

# Fatigue and Sleep Experiences at Home in Children and Adolescents With Cancer

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Children and adolescents undergoing cancer treatment frequently experience distressing symptoms, such as fatigue and sleep disturbance (Edwards, Gibson, Richardson, Sepion, & Ream, 2003; Miller, Jacob, & Hockenberry, 2011; Walker, Gedaly-Duff, Miaskowski, & Nail, 2010; Walker, Johnson, Miaskowski, Lee, & Gedaly-Duff, 2010). Fatigue is often characterized by physical symptoms, including lack of energy, decreased physical ability, and feelings of tiredness. It may be experienced before the initiation of treatment (Goedendorp, Gielissen, Verhagen, Peters, & Bleijenberg, 2008), during cancer treatment (Hinds, Hockenberry, Gattuso, et al., 2007; Perdikaris et al., 2009; Purcell et al., 2010), in disease-free survivors (Andrykowski, Donovan, Laronga, & Jacobsen, 2010; Bower et al., 2006), and at the end of life (Murphy, Alexander, & Stone, 2006; Teunissen et al., 2007; Ullrich et al., 2010).

Although the severity and frequency of fatigue have frequently been reported, many studies have not examined the multiple dimensions of fatigue—namely general, cognitive, and sleep/rest fatigue. The strategies for minimizing cancer-related fatigue in previous studies were predominantly physical exercise training interventions that primarily addressed the physical dimension and had documented benefits regarding fat mass, muscles, bones, flexibility, and endurance (Baumann, Bloch, & Beulertz, 2013; Braam et al., 2013; Chang, Mu, Jou, Wong, & Chen, 2013; Cramp & Daniel, 2008; Huang & Ness, 2011; Keats & Culos-Reed, 2008). However, other nonpharmacologic interventions (e.g., cognitive behavioral therapy, mind-body relaxation therapy, music therapy, sleep hygiene) may be useful in addressing other dimensions of fatigue, such as cognitive and sleep/rest fatigue, particularly in children who may not be able to perform physical exercise.

Multidimensional fatigue measures define the physical dimensions of fatigue with items such as feeling tired or experiencing physical weakness (Hinds, Hocken-

**Purpose/Objectives:** To (a) investigate fatigue and sleep patterns of children and adolescents at home and (b) examine factors associated with fatigue and sleep.

**Design:** Descriptive with repeated measures.

**Setting:** Homes of study participants in Los Angeles and Orange, California.

**Sample:** 35 children and adolescents with cancer.

**Methods:** Data were collected using the PedsQL™ Multidimensional Fatigue Scale, which was completed once at home by each participant, and sleep actigraphs, which were worn for five days at home following discharge from hospitalization.

**Main Research Variables:** General fatigue, cognitive fatigue, sleep-rest fatigue, sleep duration, sleep quantity, sleep efficiency, and wake after sleep onset.

**Findings:** More than half of the participants had problems with fatigue at home. Significant correlations were found between sleep/rest fatigue and sleep duration. Factors that affected fatigue were age, gender, and cancer diagnosis. Adolescents had more problems with fatigue than children, and female patients had more problems with fatigue than male patients. Patients with sarcoma had more problems with fatigue than those with leukemia, lymphoma, and other cancer diagnoses. Adolescents slept less than children.

**Conclusions:** Children and adolescents with cancer have fatigue and sleep problems at home that vary by age, gender, and cancer diagnosis.

**Implications for Nursing:** Data from the current study support the need for nurses to provide teaching about fatigue and sleep at home in children and adolescents with cancer. Future studies are needed to examine interventions that may alleviate fatigue and improve sleep at home.

**Key Words:** child; adolescent; fatigue; sleep

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berry, Tong, et al., 2007; Varni, Burwinkle, Katz, Meeske, & Dickinson, 2002; Varni, Burwinkle, & Szer, 2004). Cognitive fatigue is defined by items such as having difficulty with paying attention to things or remembering what people say (Varni et al., 2002). Sleep/rest fatigue is

defined by items such as sleeping a lot, having difficulty with sleeping through the night, feeling tired when waking up in the morning, or spending a lot of time in bed and taking a lot of naps (Varni et al., 2002).

