The Predictive Power of Pain Characteristics and Sleep Quality on Fatigue in Adolescents With Cancer

Aslı Akdeniz Kudubes, RN, PhD, Murat Bektas, RN, PhD,† and Gülçin Özalp Gerceker, RN, PhD†*

Summary: This study was conducted as descriptive, methodological, and cross-sectional research to determine the predictive power of pain characteristics and sleep quality on fatigue in adolescents with cancer. The study was conducted between November 2020 and April 2021 with 139 adolescents with cancer who reported pain. The study data were collected via an AdolescentInformation Form, the Adolescent Pediatric Pain Tool, the Scale For The Assessment Of Fatigue in Pediatric Oncology Patients Aged 13-18, and the Sleep Assessment Scale for Children with Cancer—Adolescent Form. Mean values, percentage calculations, Pearson correlation analysis, and linear regression analysis were used in the analysis of the data. There was a high level and negative correlation between pain characteristics (pain location, severity, and quality) of the adolescents participating in the study and their mean scores from the overall fatigue scale and its subdimensions and a high level and positive correlation with their mean scores from the overall sleep quality scale. Pain characteristics and sleep quality of adolescents with cancer explained 74% of fatigue. Pain, sleep quality, and fatigue are symptoms that should be closely addressed in adolescents with cancer.

Key Words: pain, fatigue, sleep, cancer, adolescent

(*J Pediatr Hematol Oncol* 2023;45:301–308)

As a result of medical developments in pediatric oncology, childhood cancers today are not seen as an acute or terminal disease but a life-threatening chronic disease.[1] However, while the methods used in cancer treatment increase the recovery rates, on the other hand, they can cause undesirable outcomes for the child and the family.[1] Cancer treatment can cause many disturbing symptoms in children. Pain, fatigue, and sleep problems are among the most common symptoms and constitute an important area in the care of children with cancer.[2,3]

Pain is a common experience in adolescents with cancer and is cited as one of the most common factors that impair quality of life. Pain in adolescents with cancer is seen depending on the nature of cancer, its treatment and side effects, and various interventional procedures.[2,4] Adolescents experience problems such as fatigue, decrease in sleep quality, eating disorders, and decrease in school success due to pain. Depending on these problems, daily living activities of adolescents are affected.[5,6] Depending on various factors such as the type, location, duration, and cause of the pain, the fatigue and sleep quality of adolescents change.[2,3]

Fatigue is one of the common symptoms in adolescents with cancer. Some studies in the literature have shown that 51% to 86% of adolescents with cancer experience fatigue due to cancer and its treatment.[3,7,8] In particular, as the severity and the duration of pain that adolescents experience increase, their fatigue increases, as well.[9,10] The child's need for rest increases depending on fatigue, and problems such as insomnia/excessive sleepiness are observed. Therefore, it is important to determine the factors that affect fatigue to plan care.[10]

Frequent hospitalizations, physical symptoms, and the side effects of drugs/treatment are factors that cause sleep problems in adolescents with cancer. Sleep quality frequently decreases, especially due to side effects, such as pain, oral mucositis, and nausea-vomiting experienced by adolescents.[11] Some studies have reported that adolescents with chronic diseases such as cancer experience more sleep problems.[11–13] Inadequate and poor-quality sleep may lead to difficulties in performing daily functions, focusing and memory problems, low motivation, deterioration in mood, behavioral and cognitive problems, anxiety, and increased fatigue.[11]

The effectiveness of interventions to treat fatigue and sleep problems depends on the accurate assessment of the factors that affect these symptoms. Considering the multidimensional nature of fatigue and sleep problems, it is important to determine each of the influencing factors.[14] For this reason, it is important to comprehensively evaluate pain, which is one of the important factors that affect fatigue and sleep quality, and to reveal the relationship between these 3 factors.[14,15] A review of the literature indicated that fatigue, sleep quality, and pain were examined in detail separately, but studies on the relationship between these 3 symptoms and the predictive power of pain and sleep quality on fatigue were limited.[4,11,15,16] Therefore, there is a need for studies on the predictive power of pain characteristics and sleep quality on fatigue in adolescents with cancer in our country.

This study was planned to determine the predictive power of pain characteristics and sleep quality on fatigue in adolescents with cancer. To do this, the following research questions were generated:

(1) What are the pain characteristics of adolescents with cancer?
(2) What are the mean fatigue and sleep quality scores of adolescents with cancer?
(3) What is the relationship between pain characteristics, fatigue, and sleep quality in adolescents with cancer?
(4) What is the predictive power of pain characteristics and sleep quality on fatigue in adolescents with cancer?

