


Clinical and Demographic Factors Associated With Follow-Up in a Hospital-Based Exercise Oncology Program

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Abstract

Objective: Despite the numerous benefits of regular exercise participation for cancer survivors, nearly 60% of survivors do not meet current guidelines. Hospital-based exercise oncology programs may be one strategy to promote exercise engagement as survivors have expressed a preference for exercise programs associated with a cancer hospital. However, follow-up rates in hospital-based exercise oncology programs can be low. Follow-up assessments are a critical component of exercise oncology programs as they determine survivor progress, allow for revision of exercise prescriptions, and demonstrate the effectiveness of the exercise program. Therefore, the purpose of this study was to identify clinical and demographic factors associated with not attending a 12-week follow-up assessment in a hospital-based exercise oncology program. **Methods:** We analyzed data collected from 2016 to 2019 ($n=849$) from the Huntsman Cancer Institute's hospital-based exercise oncology program, the Personal Optimism with Exercise Recovery (POWER) program. Cancer survivors completed an assessment at the start of POWER and were encouraged to attend a 12-week follow-up assessment. Factors associated with not attending a 12-week follow-up assessment were identified using logistic regression. **Results:** Multiple myeloma cancer survivors were more likely (OR 2.33; 95% CI 1.09, 4.98) to not attend a 12-week follow-up assessment, whereas endometrial cancer survivors were less likely (OR 0.39; 95% CI 0.18, 0.87). Greater travel time (OR 2.69; 95% CI: 1.83, 3.96) and distance (OR 2.37; 95% CI: 1.61, 3.49) were associated with not attending a 12-week follow-up assessment. Immunotherapy (OR 1.66; 95% CI 1.02, 2.72), waist circumference (OR 1.01; 95% CI 1.00, 1.02), overweight status per body mass index (OR 1.62; 95% CI 1.11, 2.38), and male sex (OR 1.70; 95% CI 1.23, 2.35) were associated with an increased likelihood of not attending a 12-week follow-up assessment. Survivors with a higher baseline quality of life (OR 0.96; 95% CI 0.93, 0.99) and peak oxygen consumption (OR 0.97; 95% CI 0.95, 0.99) were less likely not to attend a 12-week follow-up assessment. **Conclusions:** Both clinical and demographic factors were associated with not attending a 12-week follow-up assessment in a hospital-based exercise oncology program. Understanding factors related to follow-up assessment attendance in exercise oncology programs can inform the development of targeted interventions to improve follow-up rate thus maximizing exercise support for cancer survivors.

Keywords

exercise, cancer survivors, follow-up, hospital-based exercise program

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Introduction

Participation in physical activity has been shown to have positive effects on cancer treatment-related side-effects such as cancer-related fatigue, declines in cardiorespiratory fitness, and declines in physical function.^{1,2} Physical activity participation has also been positively associated with quality of life in cancer survivors.^{3,4} Consistent with

national physical activity guidelines, the American Cancer Society and American College of Sports Medicine encourages cancer survivors to engage in at least 150-minutes per week of moderate-intensity physical activity, 75-minutes per week of vigorous-intensity physical activity, or any combination of the 2.^{5,6} It is also recommended that survivors participate in resistance training 2 times per week.^{5,6} However, nearly 85% of cancer survivors are not currently



meeting national physical activity guidelines⁷ and are therefore not reaping the numerous benefits of physical activity. The number of cancer survivors in the United States is increasing and expected to exceed 22-million by the year 2030⁸; therefore, it is important to identify strategies to promote physical activity engagement in cancer survivors to attenuate long-term and latent treatment side-effects, as well as support a high level of quality of life among the growing population of cancer survivors.

Hospital-based exercise oncology programs are one strategy to promote physical activity engagement in cancer survivors. Hospital-based exercise oncology programs are defined as personalized exercise programs for cancer survivors with staff who have expertise specific to exercise and cancer (ie, how exercise physiology may change secondary to cancer treatment history and/or cancer type) and are associated with a cancer center or hospital. These programs are often designed to help cancer survivors work toward meeting or maintaining physical activity guidelines through participation in exercise.^{4,9} Further, cancer survivors have expressed a salient preference for exercise programs associated with a cancer hospital and health professionals with training in exercise oncology,^{9,10} which highlights the utility of hospital-based exercise programs for promoting exercise among survivors.

