Cancer-Related Impairments Influence Physical Activity in Uterine Cancer Survivors

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ABSTRACT

HAMMER, S. M., J. C. BROWN, S. SEGAL, C. S. CHU, and K. H. SCHMITZ. Cancer-Related Impairments Influence Physical Activity in Uterine Cancer Survivors. *Med. Sci. Sports Exerc.*, Vol. 46, No. 12, pp. 2195–2201, 2014. **Introduction**: The extent to which physical activity (PA) participation among uterine cancer survivors may be limited by physical and functional impairments (PFI) related to cancer treatment is unknown. We sought to describe PA participation, characterize the prevalence of PFI, and examine the association between PFI status and PA participation within this population. **Methods**: We conducted a study using a mailed survey among uterine cancer survivors who received treatment at a university hospital. We asked about PA and PFI using validated self-report questionnaires. PA was calculated using MET-hours per week (MET·h·wk^{-1}). PFI was defined as having one or more of the following symptoms: lower limb lymphedema, general pain, fatigue, or severe bladder, bowel, or pelvic issues. Ordinal logistic regression was used to quantify the odds ratio (OR) between PA and PFI. **Results**: The response rate to our survey was 43%. Among the 213 study participants, 40%, 13%, 13%, 12%, and 23% reported participating in <3.0, 3.0–8.9, 9.0–17.9, 18.0–26.9, and ≥27.0 MET·h·wk^{-1} of PA, respectively. Walking is the preferred mode of exercise for physically active uterine cancer survivors. Of the survivors, 53% experience at least one PFI. The most common PFI is lower limb lymphedema (36.2%), followed by general pain (22.5%). The OR of PFI decreased as MET-hours per week of PA increased (OR, 0.51; 95% confidence interval, 0.31–0.84; P = 0.009). **Conclusions**: The majority of uterine cancer survivors experience PFI that significantly reduce the likelihood of PA participation. PA recommendations for uterine cancer survivors should take into account treatment-related impairments that can affect PA participation. **Key Words:** GYNECOLOGIC CANCER, EXERCISE, LYMPHEDEMA, PAIN, BARRIERS TO EXERCISE

Uterine cancer is the fourth most common cancer among women and the most commonly diagnosed gynecologic cancer in the United States, with 47,130 incident cases expected in 2012 (20). Endometrial cancer is the most common type of uterine cancer, accounting for 95% of all uterine cancer diagnoses (20). Obesity is a major risk factor for developing uterine cancer; approximately half of all cases of uterine cancer in postmenopausal women are attributable to excess weight and obesity (38). Uterine cancer is usually diagnosed at early stages because of the onset of noticeable symptoms, such as abnormal or postmenopausal bleeding (22). The primary treatment modality is surgery, which may be followed by adjuvant radiation and/or chemotherapy depending on stage and risk factors for recurrence (22).

As a consequence of early detection and successful medical intervention, the 5-yr survival rate for early-stage uterine cancer patients is >95% (20). However, survivors experience symptoms and adverse effects associated with their cancer and cancer treatment, such as pain, fatigue, pelvic floor symptoms, and impairments on activities of daily living for 5–7 yr after completing treatment (3,10,11,12,26,28,29,44). Approximately 50% of women with uterine cancer are obese (7). This is important because uterine cancer survivors frequently experience obesity-related comorbidities, including diabetes, hypertension, heart disease, pulmonary disease, and musculoskeletal impairments (7,21). Higher body mass index (BMI) is associated with decreased survival and lower quality of life (QOL) among uterine cancer survivors (13,18,33,37,38,43).

Although evidence from observational trials suggests that increasing physical activity (PA) among uterine cancer

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survivors is a viable path to improve QOL and reduce morbidity and mortality, the extent to which cancer-related adverse effects influence PA participation in this population remains unknown (7,41,42). Several studies have reported that approximately 70% of endometrial cancer survivors do not meet public health guidelines of 150 min of moderate- to vigorous-intensity PA per week (7,9,18,24,36). According to a 2011 Centers for Disease Control and Prevention report, 53.7% of people 55–64 yr old and 64.6% of people age 65 yr and older met neither the aerobic activity nor muscle strengthening guidelines (34); this suggests that uterine cancer survivors are less likely to participate in PA than their peers in the general population. High intention to participate in PA, high self-efficacy in completing PA, and favorable attitudes and beliefs regarding PA are factors associated with higher rates of participation in PA among uterine cancer survivors (24). Conversely, poor health, lack of time, poor weather conditions, injury, and fatigue are factors associated with lower rates of participation in PA among uterine cancer survivors (24). Few studies have detailed PA participation patterns among uterine cancer survivors, including type, frequency, intensity, and duration of PA.