Received for publication April 13, 2022; accepted May 15, 2023.
From the *Department of Pediatric Nursing, Bilecik Şeyh Edebali University Faculty of Health, Bilecik; and †Dokuz Eylul University Faculty of Nursing, Izmir, Turkey.
This study was approved by the Institutional Review Board of the University.
All the authors contributed to the concept and design, acquisition and interpretation of data, drafting the article, and gave final approval of the version to be published.
The authors declare no conflict of interest.
Reprints: Aslı Akdeniz Kudubeş, RN, PhD, Department of Pediatric Nursing, Bilecik Şeyh Edebali University Faculty of Health, Bilecik, 11220, Turkey (e-mail: asliakdeniz@hotmail.com).

DOI: 10.1097/MPH.0000000000002707

METHODS

Study Design and Setting

The study sample consisted of adolescents who were being treated at the Pediatric Oncology and Hematology Divisions of a university hospital located in Izmir and who had undergone chemotherapy between November 2020 and April 2021.

Participants

Participants were individuals who (a) were between 13 and 18 years of age, (b) were being treated at the Pediatric Oncology and Hematology Department, (c) who reported pain, (d) adolescents without nausea and vomiting, (e) adolescents not using sedative analgesics, (f) adolescents with a hemoglobin value >10 mg/dL and (g) volunteered to participate in the study. Adolescents who were in the terminal period, had consciousness and/or sensory disorders, could not express themselves, were not literate, and did not want to participate were not included in the study. The minimum sample size required for the study was calculated using the GPOWER 3.0 statistical analysis software based on a type I error of 0.05, type II error of 0.20 (0.80 power) and 0.15 (medium) effect size, and the sample size required for multiple linear regression analysis was determined as 107 adolescents with cancer.

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Checklist was used as a guideline (Fig. 1). A total of 143 adolescents were evaluated for eligibility between November 2020 and April 2021. Individuals with communication problems (n = 1) and those who refused to participate (n = 3) were not included in the study. Therefore, a total of 139 adolescents were included in the study by using the convenience sampling method (Fig. 1).

Outcome Measures

Adolescent Information Form

This form, which was created by the researchers based on the literature, consists of 12 questions, which were designed to obtain descriptive data about variables used in the study, such as age, sex, diagnosis, stage of the disease, type of treatment, duration of treatment, place of treatment, presence of painful procedures applied recently (in the last week), presence of mucositis, use of analgesic medication recently (in the last week), the status of undergoing surgery recently (in the last month), and method of coping with pain.[3,14–16]

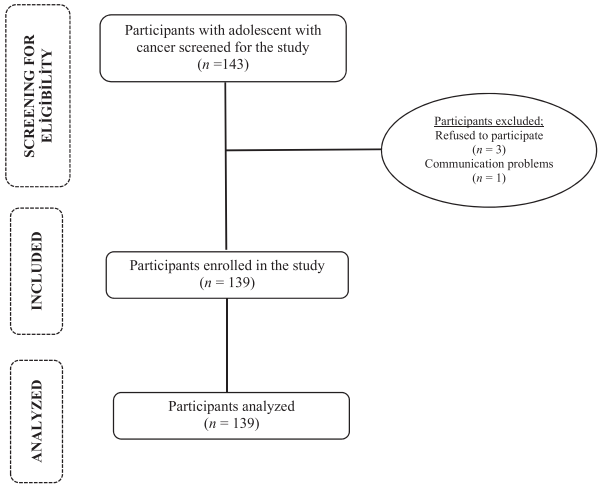

FIGURE 1. Participant flow diagram.

The Adolescent Pediatric Pain Tool (APPT)

This scale was originally developed by Savedra et al[17] as a multidimensional (location, intensity, severity, and quality of pain) measurement instrument for self-report of pain by children and adolescents between the ages of 8 and 17. Its validity and reliability study in Turkish population was conducted by Özalp Gerçeker et al.[16] It is frequently used in the evaluation of cancer pain and is a multidimensional self-report tool that measures the intensity and severity of the pain experience. Cronbach α value of the total scale is 0.78. It consists of 3 independent parts:

(1) The total number of body areas marked on body outline diagram for the measurement of pain location.
Assessment: The child can mark the anterior and posterior sides-upper extremity, lower extremity, head, neck, abdomen, chest, shoulder, back, etc. so that the pain area location and number are evaluated.
(2) Word graphic rating scale for the measurement of pain intensity.
Assessment: With a 0 to 10 cm scale, the child evaluates the pain from 0 to 10 and defines the intensity of the pain by choosing one of "no pain, little pain, medium pain, large pain and worst possible pain."
(3) Word descriptor list, sensory, affective, evaluative, and temporal word descriptors.
Assessment: Contains 15 word sections, marks the words describing the pain. The percentage is obtained by dividing the total number of words in each dimension by the total number of words in that dimension.[16,17]

The Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18

This scale was developed by Bektas and Kudubeş in 2014.[18] It consists of questions that determine the fatigue status of pediatric oncology patients in the 13 to 18 age group. Cronbach α value of the total scale was 0.99, the total factor load was between 0.82 and 0.95, and the total explained variance was 89.4%. There are a total of 32 items and 4 subdimensions on the scale. The general problems subdimension includes the first 19 items for determining the fatigue of pediatric oncology patients. The sleep problems subdimension consists of items from 20 to 25, which are used to identify sleep-related problems due to the fatigue experienced by pediatric oncology patients. The cognitive problems subdimension includes items from 26 to 29, which are used to determine the cognitive problems that develop due to fatigue experienced by pediatric oncology patients. The treatment-related problems subdimension includes items between 30 and 32, which are used to determine the effect of the treatment received by pediatric oncology patients on fatigue. The scale has a 5-point Likert-type evaluation structure, and each item is scored between "1" and "5." Scores that can be obtained from the scale range between 32 and 160. The cutoff point of the scale is 75.5, and scores below 75.4 indicate that the adolescent is tired. Increased scores on the scale indicate decreased levels of fatigue.

The Sleep Assessment Scale for Children With Cancer —Adolescent Form

This scale was developed by Arıcıoğlu and Bektaş in 2018.[19] It consists of questions that were designed to determine the sleep quality of children with cancer in the 13 to 18 age group. Cronbach α value of the total scale was

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0.96, the total factor load was between 0.54 and 0.90, and the total explained variance was 82.5%. The scale consists of 20 items in total. It is a 4-point Likert-type scale, and each item is scored between "1" and "4." Scores on the scale range between 20 and 80. Increased scores indicate decreased levels of sleep quality.

Data Collection Procedure

The purpose of the study was explained to all adolescents and their parents, and they were asked to sign an informed consent form. Then, data were collected via face-to-face interviews by the principal researcher using data collection forms. Data collection took ~10 to 15 minutes for each participant.

Ethical Considerations

Before the study was initiated, the permission of the owners of the scales used in the research was obtained via e-mail. The necessary institutional permission to conduct the research was obtained. The study was approved by the University Non-Interventional Clinical Research Ethics Committee (Decision No: 5699-GOA, 2020/27-34). The principal researcher explained the purpose of the study, and obtained verbal and written informed consent from all adolescents and their parents. Participants were allowed to withdraw from the study anytime without giving any reason.

Data Analysis

The data were analyzed using SPSS, version 28.0 (IBM Corp). The Shapiro-Wilk *W* test, histogram, and normal Q-Q plot were used for tests of normality. Frequency and percentage values were calculated for categorical variables. Mean and SD values were calculated for features showing normality. Pearson correlation analysis was employed to evaluate the relationships between the sections of the APPT and the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 and the Sleep Assessment Scale for Children with Cancer—Adolescent Form. According to the cutoff point of the fatigue scale, the patients with scores <75.4 were determined as tired, and those with scores greater than this cutoff point were considered not tired. The predictive level of the adolescent's pain characteristics (pain location/the total number of body areas marked on body outline diagram, pain intensity, pain severity, and pain quality/total number of word descriptors) and sleep quality on fatigue was evaluated by logistic regression analysis. A variance VIF value of <10, a tolerance value of <0.2, and a condition index value of <15, which are independent variables, were included in the logistic regression analysis. Results were evaluated with a 95% CI, and the *P* value <0.05 value was accepted as a significance level.

RESULTS

Descriptive Characteristics of the Participants

The descriptive characteristics of the adolescents participating in the study are given in Table 1. The participants in this study were homogeneous in terms of descriptive characteristics ($P > 0.05$).

TABLE 1. Patient Characteristics (N = 139)

	n (%)
Age, mean ± SD (minimum-maximum)	12.6 ± 3.8 (8-18)
Sex	
Male	71 (51)
Female	68 (49)
Diagnosis	
Acute lymphoblastic leukemia	49 (35.3)
Acute myeloid leukemia	11 (7.9)
Ewing sarcoma	22 (15.8)
Osteosarcoma	21 (15.1)
Neuroblastoma	9 (6.5)
Lymphoma	15 (10.8)
Other tumors	12 (8.6)
Stage of the disease	
New diagnosis/induction	10 (7.3)
Consolidation	82 (59.0)
Remission	45 (32.3)
Relapse	2 (1.4)
Type of treatment	
Chemotherapy	112 (80.5)
Radiotherapy	10 (7.3)
Surgical	15 (10.8)
Bone marrow transplantation	2 (1.4)
Treatment duration	
1-4 mo	60 (43.3)
5-9 mo	70 (50.3)
Over 10 mo	9 (6.4)
No. chemotherapy cure	4.1 ± 3.6 (1-15)
Site where chemotherapy received	
Inpatient	112 (80.5)
Outpatient	27 (19.5)
The presence of mucositis	
Yes	18 (13.0)
No	121 (87.0)
Painful procedures (last week)	
Port needle change	46 (33.0)
Intravenous catheter change	22 (15.9)
Lumbar puncture	22 (15.9)
None	49 (35.2)
Surgery (last month)	
Yes	17 (12.3)
No	122 (87.7)
Use of pain medication (last week)	
Yes	89 (64)
No	50 (36)