Hospital-based exercise oncology programs generally provide cancer survivors with a personalized exercise prescription that includes both aerobic and resistance training.^{4,9,11} Exercise prescriptions are personalized based on survivors' cancer-treatment history, goals for exercise, and initial baseline assessment.^{4,9,11} These factors are reevaluated at regular intervals as treatment status, goals, and abilities change to ensure the personalized exercise program is meeting the cancer survivor's current needs. These reevaluations, referred to as follow-up assessments, are a crucial component of hospital-based exercise oncology programs for several reasons. First, follow-up assessments are an evaluation of the survivors' progress across the duration of the program and allows for the adaptation of the exercise prescription. Revising the exercise prescription promotes continued progress and continued exercise participation. Second, the follow-up assessment is an opportunity to address any new or changing symptoms of cancer treatment (ie, nausea, fatigue, pain, etc.) or new barriers that may be impeding the survivors' ability to participate in exercise. The exercise program staff can then work collectively with the survivor to develop strategies to overcome any treatment-related effects

or barriers to exercise. The follow-up assessment is also an important metric in the evaluation of exercise oncology program effectiveness. Demonstrating the effectiveness of exercise oncology programs is a critical step toward medical insurance reimbursement for clinical exercise physiology services in exercise oncology.¹² Currently, most exercise oncology services are not covered by medical insurance reimbursement,^{13,14} which may place an additional burden on survivors and contribute to their barriers to exercise.¹⁵ Establishing evidence of cancer specific exercise program effectiveness is a critical step toward medical insurance reimbursement for clinical exercise physiology services in exercise oncology.¹² Despite the importance of the follow-up assessment, the follow-up rate in hospital-based exercise oncology programs is commonly low, with as little as 30% of survivors who participated in the program attending a follow-up assessment.¹⁶

The purpose of this study was to identify clinical and demographic factors that are associated with not attending a 12-week follow-up assessment in the Personal Optimism with Exercise Recovery (POWER) hospital-based exercise oncology program at the Huntsman Cancer Institute at the University of Utah (HCI). We hypothesized that a higher body mass index (BMI), greater waist circumference, higher level of fatigue, and lower quality of life would be associated with survivors not attending a 12-week follow-up assessment.¹⁷⁻¹⁹ Additionally, we hypothesized that a greater travel distance and travel time would be associated with not attending a 12-week follow-up assessment due to the large, primarily rural catchment area that HCI serves.

Methods

Study Design and Participants

This retrospective analysis examined POWER program data collected at HCI at the University of Utah from 2016 to 2019. The POWER program is available to any individual seeking cancer treatment at HCI at any point along the cancer care continuum. To be included in this analysis, participants must have received a diagnosis of invasive cancer. The protocol and waiver of informed consent was approved by the University of Utah Institutional Review Board in accordance with the Declaration of Helsinki.

The POWER program is available to all patients seeking care at HCI and aims to (1) attenuate treatment-related

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side-effects, (2) improve quality of life, and (3) promote long-term exercise engagement. All survivors who participated in the POWER program were provided with a personalized exercise prescription that included aerobic and resistance training. This exercise prescription was created using information from the initial medical and physical function assessments conducted by a team of physical medicine and rehabilitation physicians and exercise physiologists. The initial assessment, which includes a detailed medical history, physical exam, review of current activity level, discussion of goals as well as barriers to achieving those goals, and the baseline exercise assessment (including cardiorespiratory fitness, physical function, quality of life, muscular strength, and endurance assessments), took place in person at the HCI wellness center gym. The exercise prescription for each survivor was designed with the goal of survivors progressing to meeting or maintaining national physical activity guidelines. Both aerobic and whole-body resistance training prescriptions were individualized using the FITT principle (frequency, intensity, time, and type). Two 60-minute supervised sessions per week focused on resistance training. The resistance training portion of the exercise prescription contained up to 12 exercises total and focused on all major muscle groups using weight training, body-weight training, and resistance bands, depending on the equipment available. Prescribed aerobic exercise was completed unsupervised. If survivors reported side-effects or adverse responses during training, that day's workout or the exercise prescription was adjusted to meet the survivors' needs.

The POWER program could be completed through a combination of the following modalities: (1) supervised in-person exercise, (2) supervised via telemedicine, (3) unsupervised, home-based, or (4) a combination of modalities. The POWER program is designed to be broken down into 12-week intervals; however, due to its personalized nature the program length can be variable (eg, reassessments occur after any significant change such as following a surgery, significant hospitalization, new diagnosis, etc.). The physiatrists and exercise physiologists in POWER explain the benefits of follow-up assessments to survivors and encourage survivors to complete a follow-up assessment at the conclusion of each 12-week phase in the program. After each 12-week follow-up assessment, survivors may choose to continue participating in the POWER program or transition to either a community-based program or exercise on their own. Since most survivors typically complete the first 12-week phase and then transition to community-based programming or exercising on their own, the present study focused on attendance at the first 12-week follow-up assessment. The baseline and follow-up assessments in the POWER program are covered by medical insurance reimbursement; however, there is a nominal out-of-pocket cost for the exercise training visits.

