Feasibility of a Pedometer-Based Walking Program for Survivors of Breast and Head and Neck Cancer Undergoing Radiation Therapy

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ABSTRACT

Purpose: This pilot study assessed the feasibility and acceptability of a pedometer-based walking program for people with breast cancer and head and neck cancer (HNC) undergoing radiation therapy treatment. **Methods:** Participants were given a pedometer and prescribed a home-based walking program that included an individualized weekly step-count goal during the 3- to 5-week course of radiation therapy. Feasibility was determined by calculating recruitment rate, completion rate, and rate of adherence. Secondary outcomes included 6-minute walk test (6MWT) distance, step count, physical activity level, and psychological outcomes of depression, happiness, self-esteem, and sleep quality. **Results:** A total of 21 participants were recruited. All participants completed the study; adherence to prescribed step counts was 91% at follow-up. Analysis found a significant improvement in happiness, as measured by the Oxford Happiness Questionnaire (mean difference 0.3, $p = 0.003$), and a borderline significant improvement in 6MWT distance (mean difference 35 m, $p = 0.008$). **Conclusion:** This pilot study demonstrated the feasibility of a pedometer-based walking program for survivors of breast cancer and HNC undergoing radiation therapy.

Key Words: breast cancer; head and neck cancer; physical activity; radiation therapy; walking.

RÉSUMÉ

Objet: Cette étude pilote a évalué la faisabilité et l'acceptabilité d'un programme de marche à base de podomètre pour les personnes qui ont un cancer du sein et un cancer de la tête et du cou (CTC), et qui suivent une radiothérapie. **Méthodes:** Les participants ont reçu un podomètre et on leur a prescrit un programme de marche à domicile comportant un nombre personnalisé de pas par semaine à effectuer au cours de la radiothérapie d'une durée de 3 à 5 semaines. On a déterminé la faisabilité en calculant le taux d'inscription, le taux d'achèvement et le taux d'observation. Les résultats secondaires ont inclus la distance parcourue pendant le test de marche de 6 minutes (TM6M), le nombre de pas, le niveau d'activité physique (AP) et les résultats psychologiques liés à la dépression, au bonheur, à l'estime de soi et à la qualité du sommeil. **Résultats:** Au total, 21 participants ont été recrutés. Tous les participants ont terminé l'étude et avaient effectué le nombre de pas prescrit dans une proportion de 91% au moment du suivi. L'analyse a révélé une amélioration importante du bonheur mesuré au moyen du questionnaire d'Oxford sur le bonheur (différence moyenne de 0,3, $p = 0,003$) et une amélioration significative limite de la distance parcourue pendant le TM6M (différence moyenne de 35 m, $p = 0,008$). **Conclusion:** Cette étude pilote a démontré la faisabilité d'un programme de marche à base de podomètre pour les survivants d'un cancer du sein et d'un CTC qui suivent une radiothérapie.

Physical exercise has been shown to be safe and effective for cancer survivors¹ and to produce benefits for both physical and psychological outcomes.^{2,3} Research studies examining physical activity (PA) in survivors of cancer have consistently reported reductions in PA levels in the range of 33%–39% during the active cancer treatment period,^{4,5} and PA levels remain low even after com-

pletion of treatment. Although previous studies with survivors undergoing chemotherapy and radiation therapy have shown improvements in functional and psychological outcomes with supervised exercise,^{6,7} survivors report a preference for face-to-face exercise counselling and home-based walking-type programmes.¹

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A pedometer is a simple and inexpensive device that counts the number of steps walked per day. Several studies that have included special populations such as older adults and individuals with diabetes, cardiovascular disease, or cancer have demonstrated that programs using a pedometer and a set daily step goal have increased PA participation relative to a control group.^{8,9} In a 4-week pilot randomized trial with 39 survivors of breast and prostate cancer who were undergoing radiation therapy, Mustian and colleagues¹⁰ found that a combined pedometer-based walking and resistance exercise program resulted in significant improvements in quality of life (QOL) and diminished fatigue. They highlighted the need to evaluate the separate and combined effects of the two interventions to inform optimal exercise prescription. In a study with 377 survivors of breast cancer, Vallance and colleagues¹¹ found that PA print materials and pedometers, especially when combined, were effective in increasing participants' PA levels. Their study took place after cancer treatment was completed, and thus whether people currently undergoing radiation therapy would gain similar benefits is not clear.