Fatigue and Sleep Quality Scores of the Participants

The mean score of the adolescents in the study from the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 was 86.63 ± 40.17. According to the score obtained from this scale, 49.6% (n = 69) of the adolescents were determined as tired, and 50.4% (n = 70) were determined as not tired. The mean scores of the adolescents participating in the study from the subdimensions of the scale were 51.50 ± 23.68 for general problems, 16.27 ± 7.77 for sleep problems, 10.63 ± 5.24 for cognitive problems, and 8.22 ± 3.79 for treatment-related problems. In addition, it was determined that the mean score of the adolescents from the Sleep Assessment Scale for Children with Cancer was 51.35 ± 17.07.

Pain Characteristics of the Participants

The pain characteristics (pain location, intensity, severity, and quality) of the adolescents in the study are given in Table 2. Pain in adolescents was determined to localize in the lower extremities (43.9%) and shoulders (56.8%). The total number of body areas marked on the body outline diagram was 3.58 ± 1.17, and pain intensity was evaluated as 6.34 ± 2.11. Most of the patients stated that

TABLE 2. Pain Location, Intensity, Severity, and Quality According to the Adolescent Pediatric Pain Tool (N = 139)

	n (%)		
Pain location (front)			
Upper extremities	9 (6.5)		
Lower extremities	61 (43.9)		
Head and neck	35 (25.1)		
Abdomen	25 (18.0)		
Chest	9 (6.5)		
Pain location (back)			
Upper extremities	10 (7.2)		
Lower extremities	22 (15.8)		
Shoulder	79 (56.8)		
Head	28 (20.2)		
The total number of body area marked on body outline diagram, mean ± SD (minimum-maximum)	3.58 ± 1.17 (2-5)		
Pain intensity ratings (0-10), mean ± SD (minimum-maximum)	6.34 ± 2.11 (4-10)		
Pain Severity			
No pain (0)	—		
Little pain (1)	48 (34.5)		
Medium pain (2)	38 (27.3)		
Large pain (3)	34 (24.5)		
Worst possible pain (4)	19 (13.7)		
Pain descriptors* (sensory)			
Aching	79 (56.8)	Burning	93 (66.9)
Hurting	94 (67.6)	Hot	72 (51.8)
Like an ache	91 (65.5)	Cramping	102 (73.4)
Like a hurt	79 (56.8)	Crushing	93 (66.9)
Sore	78 (56.1)	Like a pinch	93 (66.9)
Hitting	114 (82.0)	Pressure	87 (62.6)
Punching	88 (63.3)	Itching	93 (66.9)
Throbbing	93 (66.9)	Like a sting	94 (67.6)
Like a pin	66 (47.5)	Scratching	92 (66.2)
Cutting	92 (66.2)	Stinging	96 (69.1)
Pin like	88 (63.3)	Shocking	98 (70.5)
Like a sharp knife	107 (77.0)	Shooting	99 (71.2)
Sharp	78 (56.1)	Numb	102 (73.4)
Stabbing	78 (56.1)	Stiff	94 (67.6)
Blistering	100 (71.9)	Swollen	95 (68.3)
		Tight	84 (60.4)
Pain descriptors* (evaluative)			
Miserable	85 (61.2)	Annoying	84 (60.4)
Bad	84 (60.4)	Never goes away	73 (52.5)
Horrible	83 (59.7)	Uncontrollable	53 (38.1)
Uncomfortable	84 (60.4)		
Pain descriptors* (affective)			
Awful	73 (52.5)	Terrifying	60 (43.2)
Dying	53 (38.1)	Dizzy	104 (74.8)
Crying	115 (82.7)	Sickening	76 (54.7)
Frightening	120 (86.3)	Suffocating	85 (61.2)
Screaming	73 (52.5)		
Pain descriptors* (temporal)			
Always	980 (57.6)	Forever	90 (64.7)
Off and on comes on all of a sudden	110 (79.1)	Once in a while	95 (68.3)
Constant	118 (84.9)	Sometimes	111 (79.9)
Continuous	116 (83.5)	Steady	102 (73.4)
Pain quality			
Type of word descriptors, mean ± SD (minimum-maximum)			
Sensory	20.32 ± 8.22 (9-31)		
Evaluative	3.51 ± 1.92 (1-6)		
Affective	5.15 ± 3.03 (1-9)		
Temporal	6.29 ± 2.23 (3-9)		
Total number of word descriptors	34.42 ± 14.31 (14-52)		

*Multiple fields are marked.

