A Feasibility Study to Measure Physical Activity, Fatigue, Sleep–Wake Disturbances, and Depression in Young Adults During Chemotherapy

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Little is known about the physical activity (PA) of young adults (YAs) during cancer therapy. In this feasibility study, 14 YAs (20–34 years old) completed a six-minute walk test, recorded their steps per day for one week, and answered weekly self-reports about physical activity, fatigue, sleep–wake disturbances, and depression during one cycle of chemotherapy. Findings suggest YAs are willing to complete a PA study during chemotherapy and have variable sleep and activity schedules. Their symptoms varied in severity, with highest scores for fatigue. Studies to improve PA in YAs during chemotherapy are warranted to manage short- and long-term treatment effects.

Keywords: cancer care continuum, chemotherapy, exercise, physical activity, supportive care

PHYSICAL ACTIVITY (PA) DURING TREATMENT for cancer is an evidence-based intervention recommended to relieve disease- and treatment-related symptoms such as fatigue and sleep disturbances.^{1–3} Maintaining PA during cancer treatment may also mitigate the long-term negative effects of inactivity, such as deconditioning and weight gain, that often occur during and after the cancer treatment period.^{4,5} Staying physically active may also promote better disease outcomes for patients at high risk for developing second cancers.⁶ Many young adults (YAs) with cancer, however, become sedentary during their months of chemotherapy due to common physical and psychosocial symptoms, such as fatigue and depressed mood. Frequent clinic and hospital visits disrupt daily activity and sleep routines, making it difficult to maintain previously established habits and schedules.

PA research to date has focused mainly on outcomes in adults with common cancers, especially following the completion of therapy, and little is known about PA in YAs with cancer. Emerging evidence suggests that adolescent cancer survivors experience significant declines in PA during treatment that may last past completion of treatment.^{7–9} Studies are needed to describe PA in YAs during active treatment and to test PA interventions for YAs receiving chemotherapy.

The aims of this study were to: (1) test the feasibility of procedures to measure four symptoms (fatigue, sleep disturbance, wake disturbance, and emotional disturbance–depression) and PA in YAs; and (2) gather feasibility data related to functional status, symptom severity, and PA over the

course of one cycle of chemotherapy. These data will inform the design of a trial to test an age-specific intervention to improve symptom management, PA, and quality of life outcomes for YAs who may become long-term cancer survivors.

Methods

Data collection began on the first day of a chemotherapy cycle and lasted 2 weeks. This feasibility study was conducted at the University of Virginia Medical Center between November 2010 and May 2012.

Participants

Inclusion criteria included patients who: (1) were diagnosed with any cancer between the ages of 18 and 39; (2) were receiving chemotherapy on a cycle every 3–4 weeks; (3) were in their first through sixth month of chemotherapy; (4) were ambulatory without assistance and without a specific gait disorder; and (5) had the ability to understand English. Individuals who were experiencing any symptoms that were not adequately controlled or that would interfere with ambulation were ineligible for the study.

Study procedures

The study was approved by the Cancer Center Protocol Review Committee and the Institutional Review Board. Eligible participants were approached to participate in the

2-week long study at the start of a chemotherapy cycle, and those interested completed the consent process. On the first day of their chemotherapy cycle (day 1), participants completed a demographic questionnaire, a six-minute walk test (6MWT), and questionnaires about sleep hygiene, PA, and four symptoms (fatigue, sleep and wake disturbances, and emotional disturbance-depression). Participants received a notebook with study measures and an accelerometer. They were asked to carry the accelerometer for 7 days, beginning the day after their chemotherapy was completed, and to complete the accompanying PA log. They also completed weekly measures of the four symptoms and a PA questionnaire (Table 1). Participants received compensation for their participation when they returned the completed study measures.

Instruments and measures

Sleep hygiene and environment. The original version of the Adolescent Sleep Hygiene Scale¹⁰ was used to measure sleep facilitating and sleep-inhibiting behaviors over the “past months.” Respondents answered 26 items using a 5-point Likert scale. The total score was an average of item responses; a higher scale score indicated better sleep hygiene. Three questions were added to capture additional aspects of the sleep environment that may be unique to YAs with cancer, such as variations in bedroom, sleep partners, and sleep interruptions.