The purpose of our study, therefore, was to assess the feasibility of study recruitment and the acceptability of a pedometer-based walking intervention for survivors of breast cancer (BC) and head and neck cancer (HNC) undergoing radiation therapy. We also aimed to explore the program's feasibility and its preliminary efficacy with respect to selected physical and psychological outcomes to inform a future randomized trial.

METHODS

Study design

For this prospective pilot single-group trial, eligible participants were recruited through the Radiation Therapy and Rehabilitation Medicine Departments at the Cross Cancer Institute in Edmonton. Potential participants were identified by radiation therapy staff at the time of their radiation simulation appointment or by physician referral to the Rehabilitation Medicine Department. Before baseline testing, the principal investigator did a final screen to ensure eligibility. The 3- to 5-week study period corresponded to the time frame of each participant's prescribed radiation therapy treatment period. Participants' baseline testing took place before their radiation therapy began; final testing was done within 5 days of treatment completion, and out-of-town participants had the option of completing their final testing on their last day of radiation therapy. Before beginning the study, we obtained approval from the Alberta Cancer Research Ethics Committee and the Health Research Ethics Board of the University of Alberta.

Recruitment

Our initial recruitment strategy was to provide a study brochure to eligible survivors of BC at the time of their radiation therapy simulation appointment; survivors with

HNC received the brochure with a standard mail-out letter inviting them to participate in a multidisciplinary rehabilitation education class addressing the symptoms and side effects of radiation therapy. In both cases, those interested in participating in the study were required to initiate contact with the researchers.

When this method produced low recruitment numbers, we adopted a more active strategy, in which the principal investigator attended the cancer centre's radiation therapy education classes (which are held before commencement of radiation therapy) and provided potential participants with a brief overview of the study and the study brochure. Those interested in taking part were required to contact the researchers to book an appointment for initial assessment.

Participants

We recruited participants with a confirmed histological diagnosis of BC or HNC who were beginning radiation therapy treatment. We chose these two tumour groups because both attend a clinical physical therapy education class at the start of radiation therapy at our cancer centre, during which the physical therapist discusses the benefits of PA during and after cancer treatment. A pedometer-based walking program was seen as a potentially feasible method that could be implemented clinically to support increased PA for survivors undergoing radiation therapy.

Participants were deemed eligible if they were aged at least 18 years and had a Karnofsky Performance Status of 60% or more.¹² We excluded those who presented with (1) clinical or radiological evidence of active disease, either local or metastatic; (2) serious non-malignant disease, such as cardiac failure or advanced arthritis of weight-bearing joints, which would preclude daily treatment and follow-up; (3) psychiatric or addictive disorders that would preclude obtaining informed consent or adherence to the protocol; or (4) inability to comply with the protocol, measurement, and follow-up schedule (e.g., scheduling conflicts, time commitment).

Medical and demographic information

We obtained initial demographic and medical information from participants' charts, their medical referral forms, and directly from the participant interview at baseline testing. Type and stage of cancer, type of surgery, age, gender, and adjuvant cancer treatment (radiation administration, chemotherapy administration) were recorded by the principal investigator.

Feasibility outcomes

Feasibility was determined by calculating (1) recruitment rate (number who agreed to participate/number eligible); (2) completion rate (number who completed the baseline and post-intervention assessments/number entering the trial); and (3) rate of adherence to step goal (steps performed per day/prescribed steps per day).

Box 1 Details on Scoring, Interpretation, and Psychometrics of Psychosocial Outcomes

