

Patterns of fatigue in adolescents receiving chemotherapy

By: Jeanne M. Erickson, Susan L. Beck, Becky Christian, [William N. Dudley](#), Patricia J. Hollen, Karen Albritton, Margaret M. Sennett, Robyn Dillon, and Kamar Godder

Erickson, J., Beck, S., Christian, B., Dudley, W., Hollen, P., Albritton, K., et al. (2010). Patterns of fatigue in adolescents receiving chemotherapy. *Oncology Nursing Forum*, 37(4), 444-455.

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Abstract:

Purpose/Objectives: To describe patterns of fatigue in adolescents and the impact of fatigue during one month of chemotherapy, to explore variables that affect fatigue, and to explore the feasibility of collecting daily self-report data in this population.

Design: Longitudinal, descriptive.

Setting: Two pediatric oncology centers in central Virginia.

Sample: 20 adolescents with a variety of cancer diagnoses receiving chemotherapy.

Methods: Adolescents described daily fatigue for one month using rating scales and qualitative diaries

Main Research Variables: Fatigue severity.

Finding: Adolescents commonly reported a peak in fatigue in the days immediately following chemotherapy administration. The most common pattern for adolescents who received chemotherapy on a schedule every three to four weeks was a "declining rollercoaster" pattern, with fatigue severity alternating on a daily basis but gradually declining until chemotherapy was scheduled again. Adolescents who received chemotherapy weekly showed more frequent peaks and troughs (the "yo-yo" pattern) that did not diminish in severity over the weeks of the study. Adolescents associated fatigue with other symptoms, particularly sleep-wake disturbances, pain, and nausea, and frequently reported that fatigue interfered with daily activities.

Conclusions: Fatigue commonly bothers adolescents receiving chemotherapy, particularly in the days following chemotherapy administration and when other symptoms are present. Although fatigue interfered with the adolescents' abilities to maintain their usual lifestyles, many still participated in the typical activities of adolescence.

Implications for Nursing: Fatigue is a complex and dynamic symptom. Oncology clinicians and researchers should frequently assess fatigue in adolescents receiving chemotherapy and apply timely and tailored interventions to match the factors that contribute to fatigue and influence fatigue severity. Management of fatigue during treatment will help adolescents stay involved in age-related activities and meet developmental milestones.

Article:

Adolescents diagnosed with cancer represent a group of patients with a unique cancer epidemiology, development profile, and research needs. The population's most common cancers include lymphoma, leukemia, central nervous system cancers, endocrine and germ cell tumors, and sarcomas--a spectrum of cancers different than that seen in adults or in younger children (Bleyer, Viny, & Barr, 2006). Adolescents face cancer and receive treatment at a time in life that is full of physical, social, and psychological growth that determines future careers, lifestyles, and relationships. These circumstances result in cancer treatment and symptom experiences for adolescents that are not likely to reflect those of younger children or adult patients. Age-specific research, therefore, is required to determine tailored disease and symptom-management strategies for these vulnerable adolescents with cancer.

Cancer-related fatigue is one of the most frequent symptoms reported by adolescents and rated as one of the most distressing (Gibson et al., 2005; Hedstrom, Ljungman, & von Essen, 2005; Hockenberry-Eaton et al., 1998; Ream et al., 2006). Compared to children, adolescents are more aware of the combined physical and mental aspects of fatigue as well as more contributing and alleviating factors (Hinds et al., 1999). Fatigue adds a burden to adolescents' abilities to participate in usual activities and affects their mood and quality of life (Davies, Whitsett, Bruce, & McCarthy, 2002; Gibson et al., 2005; Meeske, Katz, Palmer, Burwinkle, & Varni, 2004; Woodgate, 2005). Although fatigue may be most disruptive to adolescents during cancer treatment, studies show that fatigue can persist as adolescents complete their treatment and mature into young adults, affecting social and career outcomes (Edwards, Gibson, Richardson, Sepion, & Ream, 2003; Langeveld, Ubbink, & Smetz, 2000; Ng et al., 2005; Ream et al., 2006).

Fatigue severity fluctuates during the trajectory of cancer treatment and is associated with numerous treatment-related factors. Evidence from adult studies suggests that, during a cycle of chemotherapy, fatigue increases in severity during the first few days after chemotherapy administration and declines until the next cycle (Berger, 1998; Schwartz et al., 2000; Stasi, Abriani, Beccaglia, Terzoli, & Amadori, 2003; Wu, Dodd, & Cho, 2008). Yeh et al. (2008) confirmed this pattern in a sample of 48 children and adolescents receiving a variety of chemotherapy regimens. A number of factors contribute to cancer-related fatigue in adolescents, including diagnosis, type of treatment and side effects, environment, and other symptoms such as pain and sleep disturbances (Gedaly-Duff, Lee, Nail, Nicholson, & Johnson, 2006; Hinds, Hockenberry, Rai, et al., 2007b; Yeh et al., 2008). Corticosteroids are linked to higher fatigue levels, possibly because they cause disrupted sleep and an altered activity and sleep cycle (Hinds, Hockenberry, Gattuso, et al., 2007; Yeh et al., 2008).