Very little information is available about the cognitive and sleep/rest dimensions in children with cancer who are at home. The purpose of the current study was to examine (a) fatigue and sleep patterns at home and (b) whether factors such as age, gender, and cancer diagnosis were associated with fatigue and sleep patterns at home.

## Significance and Background

The incidence of children diagnosed with all forms of invasive cancer has increased from 11.6 cases per 100,000 children in 1975 to 15.7 cases per 100,000 children in 2011 (Howlader et al., 2014). Children with cancer experience multiple symptoms, with the most common being fatigue, sleep disruptions, pain, nausea, and decreased appetite (Miller et al., 2011; Walker, Johnson, et al., 2010). These symptoms are associated with diminished quality of life (Berger et al., 2005).

### Fatigue

Fatigue is one of the most prevalent symptoms in hospitalized children with cancer (Miller et al., 2011), and it often begins at the time of diagnosis and continues throughout treatment (Williams et al., 2012; Yeh, Wang, Chiang, Lin, & Chien, 2009). More than 50% of children with advanced cancer report drowsiness and energy loss (Van Cleve et al., 2012), and fatigue typically worsens at the end of life (Tomlinson, Hinds, Bartels, Hendershot, & Sung, 2011). Ullrich et al. (2010) found that 96% of children experienced fatigue during the last month of life, noting that it is a common source of suffering at the end of life. Walker, Gedaly-Duff, et al. (2010) discovered that fatigue was associated with negative emotions (e.g., feeling sad, mad, and sorry for oneself) and was reported to be burdensome and distressing. Children receiving treatment for cancer experience more fatigue-related distress than children not receiving treatment (Hinds, Hockenberry, Gattuso, et al., 2007; Jalmesell, Kreicbergs, Onelöv, Steineck, & Henter, 2006; Pöder, Ljungman, & von Essen, 2010; Theunissen et al., 2007; Yeh et al., 2009). Fatigue symptoms often continue in young survivors even after treatment is completed (Baggott, Dodd, Kennedy, Marina, & Miaskowski, 2009).

### Sleep

Lack of sleep is recognized as a problem that commonly occurs in patients with cancer and may be related to a disruption in the circadian control of the cell cycle (Rosen, Shor, & Geller, 2008). Sleep problems may

be associated with cancer itself or treatments for cancer (e.g., dexamethasone) (Hinds, Hockenberry, Gattuso, et al., 2007), as well as with pain and symptoms associated with the disease and its treatment (Sateia & Lang, 2008). In hospitalized children with cancer, sleep fragmentation is linked with nocturnal awakenings related to medical treatments and environmental interruptions (Hinds, Hockenberry, Rai, et al., 2007). Treatments may affect sleep quality, mood (e.g., anxiety, irritability), and behavior (Hinds, Hockenberry, Gattuso, et al., 2007).

Gedaly-Duff, Lee, Nail, Nicholson, and Johnson (2006) examined sleep disturbance during a three-day period in children with leukemia after they had taken vincristine. Children participating in the study were asked to wear a wrist actigraph for 72 hours so the authors could obtain activity data for naps and nighttime sleep periods. Actigraphy data showed that the children slept for 6–10 hours, with frequent awakenings. Healthy children similar in age (i.e., aged 6–13 years) typically sleep for 9–11 hours and are awakened one or two times during the night (National Sleep Foundation, 2015).

Rosen et al. (2008) noted that sleep problems in children with cancer may be associated with the direct effects of cancer and treatments for cancer (e.g., neurosurgery, chemotherapy, radiation therapy) or indirect effects from treatments (e.g., pain, fatigue, endocrinopathies, organ damage). Several studies have documented that sleep/wake disturbances occur during all phases of cancer care in children (Clark, Cunningham, McMillan, Vena, & Parker, 2004; Gibson, 2005; Gibson et al., 2005; Gibson, Edwards, Sepion, & Richardson, 2006; Vena, Parker, Cunningham, Clark, & McMillan, 2004).