The purpose of the present study was threefold. First, we sought to describe the characteristics of PA participation among a cohort of uterine cancer survivors. Second, we sought to describe the prevalence of at least one cancer-related adverse effect or other health condition that may impair PA participation among survivors. Third, we sought to investigate the extent to which physical and functional impairments (PFI) are associated with PA.

METHODS

Participants and procedures. We conducted a cross-sectional survey on patients with uterine cancer who received care at a large university cancer center. Potential participants included women ≥20 yr old with a history of uterine cancer. Potentially eligible uterine cancer survivors were identified using fellow surgical case logs from 2008 to 2010 and *International Classification of Diseases, Ninth Revision,* diagnosis codes 179.0 and 182.0–182.8 from 2006 to 2010. Women identified by their physician or with notes in the surgical logs that were unable to complete a written survey because of illiteracy, lack of English fluency, or cognitive impairment were excluded. Women identified to meet inclusion criteria by study staff were sent a letter signed by their oncologist, explaining the purpose of the study. Potentially eligible survivors were provided with the option to decline participation within 1 wk of receiving the letter from their oncologist. Those who did not decline participation were sent a survey to complete. After 2 wk, a second survey was sent to those who did not reply to the first mailed survey (25). This protocol was approved by the university institutional review board and the Clinical Trials Scientific Review and Monitoring Committee of the cancer center. Women who mailed back a completed survey were classified as providing their informed consent.

PA assessment. The Paffenbarger Physical Activity Questionnaire was used to assess participation in PA (35). The Paffenbarger Physical Activity Questionnaire has been validated (2,27) and used previously among cancer survivors (30,31). Participants were asked to "list any sports, leisure, or recreation activities you have participated in on a regular basis during the past year." Survivors were also asked to list the average number of sessions per week and the duration of each session for each PA listed. Trained research staff then coded each PA listed with an MET using the Compendium of Physical Activities (2). For reference, 1 MET is the energy expended when sitting quietly for 1 h and 3.5 METs is walking for pleasure. For each MET value, we calculated the weekly activity-specific MET-hours per week as the product of the MET value, the number of sessions per week, and the number of hours per session. For each participant, we summed the activity-specific MET-hours per week to generate an aggregate measure of MET-hours per week. Consistent with previous analyses (30,31), we created categories of MET-hours per week defined as <3.0, 3.0–8.9, 9.0–17.9, 18.0–26.9, and ≥27.0 that correspond to <1.0, 1.0–2.9, 3.0–5.9, 6.0–8.9, and ≥9.0 $h \cdot wk^{-1}$, respectively, of moderate-intensity PA.

Defining PFI. Participants completed questionnaires to examine symptoms and side effects of cancer diagnosis and treatment that we hypothesized to influence PA. Participants with significant pain, severe fatigue, lower limb lymphedema (LLL), severe bladder/urinary symptoms, severe bowel symptoms, and/or severe pelvic symptoms as defined in the next sections were classified as having PFI. The individual components of the PFI are described in the next sections in detail.

LLL assessment. The Gynecologic Cancer Lymphedema Questionnaire (GCLQ) was used to assess symptoms associated with LLL (14). The GCLQ is a validated self-report measure that assesses seven domains of symptoms in the lower extremities. The seven domains include heaviness, general swelling, limb-related swelling, infection, aching, numbness, and physical function, with one or more symptom questions per domain. Women reporting five or more symptoms of the lower extremities within the seven previously listed domains were classified as having LLL (14). Our study group omitted one of the three questions in the swelling general domain (question 20). To ensure that our findings were robust, we conducted sensitivity analyses, assuming everyone responded "no" or "yes" to this question; our findings were consistent in all analyses with those reported herein.

