	27.1	
Sleep latency (minutes)*	<15	44.64	19.88	0.000
	16-30	42.22	18.19	
	31-60	54.63	13.83	
	>60	67.63	16.52	
Use of sleeping medications*	Never	47.64	19.18	0.02
	< 1 times per week	42	13.52	
	1-2 times per week	54.66	17.91	
	>3 times per week	68.73	15.62	
Overall sleep quality**	Poor	61.21	16.64	0.000
	Good	35.96	15.56	

* ANOVA; ** Independent T-test.