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they had little pain (34.5%) and medium pain (27.3%). The number of pain descriptors chosen by the children was 34.42 ± 14.31.

Correlation of Pain Characteristics, Fatigue, and Sleep Quality by Sample Characteristics

The relationship between pain characteristics, fatigue, and sleep quality of the adolescents participating in the study is given in Table 3. While a high level and negative correlation was found between the pain location and quality (total number of sensory, evaluative, affective, and temporal word descriptors) of the adolescents participating in the study and their mean scores from the total fatigue scale and its subdimensions, there was a moderate and negative relationship between pain intensity and severity and the mean scores obtained from the total fatigue scale, general problems subdimension, sleep problems subdimension, and treatment-related problems subdimension (Table 3).

While there was a high level and positive correlation between adolescents' pain location and quality (total number of sensory, evaluative, affective, and temporal word descriptors) and their mean scores from the total sleep quality scale, a moderate and positive correlation was found between participants' pain intensity and severity and their mean scores from the total sleep quality scale. In addition, a high level and negative correlation was found between participants' mean scores from the total fatigue scale and its subdimensions and their mean scores from the total sleep quality scale (Table 3).

According to the scores obtained from the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18, 49.6% (n = 69) of the adolescents were determined as tired.

The logistic regression analysis results showed that pain characteristics (pain location/total number of body area marked on the body outline diagram, pain intensity, pain severity, and pain quality/total number of word descriptors) and sleep quality predicted 74% of fatigue. In the logistic regression analysis, the sleep quality variable showed a significant effect, and increasing the score of sleep quality indicated that the risk of fatigue decreased by 1.123 (β = 1.123) (Table 4).

TABLE 3. Correlations of Pain Characteristics, Fatigue, and Sleep Quality

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. The total number of body area marked on body outline diagram	1													
2. Pain intensity	0.815	1												
3. Pain severity	0.815	1.000	1											
4. Sensory	0.973	0.832	0.832	1										
5. Affective	0.976	0.839	0.839	0.999	1									
6. Evaluative	0.975	0.846	0.846	0.997	0.999	1								
7. Temporal	0.973	0.821	0.821	0.996	0.996	0.991	1							
8. Total number of word descriptors	0.976	0.832	0.832	0.997	0.999	0.995	0.999	1						
9. Fatigue*	−0.879	−0.686	−0.686	−0.832	−0.835	−0.824	−0.850	−0.844	1					
10. Fatigue*/General problems	−0.879	−0.679	−0.679	−0.831	−0.834	−0.822	−0.849	−0.843	−0.996	1				
11. Fatigue*/Sleep problems	−0.862	−0.677	−0.677	−0.814	−0.818	−0.806	−0.833	−0.827	0.993	0.981	1			
12. Fatigue*/Cognitive problems	−0.878	−0.711	−0.711	−0.838	−0.840	−0.831	−0.851	−0.847	0.986	0.972	0.984	1		
13. Fatigue*/Problems with treatment	−0.844	−0.655	−0.655	−0.797	−0.800	−0.789	−0.815	−0.809	0.972	0.952	0.977	0.970	1	
14. Sleep quality†	0.819	0.681	0.681	0.798	0.799	0.792	0.805	0.803	−0.852	−0.842	−0.852	−0.855	−0.834	1

*Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18.
†Sleep Assessment Scale for Children.
**All correlations were significant at the 0.01 level (2-tailed).

DISCUSSION

Adolescents experience many symptoms during cancer treatment, and a single symptom can bring about the emergence of different symptoms.[20] Although pain is one of the most frequently reported symptoms during treatment and disease process, it also leads to many conditions, such as fatigue, weakness, insomnia, anxiety, and depression.[2] Pediatric oncology nurses play a key role in pain assessment and identifying potential strategies for managing pain and pharmacological and nonpharmacological treatments.[21] Self-report scales are the gold standard for assessing pain in adolescents, and validated pain assessment tools are available to guide clinicians in assessing pain. However, most pain assessment tools are unidirectional and generally assess pain intensity. Pain should be evaluated with versatile pain measurement tools and electronic evaluation diaries in adolescents.[22,23] When the pain characteristics of the adolescents participating in this study were examined, it was found that most of them experienced pain in the lower extremities and shoulders and that the pain intensity was 6.34 ± 2.11. Patients used sensory pain descriptors, such as