Many of the studies that provide evidence about cancer-related fatigue with adolescents measured the symptom at a single time point or described fatigue in oncology samples that included children as well as adolescents. The purpose of this study was to explore the trajectory of fatigue in adolescents during an early month of chemotherapy. A mixed methods design was used to describe the effect of fatigue from the perspective of the adolescent during a month of initial chemotherapy, to explore variables that affected fatigue, and to report on the feasibility of collecting daily self-report data from adolescents.

Conceptual Framework

A developmental science approach guided this study to consider that the fatigue experience in adolescents results from a dynamic interaction between individual, social, and environmental factors in the context of this unique developmental period (Cairns, 2000). This perspective recognizes the complex influences on the individual over time and takes into account the changing abilities of the person (Miles & Holditch-Davis, 2003).

The developmental science framework was used to define and describe the sample for the study: adolescents, aged 12-19 years, and likely to be in middle school or high school. The unique epidemiology and biology of adolescent cancers and the prescribed treatments create exclusive age-related symptom experiences unlike those of younger or older patients. Psychosocial and behavioral issues at this stage focus on changing relationships with peers, partners, and family, as well as lifestyle choices. Environmental and community factors for adolescents relate to home, school, social, and career settings. Exploring chemotherapy-related fatigue in the context of these age-related factors is necessary to fully understand etiologies and possible modification of contributing factors of fatigue.

Methods

Design

This study used a concurrent mixed methods design, imbedding a qualitative measure within a quantitative method to illustrate fatigue severity during a month of chemotherapy and to describe the effect and experience of fatigue from the perspective of the adolescent during a month of initial chemotherapy. This combined methodology promotes breadth and depth of a complex experience such as cancer-related fatigue (Wilkins & Woodgate, 2008). The participants self-reported fatigue for 28 days using a numerical rating scale and diary entries.

These findings are part of a larger study that examined fatigue, sleep-wake disturbances, and quality of life in adolescents receiving chemotherapy.

Settings

This study was conducted at the University of Virginia Health Center and the Virginia Commonwealth University Health System, health systems that treat patients from urban and rural settings. The institutional review board and cancer center protocol monitoring committee at each clinical site approved the study. A certificate of confidentiality was obtained from the National Institutes of Health to protect the identity of adolescents who might self-report the illegal use of tobacco, alcohol, or marijuana on study questionnaires.

Sample

The eligibility criteria for participants included adolescents who (a) were aged 12-19 years at the time of cancer diagnosis; (b) were receiving their second, third, fourth, or fifth month of chemotherapy; (c) assented to participate in the study; (d) had a parent who consented to the study if the adolescent was a minor; and (e) had the ability to read and write English. Exclusion criteria for the sample included adolescents who had a preexisting cognitive disability, psychiatric issue, communication disorder, or an unstable physical condition that would interfere with study participation as determined by the healthcare team.

Procedures

To enroll patients, clinical staff screened potentially eligible patients for those who were interested in hearing about the study. The principal investigator then met with patients to explain the study, complete the assent or consent process with the patient or parent (if the patient was a minor), and confirm participant eligibility by reviewing the medical record.

At baseline, the adolescent received a study notebook with written instructions about self-reporting and a calendar to indicate data collection points over the one-month period. Participants chose to complete either paper or electronic versions of the questionnaires.

Data collection began on the day of the next scheduled chemotherapy treatment and continued for the next 28 days. Participants were asked to complete the daily fatigue self-report forms toward the end of every day and to return completed forms each week by mail or during a clinic visit to the primary investigator.

The participants received compensation of \$10 per week or \$50 total for their participation in the study. Medical and treatment-related data were collected weekly from the medical record during the study period.