Functional status. The 6MWT was used as a measure of functional status because it is a practical, inexpensive, and simple test that measures the distance that a person can walk on a flat surface in a period of 6 minutes.¹¹ No studies have yet documented its use in YAs with cancer. A reference equation was used to compare actual physical function with the predicted physical function of a healthy person of the same age, height, and weight.¹²

Physical activity. PA was measured by self-report using the short form of the International Physical Activity Questionnaire (IPAQ-SF).¹³ The IPAQ-SF has nine items asking respondents to recall the amount of time over the past 7 days they spent doing vigorous and moderate activities, walking, and sitting. Results can be reported in Metabolic Equivalent of Task (MET)-minutes per day or week, or in the categories of low, moderate, or high levels of PA.¹⁴ This study reports

categorical PA. The IPAQ has not yet been used in YAs with cancer. Participants were also asked to carry the accelerometer for 1 week, beginning the day after chemotherapy was completed. The YAMAX PW-611 Power Walker accelerometers used in this study have been used as reference instruments in studies with other healthy and chronically ill adults.^{15,16} On a daily log, participants recorded the hours the accelerometer was worn each day and their steps/day.

Symptoms. Symptoms of fatigue, sleep disturbance, wake disturbance, and emotional disturbance-depression were measured using PROMIS short forms. PROMIS is the Patient Reported Outcomes Measurement Information System, which offers a number of validated measures of patient-reported physical, mental, and social concepts that can be administered online or offline. Versions of PROMIS have been used with cancer patients of all ages.¹⁷ The short forms used in this study have seven or eight items for self-report of each symptom using a 5-point Likert scale (never to always), with responses recalling a 7-day period. Raw scores are converted to standardized *T*-scores, with higher scores indicating increased levels of the measured symptom. A *T*-score of 50 on these measures represents the average score calibrated with a national sample of the general population.

Data analysis

Data were entered and analyzed using SPSS v20.0 (IBM Corp, Armonk, NY). Descriptive statistics were used to calculate demographic and instrument variables and the percentage of missing data.

Results

Participants

Twenty YAs were approached to participate, and 18 agreed to enroll (90%). Reasons for non-participation were “too self-conscious” and “not interested.” Of the 18 enrolled, 14 completed the study (29% dropout rate). Table 2 summarizes demographic and disease-related variables.

Functional status

Three patients (two male, one female) did not complete the 6MWT because intravenous hydration had already

TABLE 1. SCHEDULE OF STUDY MEASURES

<i>Measure</i>	<i>Day 1 of chemotherapy cycle</i>	<i>Day 8 of chemotherapy cycle</i>	<i>Day 15 of chemotherapy cycle</i>
Demographic form	X		
Six-minute walk test	X		
Adolescent Sleep Hygiene Scale	X		
International Physical Activity Questionnaire-Short Form	X	X	X
PROMIS v1.0 Fatigue Short Form	X	X	X
PROMIS v1.0 Sleep Disturbance Short Form	X	X	X
PROMIS v1.0 Wake Disturbance Short Form	X	X	X
PROMIS v1.0 Emotional Disturbance-Depression Short Form	X	X	X
Steps/day recorded by accelerometer	Accelerometer was worn for 7 consecutive days beginning the day after chemotherapy administration was completed.		