TABLE 4. The Level by Which the Pain Characteristics and Sleep Quality of the Adolescents With Cancer Predicted Their Fatigue (N = 139)

	Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18						
	Model 1						
						95% CI	
	β	SE	Wald	Significance	Exp(*B*)	Lower	Upper
The total number of body area marked on body outline diagram	0.083	1.237	0.005	0.946	1.087	0.096	12.273
Pain intensity rating	0.126	0.280	0.203	0.653	1.134	0.655	1.964
Total number of word descriptors	0.083	0.105	0.631	0.427	1.087	0.885	1.335
Sleep Assessment Scale for Children	0.116	0.035	11.194	0.001	1.123	1.049	1.202
Nagelkerke R^2			0.740				
Cox and Snell R^2			0.555				
−2 log likelihood			80.100				
Hosmer and Lemeshow test			$\chi^2 = 15.210$, $df = 8$, $P = 0.055$				

Exp(*B*) indicates standardized β.

burning (66.9%), numb (67.6%), and punching (63.3%), to define pain quality. Chemotherapy-induced neuropathic pain is frequently encountered in children with cancer, too. This pain was described as burning, shooting, numbness, and tingling in patients.[24] Evaluation of the quality of pain and determination of the cause of pain in this population is of significance in understanding whether there is motor impairment. The APPT that we used in this study is not limited to the single dimension of pain intensity, it can help discriminate between nociceptive and neuropathic pain.[25] APTT may also be used to provide a deeper understanding of the pain experience. It has been used in very few studies, but it is recommended for routine use in clinical practice and research.[26] In a study in which the effectiveness of Pain Buddy was evaluated through APTT, less moderate to severe pain was experienced in the intervention group.[27] However, no study with a large pediatric population with cancer using APTT was found. In this respect, the study sheds light on the pain characteristics of adolescents with cancer.

Fatigue is a fairly common symptom in children with cancer. It can affect children with cancer for years, starting from the diagnosis process.[8] Cancer-related fatigue may not be addressed in detail in pediatric population. Fatigue appears to be an expected symptom as a result of aggressive treatment in pediatric patients.[28] In our study, adolescents had high mean fatigue scores (86.63 ± 40.17), and 49.6% of them were evaluated as tired according to the scores. This result showed that half of the adolescents with cancer who participated in the study experienced the symptoms of fatigue intensely. In a study conducted with adolescents with cancer and their parents, it was reported that fatigue was inevitable and unpredictable and that it threatened normal life.[29] Some studies in the literature have reported that fatigue can be reduced through education and symptom management interventions.[7,30]

Controlling symptoms such as pain and sleep quality can reduce fatigue.[31] In a study with a very small sample conducted with children with leukemia and their families, children reported that they experienced intense symptoms of pain, sleep disturbance, and fatigue for 3 days after receiving chemotherapy.[32] In our study, the pain, sleep quality, and fatigue symptoms of the adolescents were evaluated, and a moderate and high negative correlation was found between the pain characteristics of the adolescents participating in the study and their fatigue levels, and a moderate and high positive correlation was found between the pain characteristics and sleep quality. Pain, sleep quality, and fatigue are symptoms that affect each other. Many symptoms such as fatigue are not experienced alone but can lead to increased treatment-related symptoms such as sleep disturbance, depression, pain, and decreased physical performance.[2,33,34]

In our study, adolescents' mean score from the sleep assessment scale was 51.35 ± 17.07, accordingly, it can be said that their sleep quality was moderate. In a study, it was reported that most of the children with cancer experienced inadequate sleep during the hospitalization process.[35] It was reported that sleep disorders were frequently experienced in children with cancer and that sleep hygiene was not satisfactory.[36] In another study, most of the adolescents and young adults (84%) had poor sleep quality.[37] In this study, the predictive power of pain characteristics and sleep quality on fatigue was investigated, and it was found that adolescents' pain characteristics and sleep quality explained 74% of fatigue. It was observed that sleep quality was the only variable that had a significant effect and that as sleep quality increased, fatigue decreased by 1.1 times. Fatigue is one of the most common symptoms and is usually accompanied by symptoms, such as pain, nausea, and poor sleep quality.[20] It is associated with sleep disturbances. Sleep can be disrupted by the hospital environment, medication, and changes in normal childhood development. Continuation of sleep disorders during treatment reduces sleep quality. Although pharmacological and nonpharmacological interventions for symptoms, such as pain, nausea, and vomiting, have advanced, adolescents continue to struggle with the symptom of decreased sleep quality.[3] This study, which investigated the effect of pain and quality of sleep on fatigue, revealed the close relationship between these 3 variables. Fatigue is highly affected by pain and sleep quality. Although it is stated that these symptoms are seen very frequently in studies evaluating the frequency of symptoms, this study reveals the necessity of controlling pain and increasing sleep quality to reduce fatigue. Pain, sleep disturbance, and fatigue symptoms experienced by

children can also affect the quality of life of families. More comprehensive studies are needed to examine children's symptom patterns, multiple factors affecting symptoms, and health outcomes during treatment.