Research on fatigue and sleep is predominantly focused on hospitalized patients who are undergoing chemotherapy. In several studies, fatigue was found to be associated with treatments (e.g., chemotherapy, corticosteroids) and nocturnal awakenings (Gedaly-Duff et al., 2006; Hinds, Hockenberry, Gattuso, et al., 2007; Rosen et al., 2008). However, very little information is available about fatigue and sleep experiences at home.

## Theoretical Framework

The symptom management theory (SMT) consists of three components (i.e., symptom experience, symptom management, and symptom outcomes) that are highly interdependent (Dodd et al., 2001; Humphreys et al., 2008). The underlying premise of SMT is that effective symptom management requires consideration of the three components.

Symptom experience consists of the individual's perception, evaluation, and response to a symptom. Symptom management describes the "what, where, why, how much, to whom, and how" of interventions, which

**Table 1. Demographic Characteristics (N = 35)**

Characteristic	$\bar{X}$	SD
Age (years)	12.8	2.7
Characteristic	n	
<b>Age</b>		
Adolescent (aged 13–17 years)	18	
Child (aged 8–12 years)	17	
<b>Cancer diagnosis</b>		
Leukemia or lymphoma	15	
Sarcoma	11	
Other	9	
<b>Ethnicity</b>		
Hispanic	16	
Caucasian	12	
Asian, African, or other	7	
<b>Gender</b>		
Female	18	
Male	17	

guide the clinician or investigator in selecting appropriate symptom management strategies (Dodd et al., 2001, p. 170) and are intended to avoid, postpone, or reduce the symptom experience (Humphreys et al., 2008). The symptom outcomes component encompasses symptom status and seven other outcomes (i.e., functional status, emotional status, self-care, costs, quality of life, morbidity and comorbidity, and mortality) that the individual may experience as the result of symptom experience and management (Dodd et al., 2001).

SMT also places the process of symptom management within the context of three domains of nursing science: (a) person (demographic, psychological, sociologic, physiologic, and developmental variables), (b) environment (physical, cultural, and social variables representing the “aggregate of conditions” in which a symptom is occurring), and (c) health and illness (risk factors, health status, and disease and injury) (Dodd et al., 2001, p. 171).

In this study, the current authors investigated the symptom experience of fatigue and focused on the fatigue experience in three dimensions (i.e., general, cognitive, and sleep/rest). The current authors also examined sleep, a variable within the symptom outcome of functional status, and explored whether sleep was associated with the symptom experience of fatigue. In addition, the current authors looked into whether fatigue and sleep varied by the domains of person (i.e., age, gender, and ethnicity), environment (i.e., home setting), and health and illness (i.e., cancer diagnosis and reasons for hospitalization).

## Methods

The current study was part of a larger study that used a descriptive research design with repeated measures

to examine pain and symptom experience in children at home following discharge from hospitalization.

Recruitment occurred from the pediatric oncology programs of Children’s Hospital of Orange County and Children’s Hospital Los Angeles, both in California. Both programs provide a full range of clinical services for infants, children, and adolescents with cancer and blood diseases, and they treat more than 1,100 new patients each year. Although recruitment occurred during patient hospitalization, data collection took place at home. Participants had to be (a) aged 8–17 years, (b) diagnosed with cancer, (c) scheduled to be discharged to home within 24–48 hours, and (d) able to speak and/or read English. Consent from the parent or legal guardian, as well as assent from the child, also had to be obtained. Exclusion criteria included a prior history of neurologic impairments (e.g., visual, hearing, or motor function deficits, developmental delay) that precluded completion of data collection procedures.

The current study was a pilot study to examine fatigue experiences in children with cancer at home, and the sample size was guided by the minimum required for pilot studies, which is 30 (Hertzog, 2008). The sample size of 35 in the current study allowed for an estimation of a moderate value to be similar to the mean total fatigue score ( $\bar{X} = 71$ ,  $SD = 18.2$ ) on the 0–100 PedsQL™ Multidimensional Fatigue Scale (MFS) previously reported by Varni et al. (2002) using a one-sample normal (exact method) with a 0.05 two-sided significance level and 0.8 power.