Outcome	Questionnaire (score range)	Interpretation	Validity and reliability
Depression	Beck Depression Inventory II (BDI-II; range 0–63)	<ul style="list-style-type: none"> • 0–10: normal • 11–16: mild mood disturbance • 17–20: borderline clinical depression • 21–30: moderate depression • 31–40: severe depression • >40: extreme depression <p>A persistent score of ≥ 17 may indicate the need for psychosocial intervention.</p>	<ul style="list-style-type: none"> • Convergent validity: BDI–1A (revised version of the original BDI) and BDI–II, $r = 0.93$ ($p < 0.001$) • Construct validity: able to differentiate depressed from non-depressed patients. • Coefficient $\alpha = 0.92$ and 0.93 for a nonclinical sample¹⁴
Happiness	Oxford Happiness Questionnaire (range 1–6)	<ul style="list-style-type: none"> • 1–2: not happy • 2–3: somewhat unhappy • 3–4: not particularly happy or unhappy • 3.5: numerical average of happy and unhappy responses • Internal reliability coefficient of 0.7^{15} • 4: somewhat happy or moderately happy (typical score of average person) • 4–5: rather happy; pretty happy • 5–6: very happy • 6: too happy 	<ul style="list-style-type: none"> • Concurrent validity: $r = 0.73$ between Oxford Happiness Inventory and Fordyce Happiness Inventory • Cronbach's $\alpha = 0.92$
Self-esteem	Rosenberg Self-Esteem Scale (range 0–30)	<ul style="list-style-type: none"> • Scores 15–25 are within normal range • Scores < 15 suggest low self-esteem • Reliability: test–retest correlations: 0.82–$0.88^{16,17}$ • Cronbach's $\alpha = 0.77$–0.88 	<ul style="list-style-type: none"> • Construct validity of -0.64 with anxiety, -0.54 with depression; also high cross-cultural validity • Cronbach's α of 0.83 for its seven components • Reliability was examined by correlating PSQI component scores with the global score^{18,19}
Sleep	Pittsburgh Sleep Quality Index (PSQI; range 0–21)	A global sum of 5 or more indicates a poor sleeper	

Six-minute walk test

To assess exercise capacity, participants completed the 6-minute walk test (6MWT) according to American Thoracic Society guidelines.¹³ The 6MWT measures the distance a person can walk over a 6-minute period on a hard, flat surface (e.g., a 25-m hallway). The 6MWT assesses submaximal functional capacity; because most daily activities are performed at submaximal levels of exertion, it represents a metric of functional capacity for daily physical activities.¹³

Psychosocial questionnaires

Psychosocial questionnaires used were the Beck Depression Inventory II (BDI–II), Oxford Happiness Questionnaire (OHQ), Rosenberg Self-Esteem Scale (RSES), and Pittsburgh Sleep Quality Index (PSQI).^{14–19} Information on scoring and interpreting the test scores, as well as the validity and reliability of the psychosocial outcomes, is provided in Box 1.

Physical activity

Daily PA was assessed objectively with the SenseWear Pro armband (SWA). The SWA has been validated against the doubly labelled water technique and shows a strong correlation with it when estimating daily energy expenditure ($r = 0.89$).²⁰ Data collected in 1-minute intervals were used to provide information on the number of steps per day and time spent at different intensities of

activity (i.e., mild, moderate, or vigorous PA). The SWA has been shown to be valid and reliable in many populations, including cardiac patients;²¹ it has also been shown to be a viable method of quantifying PA and has been used to monitor the effectiveness of interventions to increase PA for people with rheumatoid arthritis, chronic obstructive pulmonary disease, and cancer.^{22–24}

Participants were asked to wear the SWA continuously for 3 days. To ensure an accurate representation of daily activity, we used the average of the 3 days and included for analysis only days on which the SWA was worn for 95% or more of the day.²⁵ For this study, data collected during sleep were excluded. Using the energy expenditure (EE) data from the SWA, we categorized PA intensity into three levels: mild, moderate, and vigorous PA.²⁶ Mild PA consisted of activities yielding an EE of 1.6–2.9 metabolic equivalents (METs); moderate PA, an EE of 3.0–4.9 METs; and vigorous activity, an EE of 5.0 METs or more.^{27,28}

Procedures

At the initial appointment with the principal investigator, participants provided written informed consent as well as basic demographic and medical information. Participants then performed the 6MWT, supervised by an independent research assistant, and completed the psychosocial questionnaires (BDI–II, OHQ, RSES, and

Figure 1 Flowchart of participant recruitment.

PSQI). Each participant received an SWA to wear for 3 days, a pedometer, an information package consisting of instructions for accelerometer and pedometer use, and a diary to record their step count. Participants were then booked for a 3-day follow-up session appointment at or before the start of their radiation therapy (Days 1–2). At that session, the SWA was collected, and participants received instructions for their pedometer-based walking program.