Instruments

Daily Fatigue Report Form: The Daily Fatigue Report Form is an investigator-developed form that asked the adolescents to rate their fatigue severity, fatigue bother, and fatigue interference using numerical rating scales that ranged from 0-10. Descriptive numerical rating scales and visual analog scales have been used in other studies to minimize patient burden when fatigue severity was measured on a daily basis (Ream et al., 2006; Schwartz, 2000; Wu et al., 2008). In a longitudinal study, Berger and Higginbotham (2000) included a single fatigue-intensity item and found that the item was highly correlated ($r < 0.93$, $p < 0.001$) with the Piper Fatigue Scale, and a review by Youngblut and Casper (1993) provided evidence to support the use of single-item indicators to measure symptom severity. As part of a larger study, this adolescent sample also reported their fatigue using the weekly PedsQL [TM] Multidimensional Fatigue Scale (MFS) (Varni, Burwinkle, Katz, Meeske, & Dickinson, 2002).

When daily fatigue severity scores were averaged to create one weekly fatigue severity score, this weekly average fatigue severity score was strongly correlated with the total PedsQL [TM] MFS score for that week ($r = 0.72$, $p < 0.01$) (Erickson, 2008).

The form also included five open-ended questions to elicit a richer description of the fatigue experience, based on the conceptual definition of cancer-related fatigue in adolescents by Hinds et al. (1999). Figure 1 illustrates the Daily Fatigue Report Form.

Medical record review: Baseline demographic data and information about the cancer diagnosis and treatment plan were retrieved from the medical record at the time of participant enrollment. Treatment information, such as the administration of chemotherapy agents and procedures performed, also were recorded weekly during the study period.

Data Analyses

Quantitative data from paper and electronic questionnaires were entered into a computerized database using Microsoft[R] Excel[R] and SPSS[R] 14.0 data management software. Qualitative data from the diaries were manually transcribed verbatim in chronologic order for each participant.

Patterns of fatigue: Daily fatigue scores were graphically displayed for each participant using Excel software, guided by the visual graphic analysis technique described by Brown, McGuire, Beck, Peterson, and Mooney (2007). Graphs were sorted into two groups based on the frequency of chemotherapy administered to the patients. Group 1 included eight patients who received chemotherapy every three to four weeks, and Group 2 included 12 patients who received chemotherapy treatment every week or every two weeks during the month. Trend lines were examined for peaks of fatigue severity and trajectory. The most common pattern of fatigue was identified for each group and validated by an additional researcher.

Variables affecting fatigue and impact of fatigue: Data analysis was completed following the prestructured case approach as outlined by Miles and Huberman (1994). Prestructured primary codes were created based on Hinds' conceptual definition of fatigue, and included antecedents, factors that contributed to or alleviated fatigue, and the effect of increased or decreased fatigue. Using an open-coding approach, responses were further categorized under each primary code. The number of participants who responded under a particular subcode also was counted or "quantitized" (Wilkins & Woodgate, 2008). The summary of codes, categories, and frequencies was verified by a second researcher with expertise in qualitative data analysis (Miles & Huberman, 1994). This process addressed the reliability of the coding as well as the validity of the named subcodes. Daily qualitative fatigue data for each subject also were paired with quantitative fatigue ratings for each day, and the pairings were explored for contributing and alleviating factors that further described the adolescents' experience with fatigue over one month.

Feasibility: To explore the feasibility of collecting daily self-report data in a sample of adolescents receiving chemotherapy, a percentage of missing responses was calculated for each participant. Diary entries were examined for the presence and quality of responses to each diary question. Differences in responses between paper and electronic questionnaires were explored.

Results

During the study enrollment period, 32 patients were invited to participate in the study. Twenty-five enrolled in the study, for a 78% accrual rate. Four patients who enrolled in the study returned no or minimal questionnaires (16% attrition rate), and no responses from those participants are included in these results. One patient was not included in data analysis for patterns because her chemotherapy regimen included only daily oral chemotherapy for the month. Data are reported from 20 adolescents.

Sample characteristics are shown in Table 1. The final study sample included 20 adolescents aged 12-19 years (\bar{X} age = 16.12 years, SD = 2.13) who mostly (85%) were Caucasian. The most common diagnoses were acute lymphoblastic leukemia, Hodgkin lymphoma, and non-Hodgkin lymphoma. The participants' length of time since starting chemotherapy to study entry ranged from 5-17 weeks (\bar{X} time on therapy = 8.71 weeks, SD = 3.56), although 15 (75%) completed this study during their second or third month of treatment. Participants were treated with 1 of 10 different treatment regimens specific to their cancer diagnoses. These

regimens included IV, intrathecal, and oral chemotherapy agents given every one, two, or three weeks, as well as some treatments that occurred over several consecutive days.