## Procedures

Two advanced practice RNs (APRNs) serving as co-investigators consulted with the oncology teams to determine which patients were eligible for the study. APRNs provided detailed information about the study to parents and children. Consent from the parent and assent from the child were obtained by APRNs when both agreed to participate. The research associate who received institutional review board certification and training in all data collection procedures instructed the parent and child to complete the data collection instruments at home, monitored completion of data collection instruments, and followed up with parents for logistic and technical issues. Parents were instructed to assist their children with completing the data collection instruments at home, as needed. Institutional review boards of the two participating children’s hospitals and of the University of California, Los Angeles, approved the study procedures.

## Instruments

At the time of enrollment, the research associate collected demographic information (i.e., age, gender, and ethnicity) and relevant medical information (i.e.,

**Table 2. Fatigue by Age, Gender, and Cancer Diagnosis (N= 35)**

Variable	Age				Gender				Cancer Diagnosis					
	Adolescents (n = 18)		Children (n = 17)		Female (n = 18)		Male (n = 17)		Leukemia or Lymphoma (n = 15)		Sarcoma (n = 11)		Other (n = 9)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Cognitive fatigue	78.5	20.8	81.7	17.1	72.2	19.2	90.1	13.7	80.5	15.2	69.1	15.3	90.3	16.4
General fatigue	72.9	21.3	79.8	19.8	69.6	20.6	84.7	18	82.4	15	58.4	15.7	84.8	14.7
Sleep/rest fatigue	69.4	17.1	75.5	16	68.8	15.8	76.8	17	71.7	13.6	65.4	12.5	78.6	14.4
Total fatigue	73.6	16.1	79	14.2	70.2	15	83.8	12.3	78.2	12.8	64.3	8.7	84.6	12.8

Note. Scores on the PedsQL™ Multidimensional Fatigue Scale range from 0–100, with lower scores indicating more problems with fatigue.

cancer diagnosis, reasons for hospitalization, and medications) of each child from the parent or the nurse.

**Fatigue:** The MFS, which consists of three subscales representing the different dimensions of fatigue (i.e., general, cognitive, and sleep/rest), was used to measure fatigue (Varni et al., 2002, 2004). Responses to questions related to how problematic each item was ranged from 0 (never a problem) to 4 (almost always a problem). Similar to the scoring procedures reported by Varni et al. (2002), items were reverse scored and linearly transformed ( $0 = 100$ ,  $1 = 75$ ,  $2 = 50$ ,  $3 = 25$ ,  $4 = 0$ ) to yield a score range of 0–100. Internal consistency reliability for the MFS was established previously, with the total score internal consistency reliability indicating a Cronbach alpha of 0.95. The Cronbach alphas for general fatigue, cognitive fatigue, and sleep/rest fatigue were 0.93, 0.93, and 0.88, respectively (Varni et al., 2002).

Construct validity indicated significant differences between healthy children and pediatric patients with cancer, respectively, for the total MFS ( $\bar{X} = 80.5$ ,  $SD = 13.3$  versus  $\bar{X} = 70.9$ ,  $SD = 18.2$ ,  $p < 0.001$ ); general fatigue ( $\bar{X} = 85.3$ ,  $SD = 14.9$  versus  $\bar{X} = 74.9$ ,  $SD = 19.6$ ,  $p < 0.001$ ); cognitive fatigue ( $\bar{X} = 81.1$ ,  $SD = 17.4$  versus  $\bar{X} = 70.9$ ,  $SD = 22.3$ ,  $p < 0.001$ ); and sleep/rest fatigue ( $\bar{X} = 75$ ,  $SD = 18.8$  versus  $\bar{X} = 67$ ,  $SD = 23.1$ ,  $p < 0.001$ ) (Varni et al., 2002). Construct validity of the MFS was further demonstrated by comparing healthy children (for total MFS,  $\bar{X} = 80.5$ ,  $SD = 13.3$ ) with children with cancer during treatment ( $\bar{X} = 68.5$ ,  $SD = 17.1$ ) and at 12 months off treatment ( $\bar{X} = 70.9$ ,  $SD = 19.9$ ,  $p = 0.001$ ). The MFS, which takes less than five minutes to complete, was done at the time of enrollment, on day 3 at home, and at the subsequent clinic appointment. Only data from home were included in the current study.