Pain assessment. The Brief Pain Inventory (BPI) was used to assess pain symptoms (17). The BPI is a validated self-report measure that asks patients to rate their pain at the time of responding to the questionnaire ("pain now") and also at its "worst," "least," and "average" over the last week. Item ratings are scored on a 0–10 scale. Ratings can be combined to generate composite indices of pain

severity and pain interference. Participants with either a composite pain severity or pain interference index ≥5 were classified as having significant pain capable of impairing PA participation (17).

Fatigue assessment. Fatigue was assessed using the Fatigue Symptom Inventory (FSI) (23). The FSI is a valid and reliable measure of fatigue among cancer survivors (19). The FSI is a 14-item measure that assesses three domains of fatigue, including frequency, severity, and interference, with activities of daily living. A composite fatigue score was derived by calculating the average across the three fatigue domains. Women with FSI composite scores ≥80 were classified as having severe fatigue capable of impairing PA participation (19).

Urinary, bowel, and pelvic symptom assessment. The Pelvic Floor Distress Inventory (PFDI-20) and Pelvic Floor Incontinence Questionnaire (PFIQ-7) short forms were used to assess the severity of urinary, bowel, and pelvic symptoms (5). The PFDI is a validated instrument that is both a symptom and bother inventory. It assesses three domains of distress: the Pelvic Organ Prolapse Distress Inventory 6 (POPDI-6), the Colorectal–Anal Distress Inventory 8 (CRADI-8), and the Urinary Distress Inventory 6 (UDI-6). Each scale is scored from 0 (least distress) to 100 (greatest distress) and has been shown to demonstrate good test–retest reliability (4,6). Participants who reported POPDI-6, CRADI-8, or UDI-6 score ≥75 were classified as having severe pelvic issues, severe bowel issues, or severe bladder issues, respectively. These cutoff scores were identified as the meaningful cut points because they correspond with average responses of a "moderate" bother score on the PFDI (i.e., 3 on the 0–4 scale).

The PFIQ-7 is a validated questionnaire that assesses the extent to which bladder, bowel, or vaginal symptoms affect women's activities, relationships, and feelings (6,45). Participants rated their level of interference according to symptoms on a four-point scale ranging from "not at all" to "quite a bit." Responses to the PFIQ are scored according to symptom, yielding scores on a scale from 0 to 100 for the Urinary Impact Questionnaire (UIQ-7), Colorectal–Anal Impact Questionnaire (CRAIQ-7), and Pelvic Organ Prolapse Impact Questionnaire (POPIQ-7). Participants who reported UIQ-7, CRAIQ-7, or POPIQ-7 score ≥66.7 were classified as having severe bladder symptoms, severe bowel symptoms, or severe pelvic symptoms, respectively. These cutoff scores were identified as the meaningful cut points because they correspond with average responses of being "moderately" affected by bladder or urinary symptoms on the PFIQ-7 (i.e., 2 on the 0–3 scale).

Participants who reported severe bladder, bowel, or pelvic issues on either of the relevant PFDI-20 or PFIQ-7 subscales were classified as having PFI.

Covariates. Information on covariates came from self-report or electronic medical records. Variables collected from self-report included age, marital status, race, education, employment, height, and weight, and comorbidities whose symptoms may be similar to our defined PFI were assessed using the Charlson comorbidity index (15,16). Variables collected from the electronic medical record included pathology type, stage of cancer, time since diagnosis, cancer treatment history, and recurrence.

Statistical analysis. Response rates to our survey were calculated using the American Association for Public Opinion Research; this method counts complete and partial survey responses as respondents and divides it by the number of surveys mailed (25). We performed descriptive statistics and bivariate analyses on all study variables using the Wilcoxon rank sum test for continuous variables and chi-square test for categorical variables. The distribution of PFI was significantly skewed ($P < 0.0001$ for skewness). We created a binary variable (0 vs ≥1 PFI), which had a similar proportion of participants (47% vs 53%, respectively). Ordered logistic regression models estimated the odds ratio (OR) with 95% confidence intervals (CI) to estimate the proportional odds of increasing PA given the presence of a PFI. Statistical tests were two sided, and $P < 0.05$ was the threshold for statistical significance. All statistical analyses were conducted using Stata 12.0 (College Station, TX).