Measures

Clinical factors. Cancer type, stage, recent cancer treatment history, and BMI were extracted from each survivor's medical record. BMI was calculated using baseline height and weight data. Recent cancer treatment history was defined as occurring within ± 12 months of enrollment in POWER. The number of different cancer treatment types the survivor had received were categorized into 3 groups: unimodal (1 treatment type), bimodal (2 treatment types), or multimodal therapy (3 or more treatment types). Of the 28 distinct cancer types represented in this sample, we identified the 10 most prevalent cancer types to be included as individual categories for analysis. The remaining 18 cancer types were included in the "other" group for analysis of cancer type. This method was employed due to the heterogeneous sample sizes among cancer types in the sample, with some cancer types having very small sample sizes (ie, $n=2$).

Waist circumference, cardiorespiratory fitness, quality of life, and fatigue were assessed during the initial POWER program assessment (ie, at baseline) and extracted from the medical record. Waist circumference was measured at the natural waistline, approximately 2 in above the umbilicus. Presence of abdominal obesity, defined as a waist circumference >88 cm for women and >102 cm for men, was determined using waist circumference measurements. Cardiorespiratory fitness was assessed using the modified Bruce protocol treadmill test. Further details on the methods used to collect anthropometric and cardiorespiratory fitness data is reported elsewhere.¹⁶ Quality of life was assessed using the rapid version of the Function Assessment of Cancer Therapy—General (FACT-G7) questionnaire.²⁰ The Functional Assessment of Chronic Illness Therapy—Fatigue (FACIT-F) was used to assess fatigue.²¹ Both the FACT-G7 and FACIT-F have demonstrated good reliability coefficients of .74²⁰ and .90,^{21,22} respectively. The exercise training session modality (ie, in-person, telehealth, combination, or home-based) was pulled from the POWER program database. Exercise training modality data (ie, in-person, telehealth, a combination of the 2, or home-based unsupervised or unknown) were used to describe the proportion of survivors who utilized each of the program delivery modalities during their participation in POWER.

Demographic factors. Height, weight, sex, age, race, ethnicity, and medical insurance data were extracted from the survivor's medical records. Height and weight were assessed using standard procedures. Medical insurance status data were categorized based on the type of insurance the survivor had at the time of the initial POWER program assessment. Categories of medical insurance status included: (1) privately insured, (2) Medicare, (3) Medicaid, and (4) uninsured.

Travel time and travel distance to HCI one-way (ie, from the survivor's home to cancer center) were estimated using the survivor's home address zip code listed in the medical record. The shortest distance from the epicenter of each zip code to HCI were estimated using Google Maps. The shortest average travel time (ie, drive or flight time) from the epicenter of the zip code to HCI on a weekday morning was utilized in analysis. Travel time and travel distance were divided into groups using tertiles; the tertiles approximate travel time and distance within the city HCI is located in, from an adjacent city, and from a more distant city. Drive time was reported for all states within the HCI catchment area (ie, Utah, Wyoming, Montana, Idaho, and Nevada) and flight time was reported for all other states. The HCI catchment area covers 17% of the contiguous United States landmass and is composed of predominantly rural areas. Although additional modes of transportation may be utilized by survivors (ie, public or active transportation), there is poor infrastructure for these modes of transportation in rural areas. Therefore, public and active transportation may not be feasible modes of transportation for the majority of survivors who are traveling to HCI for cancer care.

Statistical Analyses

Descriptive statistics were presented as means and standard deviations or frequencies and percentages. Normality was assessed for all continuous variables using Q-Q plots. All continuous variables met the assumption of normality except for travel time and travel distance. Binary logistic regressions were utilized to determine the associations between clinical and demographic factors with attending a 12-week follow-up assessment (yes/no) among all POWER program participants from 2016 to 2019 (n=849). Univariate models were conducted for all clinical and demographic factors. The odds ratio and 95% confidence interval were reported for all univariate and multivariate models. For the predictor variables of cancer treatment type, cancer stage, and cancer type, the following multivariate models were conducted: (1) age, sex, and BMI and (2) age, sex, BMI, and number of treatments. Cardiorespiratory fitness was adjusted for the following potentially confounding variables using multivariate modeling: (1) age, sex, and BMI. A multivariable model was conducted for sex controlling for age and BMI. Decisions on variables to include in multivariate models were supported by evidence suggesting age, sex, and BMI could be potential confounders in exercise program participation and outcomes.^{23,24} All data were analyzed in SPSS version 27.0 (Chicago, IL).