Intervention

All participants were prescribed a pedometer-based walking program based on their 3-day pre-radiation therapy average daily step count from the pedometer (StepsCount Piezo-01; StepsCounts, Deep River, Ontario).^{9,29} Participants were instructed to wear the pedometer every day throughout their radiation therapy treatment and to

record their daily step total in the step-count diary at the end of each day. They were also asked to record other daily activity (e.g., mode and minutes of other PA), fatigue level, exercise-related adverse events (e.g., muscle soreness), and any reasons for not meeting the step goal in the step-count diary. Fatigue was assessed using a visual analogue scale (0 = no fatigue, 10 = worst fatigue ever experienced).

For the first 2 weeks of the intervention, the weekly step-count goal was increased by 5%. Thereafter, the daily step-count goal was reviewed and modified (increased by 5%, maintained, or reduced by 5%) depending on treatment-related symptoms, adherence in the previous week, and participant feedback. Although we anticipated reductions in step count in the final weeks of radiation therapy, our goal was to have participants

Table 1 Baseline Demographic Characteristics of Participants ($n = 21$)

Characteristics	Group; No. (%) [*]		
	All ($n = 21$)	BC ($n = 16$)	HNC ($n = 5$)
Median (range) age, y	56 (38–78)	53 (38–69)	67 (56–78)
Sex, M:F	3:18	0:16	3:2
Marital status			
Married or common law	16 (76)	11 (69)	5 (100)
Never married	3 (14)	3 (19)	0 (0)
Divorced or separated	2 (10)	2 (12)	0 (0)
Education			
Some or completed high school	9 (43)	6 (37)	3 (60)
Completed university or college	8 (38)	7 (44)	1 (20)
Some university or college	4 (19)	3 (19)	1 (20)
Employment status			
Disability	1 (5)	1 (6)	0 (0)
Full time or homemaker	10 (48)	9 (56)	1 (20)
Retired	8 (38)	5 (32)	3 (60)
Semi-retired or part time	2 (9)	1 (6)	1 (20)
Smoking status			
Ex-smoker	6 (28.6)	4 (25)	2 (40)
Never smoked	14 (66.7)	12 (75)	2 (40)
Regular smoker	1 (4.8)	0 (0)	1 (20)
Drinking status			
Missing information	1 (5)	0 (0)	1 (20)
Never drinks	3 (14)	3 (19)	0 (0)
Drinks socially, seldom, occasionally	16 (76)	13 (81)	3 (60)
Regular drinker	1 (5)	0 (0)	1 (20)

* Unless otherwise indicated.

BC = breast cancer; HNC = head and neck cancer.

maintain a step count at or above 80% of their baseline in their final week of radiation therapy (i.e., to attenuate declines in PA). Participants were also instructed to maintain their normal activities as much as possible during the intervention period and were provided with a handout developed by the investigators that included suggestions to increase daily steps during radiation therapy.

Follow-up sessions

The principal investigator contacted each participant by phone at the end of the 1st week of radiation therapy to assess adherence to the walking prescription and to provide support. The principal investigator met with each participant in the radiation therapy department for a follow-up counselling session at the midpoint of radiation therapy. After the final session of radiation therapy, participants completed the post-intervention 6MWT and the psychosocial questionnaire booklet. At this visit, the step-count diary was collected, and an SWA was provided for the final 3-day endpoint assessment of PA.

Sample size

Our sample-size calculation for this pilot study was based on the hypothesis that an enrolment rate of 20% and a completion rate of more than 80% would demonstrate the feasibility of a subsequent randomized trial. Our goal was to recruit 20 participants in total.

Statistical analyses

The objective measures and psychosocial questionnaires were analyzed using paired *t*-tests for the inferential statistic. To account for multiple comparisons, we applied a Bonferroni correction to reduce the chances of a Type I error; thus, the threshold for significance was lowered to $p < 0.007$.

RESULTS

Participant recruitment took place between June 3 and August 26, 2013. Figure 1 illustrates the study flow of participants. Of the total sample, 16 participants were diagnosed with early-stage BC and 5 with HNC. Tables 1 and 2 provide further information on baseline characteristics and medical variables, respectively.