Limitations

This study was conducted in a clinical setting in Turkey, which limits the generalization of the findings to different populations. Adolescents without pain were not included in this study. This exclusion criterion was determined to evaluate the effect of pain characteristics on fatigue. Adolescents without pain could also be included in this study.

CONCLUSIONS

Due to the disease itself and its treatment, adolescents experience several symptoms at the same time, try to cope with these symptoms, and in the meantime, many different conditions such as fatigue and insomnia may develop in adolescents. This is an important study revealing the effect of pain characteristics and sleep quality on fatigue in adolescents with cancer. The results of this study emphasize that pain symptoms and sleep quality are important determinants of reducing fatigue. Health professionals working in this field should know that pain and sleep quality are important predictors and that they should plan their interventions by being aware that interventions to cope with these symptoms can be effective in preventing other symptoms that may occur.

Health professionals considering the outputs of this study should be aware of the possible effects of pain and sleep quality on fatigue. Particularly, pediatric hematology-oncology nurses should consider evaluating the sleep quality, presence of pain, and characteristics of pain in the adolescent comprehensively when evaluating fatigue in clinical practice. Therefore, they should address these variables together in nursing care plans. In addition, pediatric hematology-oncology nurses must be advocates of the implementation of evidence-based interventions recommended for coping with symptoms. Further studies in different populations are needed to better understand the relationship between these 3 variables. Moreover, it is thought that investigation of the emergence of pain and other symptoms in adolescents and their effects on quality of life will be effective in providing multifaceted holistic care.

ACKNOWLEDGMENTS

The authors thank all participants.