Table 1. Characteristics of Adolescent Participants

Characteristic	n	%
Gender		
Female	10	50
Male	10	50
Race		
Caucasian	17	85
African American	3	15
Diagnosis		
Acute lymphoblastic leukemia	7	35
Hodgkin lymphoma	6	30
Non-Hodgkin lymphoma	2	10
Sarcoma	2	10
Acute myelogenous leukemia	1	5
Neuroblastoma	1	5
Rhabdomyosarcoma	1	5

N = 20

Daily Fatigue Reports

Graphical displays for the three daily fatigue variables (severity, bother, and interference) generally confirmed similar trend lines, and fatigue bother and interference ratings were highly correlated with fatigue severity ($r = 0.86$, $p < 0.01$ and $r = 0.76$, $p < 0.01$, respectively). When daily ratings were averaged for the entire sample, fatigue severity scores ($[\bar{X}] = 3.15$, $SD = 2.87$) were higher than scores for fatigue bother ($[\bar{X}] = 2.27$, $SD = 2.72$) and fatigue interference ($[\bar{X}] = 2.06$, $SD = 2.65$). The maximum and minimum scores reported by each participant were used to obtain the average maximum and minimum fatigue severity, bother, and interference scores for the entire sample (see Table 2).

Table 2 Mean Scores for Daily Fatigue Reported by Adolescents During One Month of Chemotherapy

Variable	Fatigue Severity		Fatigue Bother		Fatigue Interference	
	$[\bar{X}]$	Range	$[\bar{X}]$	Range	$[\bar{X}]$	Range
Maximum	7.3	3-10	6.9	0-10	6.3	0-10
Minimum	0.8	0-3	0.4	0-2	0.15	0-1
Average	3.15	0-10	2.27	0-10	2.06	0-10

Note. Lower scores on a 0-10 scale indicate less intensity of each dimension of fatigue.

Daily fatigue reports from the participants showed extreme individual variability in fatigue severity. On a scale of 1-10, with 10 representing the highest fatigue severity, nine adolescents (45%) reported scores that ranged widely from 0-1 up to 9-10 during the month. In comparison, scores from three adolescents (15%) showed minimal variability and never exceeded 4 during the month. Three adolescents (15%), who were in months 2, 3, and 5 of therapy, reported more than 25 days with fatigue rated as 0, whereas six other adolescents (30%) never reported one day with 0 fatigue during the month. These differences in fatigue severity existed despite similarities in diagnoses, treatment regimens, and length of time on chemotherapy.

Patterns of Daily Fatigue

Group 1. Chemotherapy every three to four weeks: The first group of patients included eight adolescents who received chemotherapy no more than once during a three-to four-week period. Their diagnoses included non-Hodgkin lymphoma (n = 2), Hodgkin lymphoma (n = 2), sarcoma (n = 2), acute myeloid leukemia (n = 1), and neuroblastoma (n = 1). One common pattern of fatigue emerged from this group. Seven of the eight patients showed a brief peak in their fatigue, lasting one or two days, that occurred two to four days after the initiation of chemotherapy, followed by a trajectory of alternating days of high, moderate, and low severity fatigue that gradually diminished in intensity over the next two to three weeks. Figure 2 shows an example of a daily fatigue graph for an adolescent who represents the common "declining rollercoaster" pattern of fatigue representative of this group. Their peaks of fatigue were in the moderate (5-7 on a scale of 10) to high (8-10) range of severity.

The remaining patient in this group, a 13-year-old female with sarcoma, reported peaks of severe fatigue on days 8, 14, and 21, days when she stayed in bed and complained of troubling nausea with vomiting.

Group 2. Chemotherapy every one to two weeks: The second group of patients included 12 adolescents with diagnoses of acute lymphoblastic leukemia (n = 7), Hodgkin lymphoma (n = 4), and rhabdomyosarcoma (n = 1). The 12 patients in this group also reported brief peaks of moderate to severe fatigue that occurred one to four days after each weekly chemotherapy administration. In contrast to group 1, however, fatigue scores increased and decreased more frequently, but the peaks did not diminish in intensity across the weeks of the study. For 9 of the 12 patients, their fatigue returned to minimal severity within that same week, creating a fluctuating "yo-yo" pattern of fatigue over the month. Figure 3 illustrates a daily fatigue graph for a patient with frequent swings in fatigue severity that commonly accompanied weekly chemotherapy administration.

Three adolescents in this group did not report resolution of their peak fatigue before the next weekly chemotherapy administration, resulting in sustained fatigue across the month. These patients included an 18-year-old male with acute lymphoblastic leukemia who experienced persistent postlumbar puncture headaches and nausea and a 16-year-old male with acute lymphoblastic leukemia who experienced seizures and nausea during the second week of the study. The third patient was a 15-year-old male with Hodgkin lymphoma who never reported his fatigue severity as less than a score of 3 after his weekly chemotherapy treatments. He reported no specific symptoms or complications and continued with his usual activities of school, church, and extracurricular activities each week.