Feasibility

The initial passive recruitment method achieved a recruitment rate of 2% (2 of 100 eligible participants); the active strategy recruited an additional 19 of 60 potentially eligible participants (31%), for an overall recruitment rate of 13%. All participants completed the baseline assessments, midpoint follow-up, and post-intervention psychosocial questionnaire and accelerometer. Two participants with HNC were unable to complete the final 6MWT, however, one because of side effects requiring hospitalization and another because of extreme fatigue.

Overall adherence to the walking protocol was 91%. Of 21 participants, 11 (52%) increased ($n = 10$) or maintained ($n = 1$) their daily step count over the course of radiation therapy relative to their baseline level. Participant-reported reasons for non-adherence to the step-count goal were sciatic pain ($n = 1$), weight gain ($n = 1$), and fatigue ($n = 1$) in the BC subgroup and fatigue ($n = 2$) in the HNC subgroup.

Psychosocial, six-minute walk test, and physical activity outcomes

Table 3 summarizes baseline and post-intervention psychosocial, 6MWT, and PA outcomes. Of the psychosocial measures, only the OHQ showed a significant difference between baseline and post-intervention scores (mean increase of 0.3, $p = 0.003$), suggesting that participants were significantly happier post-intervention than at baseline. 6MWT results showed a borderline significant increase from baseline to post-intervention (mean 35 m, $p = 0.008$).

The SWA was worn for a mean of 60.2 (median 66.4) hours at baseline and 42 (median 46.5) hours at post-intervention follow-up. We found no statistically significant differences between baseline and post-intervention either in PA level (measured by 3-day SWA use) or in step count (measured by pedometer; see Table 3).

Step-count diary and symptoms of fatigue

At baseline, mean step count for the BC subgroup ($n = 16$) was 9,622 (SD 2,959) steps per day, which sug-

Table 2 Medical Variables of Breast ($n = 16$) and Head and Neck Cancer ($n = 5$) Subgroups

Characteristic	BC ($n = 16$), No. (%)	Characteristic	HNC ($n = 5$), No. (%)
Type		Type	
In situ ductal	2 (13)	Lymphoma – right maxillary region	1 (20)
Invasive lobular	1 (6)	Squamous cell carcinoma: oropharynx	4 (80)
Invasive ductal	13 (81)		
Overall stage		Overall stage	
0–1	9 (56)	1	0 (0)
2	6 (38)	2	1 (20)
3	1 (6)	3	1 (20)
4	0 (0)	4A	3 (60)
Surgery		Surgery	
Breast conserving	12 (75)	No	4 (80)
Mastectomy	4 (25)	Yes	1 (20)
Chemotherapy		Chemotherapy	
Yes	8 (50)	Before radiation therapy	3 (60)
No chemotherapy	8 (50)	Concurrent with radiation therapy	1 (20)
Radiation therapy location		No chemotherapy	1 (20)
Breast	11 (69)	Radiation therapy location	
Breast and lymph node regions	5 (31)	Tumour site	1 (20)
Radiation therapy dosage, Gy		Tumour site and lymph nodes	4 (80)
42.5	13 (82)	Radiation therapy dosage, Gy	
45–50	3 (18)	35	1 (20)
No. (%) of comorbid conditions		66	4 (80)
1	3 (19)	No. (%) of comorbid conditions	
2	1 (6)	1	1 (20)
>2	1 (6)	2	0 (0)
		>2	2 (40)

BC = breast cancer; HNC = head and neck cancer.

Table 3 Changes in Outcomes from Baseline to Post-Intervention ($N = 21$)