REFERENCES

1. Pui CH, Gajjar AJ, Kane JR, et al. Challenging issues in pediatric oncology. *Nat Rev Clin Oncol*. 2011;8:540–549.
2. Linder LA, Hooke MC. Symptoms in children receiving treatment for cancer—Part II: pain, sadness, and symptom clusters. *J Pediatr Oncol Nurs*. 2019;36:262–279.
3. hooke mc, linder la. Symptoms in children receiving treatment for cancer—Part I: fatigue, sleep disturbance, and nausea-/vomiting. *J Pediatr Oncol Nurs*. 2019;36:244–261.
4. Thrane S. Effectiveness of integrative modalities for pain and anxiety in children and adolescents with cancer. *J Pediatr Oncol Nurs*. 2013;30:320–332.
5. Bukola IM, Paula D. The effectiveness of distraction as procedural pain management technique in pediatric oncology patients: a meta-analysis and systematic review. *J Pain Symptom Manage*. 2017;54:589.e1–600.e1.
6. Snaman J, McCarthy S, Wiener L, et al. Pediatric palliative care in oncology. *J Clin Oncol*. 2020;38:954–962.
7. Kudubes AA, Bektas M, Mutafoğlu K. The effect of fatigue-related education on pediatric oncology patients' fatigue and quality of life. *J Cancer Educ*. 2019;34:1130–1141.
8. Walter LM, Nixon GM, Davey MJ, et al. Sleep and fatigue in pediatric oncology: a review of the literature. *Sleep Med Rev*. 2015;24:71–82.
9. Erickson JM, MacPherson CF, Ameringer S, et al. Symptoms and symptom clusters in adolescents receiving cancer treatment: a review of the literature. *Int J Nurs Stud*. 2013;50:847–869.
10. Tomlinson D, Hinds PS, Bartels U, et al. Parent reports of quality of life for pediatric patients with cancer with no realistic chance of cure. *J Clin Oncol*. 2011;29:639–645.
11. Daniel LC, Aggarwal R, Schwartz LA. Sleep in adolescents and young adults in the year after cancer treatment. *J Adolesc Young Adult Oncol*. 2017;6:560–567.
12. Clanton NR, Klosky JL, Li C, et al. Fatigue, vitality, sleep, and neurocognitive functioning in adult survivors of childhood cancer: a report from the Childhood Cancer Survivor Study. *Cancer*. 2011;117:2559–2568.
13. Linder LA, Christian BJ. Nighttime sleep characteristics of hospitalized school-age children with cancer. *J Spec Pediatr Nurs*. 2013;18:13–24.
14. Crabtree VML, Rach AM, Schellinger KB, et al. Changes in sleep and fatigue in newly treated pediatric oncology patients. *Support Care Cancer*. 2015;23:393–401.
15. Pope N, Tallon M, McConigley R, et al. Experiences of acute pain in children who present to a healthcare facility for treatment. *JBI Database System Rev Implement Rep*. 2017;15:1612–1644.
16. Özalp Gerçeker G, Bilsin E, Binay Ş, et al. Cultural adaptation of the Adolescent Pediatric Pain Tool in Turkish children with cancer. *Eur J Oncol Nurs*. 2018;34:28–34.
17. Savedra MC, Holzemer WL, Tesler MD, et al. Assessment of postoperation pain in children and adolescents using the adolescent pediatric pain tool. *Nurs Res*. 1993;42:5–9.
18. Bektas M, Kudubes AA. Developing scales for the assessment of fatigue in turkish pediatric oncology patients aged 13-18 and their parents. *Asian Pac J Cancer Prev*. 2014;15:9891–9898.
19. Arıcıoğlu A, Bektaş M. Kanserli çocuklar için uyku değerlendirme ölçeği adölesan ve ebeveyn formunun geliştirilmesi; 2018.
20. Miller E, Jacob E, Hockenberry MJ. Nausea, pain, fatigue, and multiple symptoms in hospitalized children with cancer. *Oncol Nurs Forum*. 2011;38:382–393.
21. Duffy EA, Dias N, Hendricks-Ferguson V, et al. Perspectives on cancer pain assessment and management in children. *Semin Oncol Nurs*. 2019;35:261–273.
22. Stinson J, Jibb L, Nguyen C, et al. Development and testing of a multidimensional iPhone pain assessment application for adolescents with cancer. *J Med Internet Res*. 2013:15.
23. Baggott C, Gibson F, Coll B, et al. Initial evaluation of an electronic symptom diary for adolescents with cancer. *JMIR Res Protoc*. 2012;1:e23.
24. Lavoie Smith E, Li L, Chiang C, et al. Patterns and severity of vincristine-induced peripheral neuropathy in children with acute lymphoblastic leukemia. *J Peripher Nerv Syst*. 2015;20:37–46.
25. Jacob E, Mack AK, Savedra M, et al. Adolescent Pediatric Pain Tool (APPT) for multidimensional measurement of pain in children and adolescents. *Pain Manag Nurs*. 2014;15:694.
26. Fernandes AM, Campos Cde, Batalha L, et al. Pain assessment using the Adolescent Pediatric Pain Tool: a systematic review. *Pain Res Manag*. 2014;19:212.
27. Hunter J, Acevedo AM, Gago-Masague S, et al. A pilot study of the preliminary efficacy of Pain Buddy: a novel intervention for the management of children's cancer-related pain. *Pediatr Blood Cancer*. 2020;67:e28278.
28. Gibson F, Garnett M, Richardson A, et al. Heavy to carry: a survey of parents' and healthcare professionals' perceptions of

cancer-related fatigue in children and young people. *Cancer Nurs*. 2005;28:27–35.
29. Loades M, James V, Baker L, et al. Parental experiences of adolescent cancer-related fatigue: a qualitative study. *J Pediatr Psychol*. 2020;45:1093–1102.
30. Ekti Genc R, Conk Z. Impact of effective nursing interventions to the fatigue syndrome in children who receive chemotherapy. *Cancer Nurs*. 2008;31:312–317.
31. Ullrich C, Dussel V, Orellana L, et al. Self-reported fatigue in children with advanced cancer: results of the PediQUEST study. *Cancer*. 2018;124:3776–3783.
32. Gedaly-Duff V, Lee K, Nail L, et al. Pain, sleep disturbance, and fatigue in children with leukemia and their parents: a pilot study. *Oncol Nurs Forum*. 2006;33:641–646.
33. Zupanec S, Jones H, Stremler R. Sleep habits and fatigue of children receiving maintenance chemotherapy for all and their parents. *J Pediatr Oncol Nurs*. 2010;27:217–228.
34. Rodgers CC, Hooke MC, Hockenberry MJ. Symptom clusters in children. *Curr Opin Support Palliat Care*. 2013;7:67–72.
35. Traube C, Rosenberg L, Thau F, et al. Sleep in hospitalized children with cancer: a cross-sectional study. *Hosp Pediatr*. 2020;10:969–976.
36. Kim H, Zhou E, Chevalier L, et al. Parental behaviors, emotions at bedtime, and sleep disturbances in children with cancer. *J Pediatr Psychol*. 2020;45:550–560.
37. Fortmann J, Fisher A, Hough R, et al. Sleep quality among teenagers and young adults with cancer. *Cancer Nurs*. 2021;44:13–19.