Variables Affecting Fatigue

Treatment-related factors: Participants named many factors in their diaries that influenced their energy and contributed to fatigue. Treatment-related factors that made fatigue worse included "not being able to eat before procedures," "going to the bathroom a lot," "getting chemo in the morning," and "just getting chemotherapy." Other treatment-related factors included travelling long periods to come to the hospital, getting sedating drugs like diphenhydramine and lorazepam, and being in the hospital. For example, one 15-year-old male wrote, "Just the fact that I'm in the hospital drags me down."

Cancer-related symptoms: At times of peak fatigue, participants complained of other cancer-related symptoms. Eleven participants described issues with pain, including back pain, headaches, and sore mouth. Nine participants wrote that sleep disturbances (difficulty falling asleep, dreams, and nighttime awakenings) contributed to their fatigue. Eight participants reported episodes with nausea and vomiting. Other symptoms associated with fatigue included cold symptoms, shortness of breath, and fever.

Lifestyle: Five adolescents attributed fatigue to being too active. One 19-year-old male wrote, "I think I overdid it yesterday," after he moved back to his apartment at college. Another 15-year-old male wrote that running too much during basketball contributed to his fatigue. Another 18-year-old female wrote, "I think that I wear myself out because of all the things I want to get done." Two adolescents wrote that being bored and inactive made them more fatigued. One 16-year-old male reported, "I feel worse when I sit around in one spot for too long."

Activities that relieved fatigue: Ten participants reported that rest and sleep helped relieve their fatigue. Five adolescent participants wrote that eating in social situations helped them feel better. Three participants wrote that exercise and being more active were strategies that relieved their fatigue. Two females reported that caffeinated products (e.g., coffee, soda) gave them energy.

Impact of Fatigue

On days of peak fatigue, participants were less active, finding it hard or choosing not to do normal activities, such as going to school and church or being with friends. A 19-year-old male described a feeling of "deadness" after a chemotherapy treatment. Another 15-year-old male wrote in an entry, "Slept all day ... I wasn't awake for my little brother's birthday." An 18-year-old female wrote, "I barely left my bedroom." A 13-year-old female wrote, "All I could do was lie down and try to sleep."

Some participants described how they adapted their usual activities when they were tired. Some described doing quieter activities, such as reading, playing video games, and watching television. A 17-year-old female wrote that when she did not feel up to going out to eat, she and her boyfriend "picked up a pizza and hung out at his house." A 15-year-old male was able to take his school examinations by breaking them up into sections but said he felt "really drained."

When adolescents reported low levels of fatigue and more energy, however, they reported doing normal activities, such as going to school, participating in after-school activities, playing sports, going to school dances, and doing part-time work. All adolescents wrote about spending more time with friends when they had more energy. One 19-year-old male shared that he "loved the spontaneity" of doing things on short notice and valued being independent again. Six participants took part in sports activities, including basketball, jogging, weight lifting, ping pong, and swimming, on days with minimal fatigue.

Adolescents reported that fatigue had a negative effect on their mood, making them feel "irritable," "annoyed," "rotten," "upset," and "unhappy." One 15-year-old male wrote that he "felt bothered that I couldn't get everything done quickly." Another participant felt guilty when she canceled plans with friends because of fatigue. Conversely, on days with minimal fatigue, participants wrote that they felt "awesome," "amazing," "great," and "had great energy. You couldn't keep me quiet."

Table 3 provides examples of qualitative diary data that illustrate contributing and alleviating factors as well as the effect of increased and decreased fatigue on the adolescent lifestyle.

Table 3 .Qualitative Diary Data From Adolescents on Contributing and Alleviating Factors and Fatigue and Fatigue Impact

Code	Sample Diary Entries
Factors contributing to or associated with increased fatigue	
Others cancer-related symptoms	
* Nausea	"Major nausea and headaches." "I had almost no energy today. ... I was throwing up and very nauseous." "I haven't eaten much because I have been throwing up--this makes me feel worse."
* Pain	"... a little back pain from the night before." "My leg hurt quite a bit again today." "My joints were aching." "My head was killing me and I was sore all over."
* Sleep disturbance	"Wasn't able to sleep well last night ...

felt generally rotten and exhausted all day."
"I wasn't able to sleep last night--made me
feel worse." "Mostly tired because it was
hard to fall asleep last night."

Environment "I'm more tired because it's so hot outside."
"I can never sleep in the hospital." "My
phone kept ringing and I couldn't go to
sleep."