RESULTS

Participant characteristics. We identified 531 potentially eligible participants using the fellow surgical case logs and *International Classification of Diseases, Ninth Revision,* codes. Among the 531 mailed letters, we had a 43% response rate. Variables analyzed as potential covariates are shown in Tables 1 and 2. The age of the 213 participants ranged from 29 to 94 yr (Table 1). The majority of participants reported being white, married, high school graduates, and retired or working full time. Employment status (retired vs full time) was associated with PFI status ($P = 0.03$). Participants were

TABLE 1. Demographic characteristics stratified by PFI status.

Variable	Total Sample ($n = 213$)	No PFI ($n = 100$)	≥1 PFI ($n = 113$)	P[a]
Age (yr)	63.5 ± 10.6	62.8 ± 10.6	64.2 ± 10.6	0.58
Marital status, *n* (%)				
Married	128 (60)	61 (61)	67 (59)	Referent
Widowed	33 (16)	11 (11)	22 (19)	0.14
Divorced or separated	31 (15)	18 (18)	13 (12)	0.30
Never married	20 (9)	9 (9)	11 (10)	0.83
Self-reported race, *n* (%)				
White	177 (84)	85 (86)	92 (81)	Referent
Black	28 (13)	10 (10)	18 (16)	0.23
Other	7 (3)	4 (4)	3 (3)	0.64
Education, *n* (%)				
College degree or more	114 (54)	56 (56)	58 (52)	Referent
Some college	51 (24)	24 (24)	27 (24)	0.81
High school or less	46 (22)	19 (19)	27 (24)	0.37
Employment, *n* (%)				
Retired	94 (45)	40 (40)	54 (49)	Referent
Full time	80 (38)	47 (47)	33 (30)	0.03
Homemaker	16 (8)	6 (6)	10 (9)	0.71
Other	14 (7)	5 (5)	9 (8)	0.63
Unemployed	7 (3)	2 (2)	5 (5)	0.47

[a]By Wilcoxon rank sum or chi-square test. Values may not sum to 213 or 100% because of rounding error and item nonresponse.

TABLE 2. Clinical characteristics stratified by PFI status.

Variable	Total Sample (n = 213)	No PFI (n = 100)	≥1 PFI (n = 113)	P[a]
Pathology type, n (%)				
Endometrioid adenocarcinoma	158 (75)	75 (76)	83 (73)	Referent
Papillary serous or clear cell	35 (17)	15 (15)	20 (18)	0.62
Sarcoma	8 (4)	5 (5)	3 (3)	0.41
Carcinosarcoma	8 (4)	4 (4)	4 (4)	0.89
Other (undifferentiated)	3 (1)	0 (0)	3 (3)	0.10
Stage, n (%)				
1	157 (74)	75 (75)	82 (73)	Referent
2	13 (6)	6 (6)	7 (6)	0.91
3	26 (12)	11 (11)	15 (13)	0.61
4	5 (2)	2 (2)	3 (3)	0.73
Unknown	12 (6)	5 (5)	6 (5)	0.88
Treatment modalities, n (%)				
Surgery only	100 (47)	46 (46)	54 (48)	Referent
Surgery and radiation	37 (17)	17 (17)	20 (18)	0.99
Surgery, radiation, and chemotherapy	47 (22)	24 (24)	23 (20)	0.57
Chemotherapy only	22 (10)	9 (9)	13 (12)	0.66
None or unknown	7 (3)	4 (4)	3 (3)	0.57
No. of nodes removed	9.0 ± 10.2	9.3 ± 9.9	8.6 ± 10.5	0.31
Time since diagnosis, n (%)				
0–2 yr	69 (32)	32 (32)	36 (32)	Referent
3–4 yr	94 (44)	48 (48)	46 (41)	0.62
5–6 yr	50 (23)	19 (19)	30 (27)	0.37
BMI ($kg \cdot m^{-2}$)	31.4 ± 9.8	31.5 ± 10.7	31.2 ± 9.0	0.58
Charlson comorbidity score[b], median (interquartile range)	2 (2–4)	2 (2–3.5)	2 (2–5)	0.70