TABLE 2. CHARACTERISTICS OF PARTICIPANTS

Characteristic	N (14)	%
<i>Disease-related variables</i>		
Diagnosis		
Breast cancer	3	21.4
Hodgkin lymphoma	3	21.4
Acute lymphoblastic leukemia	2	14.3
Acute myeloid leukemia	2	14.3
Other solid tumor	4	28.6
Age at diagnosis, <i>M</i> (SD; range)	25.9 (5.2; 20–34)	
Month of therapy, <i>M</i> (SD; range)	2.9 (1.1; 2–6)	
<i>Demographic variables</i>		
Current age, <i>M</i> (SD; range)	25.9 (5.2; 20–34)	
Gender		
Female	8	57.1
Male	6	42.9
Race		
Caucasian	11	78.6
African American	3	21.4
Marital status		
Single	12	85.7
Married or partnered	2	14.3
Parental status		
Have children	5	35.7
Do not have children	9	64.3
Education		
High school degree	4	28.6
Some college	6	42.9
College degree	2	14.3
Some graduate school	1	7.1
Graduate degree	1	7.1
School		
Currently attending	3	21.4
Not currently attending	11	78.6
Employment		
Currently employed	6	42.9
Not currently employed	8	57.1
Dwelling		
House	11	78.6
Apartment/townhouse	3	21.4
Household members		
Parents	11	78.6
Spouse/partner	1	7.1
Children	1	7.1
Live alone	1	7.1
Household income		
≤\$10,000	2	14.3
>\$10,000 but ≤\$50,000	5	35.7
>\$50,000 but ≤\$100,000	3	21.4
>\$100,000	2	14.3

M, mean; SD, standard deviation.

commenced at the time of study consent and interruptions would have led to delay of treatment. The remaining 11 participants completed the 6MWT comfortably and safely on a set course in a clinic hallway. The female participants walked between 366 and 575 meters, and the male participants walked between 300 and 544 meters. Using the reference equations developed by Enright and Sherrill,¹² these values were between 57.77% and 90.86% (women) and 53.56% and 85.59% (men) of the predicted values for healthy adults.

Sleep hygiene and sleep environment

Baseline responses on the Adolescent Sleep Hygiene Scale were 99.9% complete; scores ranged from 3.00 to 4.15 out of 5, with a mean of 3.57. All participants answered the additional questions about the sleep environment. Eight participants responded that they “sometimes” or “once in a while” slept in a room alone, and five reported they do not always sleep in the same bed. Eight participants responded that they always have a bed partner, while five had a bed partner “sometimes” or “once in a while.”

Physical activity

As per IPAQ-SF scoring guidelines,¹⁴ when participants marked “don’t know” or responses were missing, that self-report was removed from analysis. Three participants had no completed self-reports, leaving 24 of 42 self-reports from 11 participants (57% completion rate). At baseline, PA levels were categorized as low (2 participants), moderate (3), and high (2). On day 8, levels were low (5), moderate (1), and high (2), and on day 15, levels were low (4), moderate (2), and high (2).

Thirteen participants reported accelerometer data (steps/day) for all 7 days and one participant reported data for 6 of 7 days, for a missing response rate of 1%. Two participants questioned whether the accelerometer was accidentally reset on one day. Table 3 summarizes the 14 participants’ accelerometer data. The participants wore the accelerometer for an average of 12.8 awake hours per day (range: 5–18), and their mean steps per day were 5699 (range: 511–17,237).

Symptoms

Three weeks of PROMIS scores for fatigue, sleep disturbance, wake disturbance, and emotional disturbance-depression were available for all 14 participants with no missing data (Table 4). Mean scores (severity) for all symptoms increased on day 8. Mean scores were lowest (least severe) for sleep disturbance across the three weeks. Fatigue scores were higher (more severe) than the other symptoms, except at baseline, when wake disturbance was highest (most severe).

Discussion

This feasibility study is one of the first to provide PA and symptom data for YAs with cancer receiving chemotherapy. The high enrollment rate of YAs who were in early treatment confirms their willingness to participate in PA studies, which is consistent with earlier studies indicating that YA survivors are interested in learning about PA.^{18,19} The study completion rate of 71% is within range of PA studies with older adult cancer patients during treatment³ and somewhat lower than other longitudinal studies with YA survivors of AYA cancers.^{19–21}

As a measure of functional capacity, the 6MWT was easy and safe for the YAs to complete. Their walk distances showed a wide range of exercise capacity—as low as 50% and as high as 90%—when compared to healthy persons of comparable age, gender, height, and weight. While some YAs had considerable deficits in physical function, others were near functional capacity for a comparable healthy YA.