**Sleep:** A wristwatch-style actigraph device was used to measure (a) sleep duration (total minutes scored as sleep consisting of naps during the day and sleep during the night), (b) sleep efficiency (percentage of time the child was asleep in relation to the amount of time spent in bed), (c) sleep quantity (percentage of sleep duration in minutes scored as sleep), and (d) wake after sleep onset (number of minutes awake during the night). The reliability and validity of actigraphs in children are well established, with high correlations between wrist- and waist-recorded activity and sleep variables (sleep duration,  $r = 0.78$ ,  $p < 0.001$ ; sleep percentage,  $r = 0.89$ ,  $p < 0.001$ ; sleep efficiency,  $r = 0.91$ ,  $p < 0.001$ ) (Paavonen, Almqvist, et al., 2002; Paavonen, Fjällberg, Steenari, & Aronen, 2002).

## Data Analyses

All data were entered into SPSS®, version 20.0, and checked by two research associates. Descriptive statistics were used to summarize total and subscale fatigue scores, the different dimensions of fatigue (i.e., general, cognitive, and sleep/rest), and sleep variables (i.e., sleep duration, sleep efficiency, sleep quantity, and wake after sleep onset). Pearson's correlation was used to examine relationships between fatigue and sleep variables, whereas t tests were used to examine differences by age (children [aged 8–12 years] versus adolescents [aged 13–17 years]) and by gender (male versus female). Analyses of variance were used to examine differences by cancer diagnosis (i.e., leukemia or lymphoma, sarcoma, and other diagnoses).



## Results

Among the 42 children who were enrolled in the current study, 7 did not have complete fatigue and/or sleep actigraph data. Therefore, 35 participants were included in the analyses, with more than half being female, Hispanic, and diagnosed with leukemia or lymphoma (see Table 1). The mean age was 12.8 years (SD = 2.7 years). The majority (60%) were hospitalized for chemotherapy. Others were hospitalized for fever and/or neutropenia (29%) and other reasons, such as vomiting, diarrhea, and dehydration (11%).

The overall mean total fatigue score was 76.2 (SD = 15.4). More than half (54%) of the study participants said they often or almost always had problems with fatigue (MFS scores of less than 75 on the 0–100 scale). The mean subscale scores for the different dimensions of fatigue were 76.3 (SD = 20.8) for general fatigue, 80.1 (SD = 19.1) for cognitive fatigue, and 72.3 (SD = 16.8) for sleep/rest fatigue. Table 2 compares fatigue by age, gender, and cancer diagnosis. Adolescents had significantly more problems than children with overall fatigue—specifically general and sleep/rest fatigue, but not cognitive fatigue. Female patients had significantly more problems than male patients with not only overall fatigue ( $\bar{X} = 70.2$ , SD = 15 for female patients versus  $\bar{X} = 83.8$ , 12.3 for male patients,  $p < 0.0001$ ), but also with general, cognitive, and sleep/rest fatigue. Significant differences were noted in fatigue levels by cancer diagnosis. Participants with sarcoma ( $n = 11$ ) had significantly more problems with fatigue ( $\bar{X} = 64.3$ , SD = 8.7) than those with leukemia or lymphoma ( $n = 15$ ,  $\bar{X} = 78.2$ , SD = 12.8) and other cancer diagnoses ( $n = 9$ ,  $\bar{X} = 84.6$ , SD = 12.8,  $p = 0.001$ ). Figure 1 compares

the dimensions of fatigue in patients with leukemia or lymphoma, sarcoma, and other cancer diagnoses.