[a] By Wilcoxon rank sum or chi-square test. Values may not sum to 213 or 100% because of rounding error and item nonresponse.
[b] Includes the following comorbidities: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic obstructive pulmonary disease, connective tissue disease, ulcer disease, diabetes mellitus, moderate-to-severe chronic kidney disease, hemiplegia, leukemia, malignant lymphoma, solid tumor, liver disease, and acquired immunodeficiency syndrome. There were no significant differences in any specific comorbidity ($P > 0.10$).

commonly diagnosed with stage I endometrioid adenocarcinoma and treated with surgery (Table 2). The BMI of study participants ranged from 14 to 67 $kg \cdot m^{-2}$; 26%, 22%, and 52% reported a BMI of <25.0, 25.0–29.9, and ≥30.0 $kg \cdot m^{-2}$, respectively. The median Charlson comorbidity index score was 2 (interquartile range, 2–4).

PA among uterine cancer survivors. Among the 213 participants, 80 (38%) reported no regular PA participation in the past year. Seventy-one (33%), 33 (15%), 21 (10%), and eight (4%) participants reported participating in one, two, three, and four or more weekly PA, respectively (Table 3). Among participants reporting one or more PA, the most common modality of PA was walking.

Characteristics between participants with versus those without PFI. Among the 213 participants, 113 (53%) experienced at least one PFI hypothesized to be associated with PA participation (Table 4). The most common PFI was LLL; 77 (36%) participants were classified as having LLL. Forty-eight (22.5%) participants reported significant pain, and 12 (5.6%) participants reported severe fatigue. The number of PFI was not related to BMI as a continuous variable ($r = 0.07$, $P = 0.28$) or to time since diagnosis ($r = 0.10$, $P = 0.16$). The number of PFI was related to BMI as a categorical variable (<25.0, 25.0–30.0, ≥30.0 $kg \cdot m^{-2}$) (Spearman rho (ρ) = 0.16, $P = 0.02$) but not to time since diagnosis ($\rho = 0.08$, $P = 0.24$). Fatigue and pain were not related to BMI as a continuous variable ($r = 0.11$ and $P = 0.09$; $r = 0.11$ and $P = 0.11$, respectively). Pain was related to BMI as a categorical variable ($\rho = 0.21$, $P = 0.002$) but not to fatigue ($\rho = 0.08$, $P = 0.22$). The number of LLL symptoms was not related to BMI as a continuous or categorical variable. The least common PFI were severe bladder/urinary symptoms (3.8%), severe pelvic symptoms (1.4%), and severe bowel symptoms (0.9%). Among the 113 participants who reported a PFI,

TABLE 3. PA characteristics of uterine cancer survivors.

		Activity Specific		
Characteristics	Doing Activity, n (%)	Bouts per Week (Mean ± SD)	Minutes per Bout (Mean ± SD)	Total MET-Hours per Week (Mean ± SD)
Physical activities reported with ≥5% prevalence in study sample				
Walking at 3.5-mph pace (3.8 METs)	89 (42)	4.1 ± 2.6	55.0 ± 49.4	30.3 ± 35.4
Gym-based activities[a] (5.5 METs)	23 (11)	2.8 ± 1.6	67.9 ± 34.1	43.7 ± 33.0
Swimming (7.0 METs)	18 (8)	3.5 ± 2.1	62.9 ± 33.8	43.8 ± 29.5
Hatha yoga/mild stretching (2.5 METs)	17 (8)	2.4 ± 1.7	65.6 ± 31.1	32.9 ± 46.5
Bicycling (4.0 METs)	14 (7)	3.1 ± 1.9	48.2 ± 31.6	43.7 ± 48.8
No. of physical activities completed per week including activities from list described previously				
0	80 (38)	—	—	—
1	71 (33)	3.5 ± 2.3	59.6 ± 42.6	15.2 ± 12.3
2	33 (15)	6.3 ± 3.4	77.3 ± 56.9	36.8 ± 39.8
3	21 (10)	8.9 ± 4.2	78.8 ± 60.0	43.5 ± 22.2
≥4	8 (4)	14.8 ± 7.9	73.0 ± 38.5	76.7 ± 56.3

[a] Includes aerobic, resistance, and flexibility exercises.

TABLE 4. PFI among uterine cancer survivors.