TABLE 3. ACCELEROMETER DATA FOR 7 DAYS FOLLOWING CHEMOTHERAPY ADMINISTRATION

Participant	Average steps/day	Range of steps/day	Average hours accelerometer worn per day	Range of hours accelerometer worn per day	Comments
1	5127	2095–5453	14.6	10.5–17	
2	1586	585–2649	11.3	10.5–12.5	Reported problem with accelerometer—reset accidentally on one of the days
3	9195	1028–17,237	14.3	10.5–16	Reported problem with accelerometer—reset accidentally on one of the days
4	6611	2645–9836	15.6	14–17	
5	2405	511–3064	11.6	6–17	Put accelerometer on in late afternoon on 5 days
6	4375	2148–5400	12.4	10.5–15	Reported sitting in clinics on inactive days
7	2960	818–7684	14.6	11–16.5	
8	8581	4996–14,079	13.0	10–18	
9	4040	1381–8500	12.1	11.5–13.5	Went to football game and shopping on the most active day
10	2545	954–4324	11.1	5–16	Took off device and went to bed early on least active days
11	3875	759–7261	11.9	11–13	
12	7000	3472–9150	10.8	8–13	
13	8803	3566–14,321	13.0	9–16	
14	12,620	10,853–14,485	13.6	12–14	

When measuring PA, the IPAQ-SF resulted in a large amount of missing data. The available self-reports, however, revealed a wide range of activity levels over the 2-week period. Participants were willing to carry a PA-monitoring device and record PA in a daily log for a week after chemotherapy. Their logs revealed the irregular daily schedules common for people receiving chemotherapy, especially when they may not follow a regular schedule set by employment or school. For example, one participant reported she did not put on the device until she got out of bed at 3pm on 5 of 7 days, while another took it off when he went to bed at 5pm on a day he was feeling ill.

The accelerometer data (steps/day) for these YAs showed a wide range of activity, even for the same individual. Two participants had daily step counts as low as 500–600, while three participants were highly active and reached step counts over 14,000. Tudor-Locke and colleagues²² suggested that while healthy adults may have 5000 steps/day in normal background activities, adults with a chronic illness or disability may average ‘basal activity’ of less than 2500 steps/day, although this range is greatly affected by varying levels of disability, mobility, and endurance. The most active YAs in this study reached activity levels expected for healthy adults, and included a mother with breast cancer who had toddlers and a young man with acute myeloid leukemia who resumed playing golf.

Symptoms of fatigue, sleep disturbance, wake disturbance, and emotional disturbance-depression are common co-

occurring symptoms in patients with cancer, including YAs.²³ Scores on the PROMIS instruments suggest that YA patients in this study had fluctuating symptom severity and that fatigue persists as a particularly troubling symptom.²⁴ YAs in this study reported worse sleep hygiene as compared to other YAs with cancer.²⁵ The worst sleep hygiene behaviors related to irregular sleep schedules, using their bed for multiple activities, and worrying at bedtime.

Conclusion

Helping patients with cancer maintain and improve PA is important to relieve symptoms and decrease long-term morbidities and risks related to inactivity. This study suggests that PA research with YAs receiving chemotherapy is feasible. Data collection and interventions, however, need to be tailored for the highly variable activity and sleep schedules of YAs. Oncology clinicians and researchers are urged to explore and develop tailored PA programs for YAs undergoing active cancer treatment as an important health promotion strategy.

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TABLE 4. WEEKLY SYMPTOM SEVERITY SCORES^a FOR PARTICIPANTS (N=14)

	Day 1 mean (SD; range)	Day 8 mean (SD; range)	Day 15 mean (SD; range)
Fatigue	52.17 (7.79; 39.60–67.80)	56.78 (7.99; 39.60–69.40)	53.10 (10.58; 39.60–79.80)
Sleep disturbance	46.85 (6.70; 35.90–57.30)	51.12 (8.59; 33.10–64.90)	48.35 (9.68; 28.90–64.90)
Wake disturbance	53.16 (7.82; 41.40–66.30)	55.65 (8.68; 38.70–67.30)	52.01 (10.48; 35.10–73.30)
Emotional disturbance-depression	49.06 (11.34; 37.10–69.30)	54.36 (9.43; 37.10–66.40)	53.07 (9.92; 37.10–67.40)

^aAs measured by PROMIS short-form instruments. A score of 50 represents the average score calibrated with a national sample of the general population.

SD, standard deviation.

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Author Disclosure Statement

No competing financial interests exist.

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