The overall mean sleep duration at home was 345.03 minutes or 5.7 hours (SD = 90.61 minutes or 1.5 hours). The average number of minutes awake after sleep onset was 34.4 (SD = 20.8). On average, sleep efficiency was 92% (SD = 4%, range = 77%–98%), and sleep quantity was 85% (SD = 9%, range = 61%–98%).

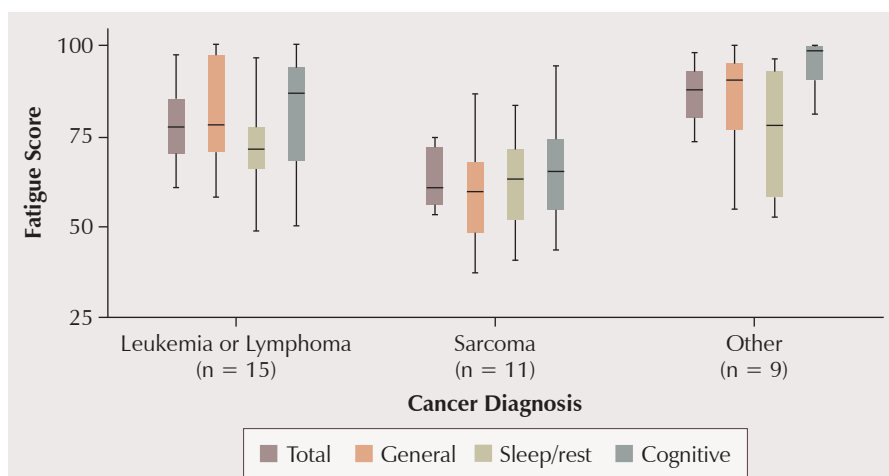
Significant differences were found in duration of sleep ( $p < 0.001$ ) between children and adolescents (see Table 3), with adolescents sleeping less ( $\bar{X} = 312$ , SD = 87.5) than children ( $\bar{X} = 380$ , SD = 82.4,  $p = 0.02$ ). Although no significant differences were observed in number of wake minutes after sleep onset, some children were awake for more than one hour after sleep onset, and some adolescents were awake for as many as two hours after sleep onset. In addition, no significant differences were observed in sleep quantity and sleep efficiency between children and adolescents; however, about half had less than 90% in sleep efficiency.

A significant correlation was found between sleep/rest fatigue and sleep duration ( $r = 0.41$ ,  $p = 0.01$ ). Children and adolescents who had shorter sleep duration were more likely to have more problems with fatigue.

## Discussion

The current authors examined fatigue and sleep in children and adolescents at home and found that study participants experienced fatigue at home that was similar to fatigue experiences during hospitalization (Erickson et al., 2011; Palmer, Meeske, Katz, Burwinkle, & Varni, 2007; Varni et al., 2002). For example, Erickson et al. (2011) found that in 20 children and adolescents (aged 12–19 years) who completed the MFS for four weeks after chemotherapy, as many as 75% reported feeling tired sometimes, often, or almost always.

Children and adolescents with cancer had significantly more problems with sleep/rest fatigue than with general or cognitive fatigue. The fatigue scores in the current study were consistent with those reported by others (Erickson et al., 2011; Palmer et al., 2007; Varni et al., 2002). Similar to the findings of the current study, Erickson et al. (2011) also noted that the children in their



Note. Scores on the PedsQL™ Multidimensional Fatigue Scale range from 0–100, with lower scores indicating more problems with fatigue.

Note. Boxplots show median, quartile, and interquartile ranges.

**Figure 1. Total, General, Sleep/Rest, and Cognitive Fatigue in Patients With Leukemia or Lymphoma, Sarcoma, and Other Cancer Diagnoses**