Resuming usual activities or lifestyle "Tired from the dance last night." "I feel
tired because of all the rowing I did." "I
was running around for graduation yesterday
and it really wore me out." "Was sore and
tired from working so much yesterday." "I was
easily worn out from swimming." "My exams
really drained me."

Treatment-related symptoms "Tired and hungry--didn't get to eat from 9
am until 9 at night because of the scans." "I
was very tired. ... I think that was due to
sitting in the clinic for six to seven
hours." "Today I got a spinal tap--made it
worse." "I had to use the bathroom a lot
today."

Factors alleviating or associated with decreased fatigue

Relief of other cancer-related symptoms

* Improved oral intake "One thing that boosted my energy was eating
and drinking." "After I had some lunch, I
felt better and not as fatigued." "I had a
good lunch which helped."

* Sleep or rest "I took a nap this afternoon and felt a
little better afterwards." "I guess I needed
a power nap." "A nap helped a little." "I
rested really well last night so I didn't
feel too tired." "Sleep made me feel
better."

* Treatment of anemia "The transfusion made me feel slightly
better." "... getting two pints of blood."

Decreasing activity "I needed to sit down." "... sitting down for
a while."

Increasing activity "I went swimming and that woke me up big
time." "After basketball, my energy level
went up."

Personal mood "Feeling happy gave me more energy." "Felt
productive, and that makes me feel better."

Social interactions "My friend came over and that made me feel
better." "Talking to my friends made me feel
better." "My friends made me feel better and
gave me more energy." "I talked with the
psychologist."

Impact of increased fatigue

- * Less activity "Didn't get up to go to church. I was too worn out." "My parents wanted me to walk down and pick out a movie, but I didn't want to get up." ". ... couldn't lift weights or exercise." "... laid around a lot." "... too tired to do much." "... didn't get enough homework done."
- * Less social interaction "I was too tired to talk today." "... kept me from doing stuff with my friends." "I didn't even want to talk on the phone." "I wasn't able to go fishing with my friends." "I could not go out with my family today."
- * Negative mood "Felt rather irritable--little things set me off for no reason." "I was tired and kind of moody." "No energy ... unhappy." "I felt annoyed with my lack of energy." "I was upset because I wanted to study and I couldn't concentrate."

Impact of decreased fatigue

- * More activity "I had plenty of energy--actually walked an hour and a half." "Lots of energy ... Walked around campus a bit and went to a Bible study." "I had a bunch of energy. I played volleyball and participated in all the activities in vacation Bible school."
- * More social interaction "I felt great ... I went to lunch with my best friend." "Today I had enough energy to go to a basketball game with my friends." "Had fun, went to movies, had a friend over." "My friend came over and we went shopping." "It felt great doing stuff again." "Great energy--felt great!" "It's nice to return to something I used to do every day." "I felt amazing!"

Feasibility

Nineteen of 25 adolescents who enrolled (76%) chose to complete paper versions of the questionnaires rather than use computers to access the electronic versions. Four participants (three using the paper version) returned no questionnaires or less than one week of data, and they were not included in this analysis. Four others (three using the paper version) missed data for an entire week. Data from the remaining 16 participants showed less than 10% sporadic missing data on the daily fatigue reports.

Eighteen of the 20 participants (90%) answered the daily diary questions with responses that gave an enhanced description of their fatigue experience. Ten of the participants (six females and four males) answered each question with rich, affective, compound sentences, whereas eight participants answered the diary questions with one or two words or short phrases. Two participants, both males, offered no qualitative diary data.

It was evident that three adolescents had the assistance of their mothers to complete several daily fatigue self-reports. For example, one mother wrote, "Mom is writing this ..." on a day when the adolescent was hospitalized for a treatment complication. Because the data could be the adolescents' self-report with the mothers acting only as recorders, these data were retained for analysis.

Discussion

Findings from this study provide a description of the fatigue self-reported by a sample of adolescents with cancer during an early month of chemotherapy. Fifteen (75%) of the 20 teenagers in the study were in their second or third month of treatment, and the sample had cancers that commonly occur in adolescents, such as lymphoma, leukemia, and sarcoma.