Outcome	Mean (SD)			95% CI	<i>p</i> -value
	Baseline	Final	Change		
OHQ (score range 1–6)	4.6 (0.6)	4.9 (0.6)	0.3 (0.4)	0.1–0.5	0.003*
PSQI (score range 0–21)	8.9 (3.4)	9.3 (2.8)	0.4 (2.7)	–0.8 to 1.7	0.43
BDI–II (score range 0–63)	9.0 (6.9)	7.4 (5.6)	–1.6 (5.6)	–4.1 to 1.0	0.22
RSES (score range 0–30)	26.3 (3.7)	27.2 (3.4)	0.9 (2.4)	–0.2 to 1.9	0.11
6MWT, min ($n = 19$)†	472 (86.8)	507 (69.8)	35 (51.2)	10–60	0.008
Step count‡	8,262 (3,619)	8,425 (3,717)	163 (2,396)	–928 to 1,254	0.76
Total PA duration (mild, moderate, and vigorous), h:min	4:10 (1:37)	3:54 (2:04)	–0:16 (1:32)	–0:55 to 0:31	0.57
Moderate PA, h:min	1:04 (0:39)	1:00 (0:39)	–0:04 (0:42)	–0:22 to 0:18	0.86
Vigorous PA, h:min	0:07 (0:12)	0:05 (0:08)	–0:02 (0:11)	–0:07 to 0:03	0.56

* $p < 0.007$.

† Two participants did not complete post-intervention 6MWT.

‡ Step-count values from pedometer: baseline, 3 days before radiation therapy; final, average of final week of radiation therapy.

OHQ = Oxford Happiness Questionnaire; PSQI = Pittsburgh Sleep Quality Index; BDI–II = Beck Depression Inventory II; RSES = Rosenberg Self-Esteem Scale; 6MWT = 6-minute walk test; PA = physical activity.

gests that our participants represented a more active segment of the BC population. Mean step count during the final week of radiation therapy was 9,538 (SD 3,139) steps per day. For the HNC subgroup ($n = 5$), the mean baseline step count was 3,909 (SD 1,261) steps per day, which suggests recruitment of a more sedentary population; step count during the final week of radiation therapy was 4,863 (SD 3,361) steps per day.

All participants (100%) completed their step-count

diary, including reporting their daily step count and the presence and severity of symptoms of fatigue. In the 1st week of radiation therapy, 19% reported symptoms of fatigue at a frequency of once per week and 33% reported symptoms between 2 and 5 days per week. In the final week of radiation therapy, all participants reported symptoms of fatigue on a daily basis: Twelve reported mild fatigue, 6 reported moderate fatigue, and 3 reported severe fatigue.

Adverse events

No minor or serious adverse events were reported as a result of participation in the study.

DISCUSSION

The main significant finding of this pilot study was that the proposed pedometer-based walking intervention is feasible from the perspectives of recruitment to the study and acceptability of the intervention. Although a shift to a more active recruitment method was needed to optimize study enrolment, this strategy achieved a recruitment rate of 31%, or close to one-third of eligible participants. In Schmitz and colleagues³⁰ meta-analysis of PA for survivors of cancer, recruitment rates in the 9 of 32 studies that reported them ranged from 17% to 94%; Maddocks and colleagues³¹ systematic review examining uptake, adherence, and completion rates of exercise studies in cancer reported a median recruitment rate of 56% for studies carried out during cancer treatment and found that studies with BC survivors reported lower recruitment rates than those examining other cancer groups. Although we found a brief in-person presentation of the study to potential participants to be an effective and feasible recruitment method, more research is needed to examine strategies to increase participation rates in exercise trials.³¹

Overall adherence was 91% for steps performed each day divided by steps prescribed each day; 16 of 21 participants (76%) were able to remain above the goal of performing 80% of their baseline step count in their final week of radiation therapy. This adherence rate is higher than those reported in other similar trials using pedometers,⁹ which may be because the short intervention period (3–5 wk) allowed for better support and counselling to encourage participants.³¹ We also personalized step-count goals to individual abilities and progressed slowly or reduced the step count as needed over the intervention period rather than using a generalized target such as 7,500 or 10,000 steps per day.⁹

Six-minute walk test

The 6MWT proved to be feasible as an objective outcome for both BC and HNC participants undergoing radiation therapy in our pilot study. A clinically meaningful difference of 50 m for the 6MWT has been reported for other populations, such as older adults and patients with stroke and lung disease.^{32,33} Samuel and colleagues³⁴ study examining a walking intervention for survivors with HNC undergoing concurrent chemoradiotherapy found an improvement of 42 m on the 6MWT for the exercise group versus a decline of 96 m for the control group. Although our study did not have a control group, participants showed a mean improvement in 6MWT distance (35 m) similar to that of Samuel and colleagues³⁴ exercise intervention group.