**Table 3. Sleep by Age, Gender, and Cancer Diagnosis (N = 35)**

Variable	Age						Gender						Cancer Diagnosis												
	Overall			Adolescents (n = 18)			Children (n = 17)			Female (n = 18)			Male (n = 17)			Leukemia or Lymphoma (n = 15)			Sarcoma (n = 11)			Other (n = 9)			
	$\bar{X}$	SD		$\bar{X}$	SD		$\bar{X}$	SD	p	$\bar{X}$	SD		$\bar{X}$	SD	p	$\bar{X}$	SD		$\bar{X}$	SD		$\bar{X}$	SD	p	
Duration (minutes)	345	90.6		312	87.5		380	82.4	0.02	342.6	81.4		347.4	100.8	0.88	339.2	87.9		319.3	108.9		386.1	60.1		0.25
Efficiency (%)	91.6	4.3		91.1	4.8		92	3.9	0.52	91.9	3.3		91.2	5.2	0.65	91.9	3.2		91.9	4.2		90.6	6.2		0.76
Quantity (%)	85.2	9.4		83.8	8.4		86.8	10.4	0.34	83.7	10.2		86.7	8.6	0.36	85.9	9.3		84.4	9.7		85.2	10.1		0.93
WASO (minutes)	34.4	20.8		35.9	23.6		32.8	18.1	0.67	34.3	15		34.6	25.6	0.97	33.4	14.4		29.7	15.4		41.9	33		0.43
WASO—wake after sleep onset																									
Note. Sleep duration was found to be significantly different between children and adolescents. No other significant differences were noted in sleep patterns by age, gender, or cancer diagnosis.																									

study, who were completing weekly fatigue scales during the 28 days after receiving chemotherapy, reported significant problems with sleep/rest fatigue. Sleep/rest fatigue may be related to symptoms that can interrupt the sleep-rest cycle (e.g., nausea, vomiting, diarrhea, urinary frequency) (Lee, Cho, Miaskowski, & Dodd, 2004; Lee & Landis, 2003). Discomfort from pain is another factor that could explain sleep/rest fatigue (Morrow, 2007). Changes in an individual's sleeping environment and routines, as well as noises, were previously reported to disrupt the sleep-rest cycle and contribute to sleep/rest fatigue during hospitalization (Hinds, Hockenberry, Rai, et al., 2007). However, the current authors were not able to collect information about the environment that could explain sleep/rest fatigue at home.

The cognitive fatigue scores in the current study were similar to those reported by hospitalized patients receiving chemotherapy (Erickson et al., 2011; Yeh, Man Wai, Lin, & Chiang, 2011). Children reported fewer problems with cognitive fatigue (Erickson et al., 2011). Survivors of childhood cancer have reported that fatigue and sleep problems affect cognitive function (e.g., attention, memory, thinking, reasoning) (Krull et al., 2012). However, cognitive fatigue, as measured by items on the MFS (Varni et al., 2002), is different from cognitive dysfunction, as measured by standardized neurocognitive testing (Krull et al., 2012). The current authors found very little information about cognitive fatigue in children and adolescents at home.

Although previous investigators did not find substantial differences in fatigue scores between children and adolescents with leukemia (Hinds, Hockenberry, Gattuso, et al., 2007), adolescents in the current study indicated more problems with fatigue than children. Meeske, Katz, Palmer, Burwinkle, and Varni (2004) also reported that adolescents with brain tumors or leukemia had more problems with fatigue than children. Adolescents who frequently engaged in poor sleep hygiene behaviors (e.g., keeping different sleep schedules on weekdays and weekends, engaging in stimulating activities prior to bed) may have disrupted their sleep-wake patterns (Meeske et al., 2004). Age differences may also be related to hormonal changes during puberty, greater social involvement, or greater awareness and symptom reporting (Erickson et al., 2011; Hinds, Hockenberry, Rai, et al., 2007; Meeske et al., 2004).

Female participants in the current study were found to have more problems with fatigue than male participants, which is consistent with findings by others (Meeske et al., 2004; Perdikaris et al., 2008, 2009). However, other investigators did not observe gender differences (Sanford et al., 2008; Williams et al., 2012). Future studies need to examine whether gender differences in fatigue frequency and severity are clinically meaningful (Miaskowski, 2004).