PFI Characteristics	*n*	% of 213
LLL[a]	77	36.2
Pain[b]	48	22.5
Severe fatigue[c]	12	5.6
Pelvic floor symptoms		
Severe bladder/urinary symptoms[d]	8	3.8
Severe bowel symptoms[e]	2	0.9
Severe pelvic symptoms[f]	3	1.4
No. of previously mentioned PFI per participant[g]		
0	100	47.0
1	89	41.8
2	15	7.0
3	6	2.8
4	2	0.9
5	1	0.5
Total	213	100.0

[a]Lymphedema, ≥5 self-reported symptoms on GCLQ.
[b]Pain, BPI pain severity or pain interference scale score ≥5 (scale, 0–10).
[c]Fatigue, FSI composite fatigue score ≥80 (scale, 0–134).
[d]Bladder/urinary symptoms, average effect on UDI-6 (PFDI) ≥75 (scale, 0–100) or average effect on UIQ-7 (PFIQ) ≥66.7 (scale, 0–100).
[e]Bowel symptoms, average effect on CRADI-8 (PFDI) ≥75 (scale, 0–100) or average effect on CRAIQ-7 (PFIQ) ≥66.7 (scale, 0–100).
[f]Pelvic symptoms, average effect on POPDI-6 (PFDI) ≥75 (scale, 0–100) or average effect on POPIQ-7 (PFIQ) ≥66.7 (scale, 0–100).
[g]One or more of previously mentioned complications include pain, fatigue, LLL, urinary/bladder symptoms, bowel symptoms, and pelvic symptoms.

89 (78.8%) experienced only one of the mentioned cancer-related adverse events (Table 4). Meanwhile, 13.3% of these participants reported two PFI and 8.0% reported three or more PFI.

Association between PFI and level of PA. Among the 213 study participants, 40%, 13%, 13%, 12%, and 23% reported participating in <3.0, 3.0–8.9, 9.0–17.9, 18.0–26.9, and ≥27.0 MET·h·wk^{-1} of PA, respectively (Table 5). The OR of PFI decreased as MET-hours per week of PA increased (OR, 0.51 (95% CI, 0.31–0.84), $P = 0.009$). This corresponds to 49% reduced likelihood for uterine cancer survivors with one or more PFI to increase their MET-hours per week to the next higher level of PA (i.e., reporting 3.0–8.9 MET·h·wk^{-1} instead of <3.0 MET·h·wk^{-1}) compared with that for uterine cancer survivors without a PFI.

DISCUSSION

The major findings of this study are that 53% of uterine cancer survivors experience at least one PFI and that this is associated with low levels of PA. Among uterine cancer survivors, the most common PFI are LLL and pain. Notably, many uterine cancer survivors do not meet the recommended guidelines for PA and 38% self-report being completely sedentary; this is comparable with the general population, in which 28%–34% of adults age 65–74 yr and 35%–44% of adults age 75 yr or older are inactive (8). Among uterine cancer survivors who are physically active, low- and moderate-intensity PA, such as walking, are preferred. Women who reported a PFI were more frequently retired and generally reported a smaller weekly volume of PA participation. These findings provide evidence that PA participation may be influenced by PFI in uterine cancer survivors. Our study confirms previous reports stating that comorbid health problems such as obesity and musculoskeletal impairments may negatively affect participation in PA among uterine cancer survivors (7). Attitudes about PA, such as intention, self-efficacy, and beliefs, are also important factors that may be mediated by comorbid health conditions such as obesity, which act to negatively influence PA participation (24). Poor health is the most common barrier to participating in PA among endometrial cancer survivors (24).