Daily reports of fatigue showed that every adolescent experienced fatigue during the month of treatment, although data illustrated great variability in fatigue severity and duration, both within and between participants over one month. Despite the differences in chemotherapy agents, doses, and routes of administration, every patient reported some increase in fatigue in the days immediately following chemotherapy administration. These treatment-related peaks are similar to the trajectory reported for adult populations with different types of cancer, particularly breast cancer (Berger; 1998; Miller, Maguire, & Kearney, 2007; Schwartz et al., 2000; Stasi et al., 2003), and consistent with the fatigue trajectory documented by Yeh et al. (2008) in a sample of children and adolescents receiving chemotherapy. For adolescents who received chemotherapy every three to four weeks, their fatigue levels commonly showed a "declining rollercoaster" pattern, with fatigue severity gradually decreasing until chemotherapy was scheduled again, consistent with the early findings of Berger (1998). For adolescents who received chemotherapy weekly, the most common indicators of fatigue showed more frequent swings of the "yo-yo" pattern that did not diminish over the weeks of the study. Numerous treatment-related factors contributed to fatigue, and following treatment, subsequent increases in the adolescents' fatigue severity coincided with chemotherapy toxicity, other cancer-related symptoms, and consequences of usual activities and lifestyle choices.

Adolescents with cancer report more fatigue than younger patients with cancer (Hinds, Hockenberry, Rai, et al., 2007b; Meeske et al., 2004). Adolescents may be better able to abstractly compare their present state to a past state than younger children. In addition, the lifestyle of adolescents that includes more academic work and extracurricular activities, as illustrated with this sample, also exacerbates cancer-related fatigue. Their pre-existing habits may result in irregular sleep schedules and insufficient sleep, which also put them at higher risk for fatigue during cancer treatment. When adolescents with cancer-related fatigue proceed to complete simple, normal activities, daily life can become a struggle, and adolescents with tired bodies may feel like "zombies," just going through the motions of their normal activities (Gibson et al., 2005; Woodgate, 2005). Alternately, on some occasions, adolescents speculated that their fatigue came from doing too little, feeling bored, and "sitting around too much." Gibson et al. (2005) suggested that adolescents experience a tension between the physical fatigue that results from too much activity and the mental fatigue that comes from doing too little. Fatigued teenagers with cancer could benefit from discussions about how to find the optimal level of function that will preserve normal activities but not exacerbate their fatigue.

As expected, adolescents frequently connected fatigue with sleep issues, particularly difficulty falling asleep and nighttime awakenings, and this association has been reported in other studies (Davies et al., 2002; Gedaly-Duff et al., 2006; Gibson et al., 2005; Hinds, Hockenberry, Rai, et al., 2007b). Although the exact nature of the relationship between cancer-related fatigue and sleep-wake disturbances is unknown, the two symptoms have been found to co-vary in a number of studies with adults (Roscoe et al., 2007). The hospital environment contributes to increased nocturnal awakenings (Hinds, Hockenberry, Rai, et al., 2007b), but, because the majority of these adolescents received their chemotherapy as outpatients, this study provides evidence that sleep problems are common at home as well.

In addition to sleep-wake disturbances, participants reported that pain and nausea co-occurred with their fatigue. Fatigue, sleep disturbances, and pain often cluster together and have been explored as one of the most common cancer-related symptom clusters in adults (Barsevick, 2007; Dodd, Miaskowski, & Lee, 2004; Hockenberry & Hooke, 2007; Roscoe et al., 2007). One possible explanation is that pain causes disrupted sleep that then leads to fatigue. Another explanation is that a common underlying biologic mechanism related to cytokine production, serotonin regulation, and disruption in the circadian activity-rest rhythm causes all three symptoms (Barsevick, 2007; Ryan et al., 2007). Nausea has not been as frequently explored as a symptom associated with

fatigue in adolescents, but the coexistence of fatigue with nausea may result from inadequate hydration and nutrition, side effects of antiemetic medications, and insufficient sleep resulting from nausea. Symptom clusters that include fatigue in adolescents need additional description so that assessment and intervention strategies can be implemented for concurrent symptom management.

When fatigue was increased, these teenagers missed out on schoolwork, family activities, time with friends, sports, and church functions. Fatigue had a negative effect on their moods, and they described themselves as irritable, unhappy, angry, and upset. However, the majority of adolescents in this study also had days with minimal or no fatigue, and they were able to carry on many normal activities during this early treatment period. They did activities with their families and friends, attended school and church, participated in extracurricular activities, played sports, and even did part-time work. These positive outcomes show that when adolescents are not limited by fatigue and other cancer-related symptoms, they are able to stay on course to reach important social, academic, extracurricular, and developmental milestones and to stay connected with friends and family. Reaching these milestones will help adolescents achieve satisfying social, emotional, and financial well-being as adults.

This study provided information about the feasibility of daily data collection for one month from a sample of adolescents during acute cancer treatment. The study had a 78% enrollment rate and an attrition rate of 15%, both of which fall in the wide range of enrollment and retention rates reported for other cancer behavior or psychosocial trials (Northouse et al., 2006). The majority of the adolescents in this study completed daily quantitative measures with minimal missing data, which confirms their willingness and commitment to participate in research about their cancer experience. Daily symptom reports provided valuable data about frequent fluctuations in fatigue severity that cannot be detected with weekly measurement, and brief daily reporting of symptoms seems to be acceptable to adolescents, even on treatment.