Children and adolescents with sarcoma had more problems with fatigue than those with leukemia, lymphoma, and other cancer diagnoses. Although previous studies found more problems with fatigue in pediatric patients with advanced leukemia, lymphoma, or brain tumors compared to those with solid tumors (Tomlinson et al., 2011), very little information was available about fatigue in pediatric patients with sarcoma. Previous studies

## Knowledge Translation

Children and adolescents with cancer had more problems with sleep/rest fatigue than with general fatigue or cognitive fatigue, whereas adolescents, female patients, and patients with sarcoma had lower mean total fatigue scores than children, male patients, and patients with other cancers.

On average, the overall mean sleep duration was less than six hours at home, with 34 minutes of being awake after sleep onset.

Shorter sleep duration was associated with fatigue problems.

combined the diagnosis of sarcoma with other types of tumors (Erickson et al., 2011; Perdikaris et al., 2008, 2009). Pediatric patients with sarcoma may have had more problems with fatigue because of bone pain, lack of activity, and impaired movement—factors that were previously noted in adults with bone cancer (Luger, Mach, Sevcik, & Mantyh, 2005).

Children and adolescents in the current study slept less than six hours (345 minutes on average) during the night, which was similar to a previous study involving hospitalized children with solid tumors or acute myeloid leukemia (Hinds, Hockenberry, Gattuso, et al., 2007). Sleep disruptions were previously reported to be associated with dexamethasone (Hinds, Hockenberry, Gattuso, et al., 2007; Vallance et al., 2010; van Litsenburg et al., 2011), a treatment that was continued at home, which could explain the shorter sleep duration. Significant correlations were found between fatigue and sleep. Those children and adolescents who had shorter sleep duration were more likely to have problems with fatigue. Gedaly-Duff et al. (2006) also found that fatigue was associated with sleep problems. Potential sleep problems at home may be attributed to disruption in sleep cycles or desynchronized sleep (Ancoli-Israel, Moore, & Jones, 2001).

## Limitations

Interpretation of the results of the current study should be considered in light of several limitations. The sample size was small, which restricted the power to detect statistical effects that otherwise may have been observed. Given the small number of participants with the different cancer diagnoses and reasons for hospitalization, drawing conclusions was not possible. Future studies would benefit from a larger sample size to describe the effects of person and health and illness variables on fatigue and sleep. In addition, the sample was recruited from pediatric oncology settings in the southwestern United States. Therefore, the findings may not be generalizable, and they may not be representative of fatigue experiences in other

settings, which may differ by characteristics related to cancer treatment. Specific types of cancer and some treatment protocols also vary widely, which may influence fatigue levels. However, because of small sample size, analyses of these variables were not possible. The current authors used the MFS (Varni et al., 2002) to measure fatigue and the sleep actigraph to measure sleep variables. Consequently, making comparisons with other studies that used different instruments and procedures to measure fatigue and sleep was not possible.

## Implications for Nursing and Conclusions

In the current study, children and adolescents with cancer experienced fatigue and sleep problems at home. They reported more problems with sleep/rest fatigue than general or cognitive fatigue. Findings from this study support the recommendation that nurses provide information about monitoring fatigue and sleep, as well as discuss strategies that could promote sleep and rest at home. For example, exercise interventions for decreasing fatigue have been shown to be effective in a small number of children and adolescents with cancer (Baumann et al., 2013; Keats & Culos-Reed, 2008). Various nonpharmacologic interventions may also be effective in addressing cognitive and sleep/rest fatigue, particularly in children who may not be able to perform physical exercises. In addition, disease-related symptoms (e.g., pain, nausea) may influence fatigue and decrease a child's willingness to participate in exercise interventions. Management of pain and other symptoms at home is important to discuss with families (Miller et al., 2011). Although very little information is available about effectiveness, other strategies for fatigue management include physical activity, massage therapy, and psychosocial interventions (Chang et al., 2013; Takken et al., 2009). Fatigue and sleep quality at home need to be assessed, similar to the way other symptoms (e.g., pain, nausea, vomiting) are evaluated during clinic visits (Miller et al., 2011). Future studies are needed to examine the different dimensions of fatigue with larger samples, factors that may affect fatigue and sleep, and the effectiveness of interventions for management of fatigue and sleep in children and adolescents with cancer at home.

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