Psychosocial outcomes

Overall, our findings showed a trend toward improved psychological outcomes after completion of the walking program. In particular, the findings suggest that participants became significantly happier from baseline to post-intervention; however, participants taking part in the study were generally happy at baseline and remained in the same classification post-intervention. Although indicative of improvement, the benefit we observed was not as large as that reported in previous research.⁶

Symptoms of fatigue

In this pilot study, we monitored fatigue as a symptom and a potential barrier to our walking program. Previous research by Mock and colleagues^{6,35} found that fatigue was both the most intense symptom of radiation therapy and one of those most responsive to their self-paced, home-based walking exercise program. Symptoms of fatigue were common among our participants—more than half reported weekly episodes of fatigue, and all reported fatigue in the final week—but although fatigue remained a concern for all participants, especially during the final weeks of radiation therapy, none reported exercise as worsening their fatigue.⁶

LIMITATIONS

The main limitation of our study was the small number of participants, which was due to the pilot design. For the same reason, this study was not a randomized controlled trial. Without a control group, the effect of the intervention on psychosocial outcomes is less clear, because the findings may represent a natural improvement in symptoms over time. Therefore, the true effect of our intervention on psychosocial outcomes needs to be explored in a future controlled trial with a larger sample size.

Another limitation was the attention given to participants by the principal investigator during the study period, which may have positively influenced psychosocial outcomes. Counselling in exercise trials is important to help individualize the prescription and to monitor participant progress, but any improvements in psychosocial outcomes are confounded by the effect of attention.³⁶ Future studies should consider comparison with a placebo attention group to control for this confounding effect and to better elucidate the effect of the exercise intervention.

Most of our participants were diagnosed with early-stage BC, had high baseline step counts (suggesting a more active population), were psychologically healthy at baseline, and volunteered to participate in the study; therefore, our results may not be generalizable to the general population of people with cancer undergoing radiation therapy, who may have more advanced stages of breast cancer, be more sedentary, or have impairments in psychosocial functioning. Future studies should attempt to target a more sedentary or compromised sam-

ple. Only five survivors with HNC participated in the trial, which limits the conclusions that can be drawn about the relative benefit for this group.

In addition, we did not measure exercise variables such as intensity; the pedometer used in this study provided data on step count alone. Fong and colleagues³⁷ have reported that exercise intensity levels may play a significant role in how PA affects individuals. Future studies should therefore consider devices that can evaluate the relative intensity level of exercise to better assess the effects of PA on psychosocial outcomes.

We also found that 3 days' wear time for the SWA was not long enough to appropriately capture data on overall activity levels. Future studies should consider extending the monitoring period to 1 week to ensure more reliable data on participants' PA levels over a longer period. Further research is also needed to explore the SWA's measurement properties in survivors of cancer, particularly those with BC and HNC, whose arm swing may be affected by upper limb dysfunction.

CONCLUSION

Research has shown that PA interventions can have physical and psychosocial benefits for people with cancer both during and after cancer treatment. The purpose of our study was to minimize reductions in PA levels for people with BC and HNC undergoing radiation therapy treatment. Participants were given an individualized walking step-count goal and a pedometer; they also received counselling sessions during radiation therapy treatment to facilitate PA. The findings support the feasibility of a pedometer-based supported walking program for people with BC and HNC undergoing radiation therapy. Also, although limited, our findings suggest a potential therapeutic role of the pedometer-based walking program as an adjunct to standard physical therapy for cancer survivors undergoing radiation therapy.

KEY MESSAGES

What is already known on this topic

For people living with cancer, PA levels decline significantly during active cancer treatment and often remain low even after treatment is completed. Past research has shown both physical and psychological benefits of exercise for survivors of cancer. Previous studies have also shown that programs using a pedometer along with a set daily step goal have increased PA participation among both healthy individuals and those who have completed cancer treatment.

What this study adds

A pedometer-based walking program was feasible and acceptable for survivors of breast cancer and head and neck cancer who were undergoing radiation therapy. Preliminary evidence suggests potential benefits, as measured by 6MWT and psychosocial outcomes that warrant

further investigation using a randomized controlled trial design and a larger sample size.

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