Although electronic versions of data collection were offered to the teenagers to minimize the recording burden, less than 33% chose to use this option. Their reasons for not preferring the computer to complete the study were not asked, and adolescents' choices for self-reporting symptom data is a future research area to explore. This study showed that acute side effects and complications during early treatment can interfere with self-report data collection methods for some adolescent patients.

Extra efforts may be required to collect data from adolescents who experience serious treatment complications and unexpected hospitalizations so that results will not be biased toward the experience of adolescents who have less acute side effects (Nathan, Furlong, & Barr, 2004).

A limitation of this study was that the participants were receiving a variety of treatment regimens for a number of different cancers. This heterogeneity limited data analysis about fatigue for specific diagnoses, chemotherapy agents, and treatment regimens. The limitations of small sample size and heterogeneity of age, diagnosis, and treatment are common in studies of adolescents because of the low prevalence of cancer, multiple primary sites, and varying regimens (Hinds, Hockenberry, Gattuso, et al., 2007; Ream et al., 2006; Yeh et al., 2008). National multisite trials are necessary to address these challenges. The study also did not control for the effects of confounding medications, such as steroids and sedatives, or the intensity of treatments that likely influence adolescents' reports of energy and fatigue. The report from this small convenience sample of mostly Caucasian adolescents receiving outpatient chemotherapy does not represent the true experience of fatigue for all adolescents with cancer. In addition, the study did not attempt to distinguish between cancer-related fatigue and fatigue in healthy adolescents. Finally, the study used only self-report measures to describe fatigue, which may have problems with recall bias. Occasional disagreements between quantitative and qualitative data for individual participants were not reconciled during analysis. Some younger adolescents may need additional assistance when asked to report their symptom severity on a numerical rating scale.

Conclusion

Adolescents receiving chemotherapy commonly experience fatigue, and these findings suggest that fatigue worsens in the days following chemotherapy and fluctuates in severity until chemotherapy is due again. Fatigue is a highly dynamic and variable state, but adolescents who receive chemotherapy on a frequent schedule (i.e., weekly) may be more at risk for limitations because of fatigue than adolescents who receive chemotherapy less frequently. Additional research to validate this finding is recommended. Qualitative data suggest that clinicians need to explore what treatment-related factors in their setting can be modified to alleviate fatigue, such as scheduling, wait times, and nothing-by-mouth preparatory times, as well as optimal management of other cancer-related symptoms, such as pain, nausea, and sleep disturbance.

Fatigue related to cancer and its treatment may interfere with adolescents' abilities to participate in activities that are critical to their development. Cancer-related fatigue may limit adolescents' involvement and success in school, emerging careers, peer relationships, and developing independence. However, this study gave a picture of many young patients successfully participating in the typical activities of middle school, high school, and college during early cancer treatment with the support of their caregivers, families, and friends.

Implications for Nursing

Findings from this study suggest a number of directions in fatigue research with adolescents with cancer. Problems related to sleep disturbances need definition and description, and age-specific interventions to promote adequate sleep should be evaluated for their effects on fatigue. Nutrition factors related to nausea and irregular and inadequate eating patterns could affect fatigue and energy balance in adolescents and should be explored with descriptive and intervention studies. Questions related to fatigue as part of symptom clusters that include pain, sleep-wake disturbances, and other symptoms, such as depression, should be answered and interpreted for clinical assessment and management purposes. Recommendations for energy conservation, relaxation, cognitive distraction, and maintenance of an optimal activity level during chemotherapy that have been developed for adults could be tailored and applied to adolescents (Mitchell, Beck, Hood, Moore, & Tanner, 2007). Finally, the feasibility and effect of interventions to enhance physical activity or promote exercise on outcomes related to fatigue need continued study to follow the trials initiated by Hinds, Hockenberry, Rai, et al. (2007a). Exercise is an intervention recommended for carefully screened adult patients that has been shown to improve fitness, relieve other physical symptoms, and positively affect emotional well-being (Mitchell et al., 2007; Mustian et al., 2007; Schmitz et al., 2005). The effects of exercise and activity programs should be studied in adolescents.

Because fatigue in adolescents receiving chemotherapy is a complex, dynamic symptom influenced by multiple factors, its management will likely require integration of several different strategies at varying times. Healthcare providers should recommend interventions to prevent and manage fatigue that are tailored to match potential patterns of fatigue that result from individual factors as well as from different chemotherapy administration schedules.

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