The major limitation of this study is its cross-sectional design, which precludes determining causal associations. For example, survivors who are more physically active may have more leakage of urine stemming from their exercise; conversely, those with urinary incontinence may have an aversion to PA. Although we postulate that uterine cancer survivors who self-report PFI may be physically or psychologically unable to engage in PA, it is plausible that individuals who engage in more PA subsequently experience fewer PFI. Exercise has been shown to have beneficial effects on cancer survivor's health-related QOL, including reduced fatigue and pain (32). Other limitations to our study include possible selection bias; we do not have data to determine whether women who experienced PFI were more likely to reply to the survey. Alternatively, women who were doing poorly or doing extremely well may have not replied to the survey. Information bias is another possible limitation, although we attempted to minimize this bias by using validated questionnaires and by verifying self-reported exposure and outcome data with survivors' medical records. A limitation to self-reported PA questionnaire was that participants provided nonspecific descriptions of PA such as "gym-based activities." Although self-reported PA is correlated with objective measures of PA (39), 47% of participants in our study reported meeting PA guidelines (i.e., ≥9.0 MET·h·wk^{-1}) whereas only approximately 10% of US adults meet such guidelines (40). Therefore, participants in our study may have overreported PA levels. We also cannot rule out the possibility that our conservative definition of PFI might exclude other adverse effects capable of influencing PA participation such as arthritis or psychosocial issues (1,7). Furthermore, some of the PFI in our study may have not been specific to cancer; rather, they may be related to obesity or other comorbid health conditions (7,24). Our study sample was hospital based and was not population based, which is a limitation compared with other previously published studies among uterine cancer survivors (7,9,24). Thus, our estimates

TABLE 5. Effect of PFI on levels of PA.

PA Intensity (MET·h·wk^{-1})	Total Sample (*n* = 213)	No PFI (*n* = 100)	PFI (*n* = 113)
<3.0, *n* (%)	85 (40)	33 (33)	52 (46)
3.0–8.9, *n* (%)	27 (13)	13 (13)	14 (12)
9.0–17.9, *n* (%)	26 (13)	10 (10)	17 (15)
18.0–26.9, *n* (%)	26 (12)	16 (16)	10 (9)
≥27.0, *n* (%)	48 (23)	28 (28)	20 (18)
OR (95% CI)[a]	—	—	0.51 (0.31–0.84)
P	—	—	0.009

[a]Ordered logistic regression controlling for employment status.

may underestimate the extent to which PFI influence PA participation in this population.

Consistent with previous studies, our results confirm the prevalence of cancer-related adverse effects and obesity-related comorbidities among uterine cancer survivors. More importantly, these findings identify potential barriers to PA participation in this population and highlight the need for PA interventions to consider PFI status as a tailoring variable. Uterine cancer survivors who are sedentary and/or obese are unlikely to spontaneously modify their exercise and diet after cancer diagnosis and treatment (22). There is limited but growing evidence to suggest that exercise interventions can improve health and QOL outcomes for uterine cancer survivors. A recent randomized controlled study of an interventional lifestyle program demonstrated that uterine cancer survivors can lose weight and improve their exercise for 6 months after the intervention (41). At 12 months, the intervention group lost 3.5 kg whereas the control group gained 1.4 kg, suggesting that a lifestyle intervention program among obese uterine cancer survivors is feasible and can result in sustained behavior change and weight loss over a 1-yr period (41). No serious adverse events were reported in this study (41).

To build upon such results, physician and nurse recommendations for PA among this population should account for the impairments as described in this study. Future research should focus on elucidating specific PA recommendations on the basis of PFI status, so as to reduce obesity-related comorbidities and improve QOL among uterine cancer survivors. Considering the prevalence of sedentary behavior in this population, qualitative interviews with uterine cancer survivors who report little to no PA participation would be a useful first step toward understanding potential motivating factors and barriers to PA in this population. In addition to PFI, understanding behavioral determinants such as intention, self-efficacy, and attitudes associated with PA is also of importance to promote PA among uterine cancer survivors (24). Interventions designed to help uterine cancer survivors overcome the many barriers to PA, including but not limited to the PFI described here, may provide significant benefits in terms of QOL improvements and reductions in mortality attributable to obesity-related comorbidities.

CONCLUSIONS

Among uterine cancer survivors, 62% regularly participate in at least one weekly PA. Walking is the preferred mode of exercise for physically active uterine cancer survivors. Meanwhile, 53% of uterine cancer survivors experience at least one PFI. The most common PFI is LLL (36.2%), followed by pain (22.5%). Most importantly, these PFI are negatively associated with participation in PA. Physicians recommending PA for uterine cancer survivors should take into account treatment-related impairments that can affect PA participation, and health and fitness professionals should receive adequate training to properly prescribe and modify PA interventions to improve health and QOL without sacrificing safety.

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