Results

Participant Characteristics

Survivors (n=849) were 61.3 ± 13.6 years of age and 62.1% of survivors were females.¹⁶ The majority of cancer

survivors included in this study were white (91.0%) and non-Hispanic (93.2%). Survivors had an average BMI of 28.6 ± 6.7 kg/m².¹⁶ The proportion of survivors with a BMI classified as overweight (25-29.99 kg/m²) or obese (≥ 30 kg/m²) was 31.4% and 34.9%, respectively. The median travel distance from the survivors' home to the HCI wellness center was 18 mi with a range of 1.5 to 2427 mi. The median travel time to HCI was 35 minutes; however, 34% of survivors had an estimated travel time less than 25 minutes. Less than 1% of cancer survivors in this study did not have medical insurance. The most common type of insurance among survivors in this sample was private insurance (58.1%), followed by Medicare (36.9%), and Medicaid (4.2%). Among the 28 cancer types in the sample the 3 most prevalent were breast (34%), prostate (13%), and multiple myeloma (8%).¹⁶ All stages of cancer were represented in this sample and approximately 19% of survivors had advanced-stage disease (ie, stage IV).

Seventy-three percent of survivors who completed an initial POWER program assessment (n=849) did not attend a 12-week follow-up assessment (n=610). Demographic and clinical baseline characteristics for survivors who did not attend a 12-week follow-up assessment are presented in Tables 1 and 2, respectively. Characteristics for the group of survivors who completed a 12-week follow-up assessment (n=239) are presented elsewhere.¹⁶ For survivors who attended a 12-week follow-up assessment, there was an average of 25.0 ± 18.5 weeks between their initial and follow-up assessments. The majority of survivors chose to complete their exercise training during the POWER program in-person at HCI (n=728; 86%). A combination of in-person and telehealth exercise was used to complete training for 3% (n=28) of survivors. Home-based, unsupervised exercise training was selected by 11% (n=93) of survivors to complete the POWER program. Of the survivors that completed supervised training (ie, in-person or telehealth; n=756) 46% (n=239) attended a 12-week follow-up, while none of the survivors that completed unsupervised, home-based training (n=93) attended a 12-week follow-up.

Clinical Factors

There were no significant associations between not attending a 12-week follow-up assessment and cancer stage, number of cancer treatment types, presence of abdominal obesity, or baseline fatigue ($P > .05$; see Table 3). Univariate modeling revealed survivors with a BMI classified as overweight were 1.6 times more likely not to attend a 12-week follow-up assessment when compared to survivors with a normal weight status (OR 1.62; 95% CI: 1.11, 2.38). No other BMI categories were significantly associated with not attending a 12-week follow-up ($P > .05$; see Table 4). Men were 1.7 times more likely to not attend a 12-week follow-up assessment when compared to women, both in univariate

Table 1. Demographic Characteristics of Survivors Who Did Not Complete a 12-Week Follow-Up Assessment (n = 610).

Characteristic	n	%
Sex		
Female	358	58.7
Male	252	41.3
Ethnicity		
Hispanic	31	5.1
Non-Hispanic	565	92.6
Unknown	14	2.3
Race		
White	548	89.8
African American	4	0.7
Asian	11	1.8
Native Hawaiian and Other Pacific Islander	3	0.5
American Indian or Alaskan Native	1	0.2
Other	43	7.0
Travel time		
<25 min	180	29.5
25-44.9 min	201	33.0
>45 min	229	37.5
Travel distance (mi; n = 607)		
<10 mi	141	23.2
10-25 mi	218	35.9
>25 mi	248	40.9
Medical insurance (n = 609)		
Private	347	56.9
Medicare	233	38.3
Medicaid	24	3.9
Uninsured	5	0.9
	Mean	SD
Age (y)	61.3	13.7

Abbreviation: SD, standard deviation.

modeling (OR 1.70; 95% CI: 1.23, 2.35) and after controlling for age and BMI (see Table 3). Univariate models indicated that endometrial cancer survivors were more likely to complete a 12-week follow-up assessment compared to other cancer types (Odds Ratio [OR] 0.39; 95% Confidence Interval [CI]: 0.18, 0.87). Survivors with multiple myeloma were 2.3 times more likely to not attend a 12-week follow-up compared to other cancer types (OR 2.33; 95% CI: 1.09, 4.98). After controlling for age, sex, BMI, and number of recent treatment types this association was still significant for multiple myeloma and endometrial cancer (see Table 3). None of the other 10 most prevalent cancer types were significantly related to not attending a 12-week follow-up assessment in this sample. Of the 5 treatment types assessed (ie, chemotherapy, immunotherapy, hormone therapy, radiation, and surgery), immunotherapy was the only treatment that was significantly associated with not attending a 12-week follow-up in the univariate models (OR 1.66; 95% CI: 1.02, 2.72); however, this effect was no longer

significant after adjustments (see Table 3). Waist circumference was also positively associated with not attending a 12-week follow-up assessment (OR 1.01; 95% CI: 1.00, 1.02). Alternatively, higher baseline quality of life (OR 0.96; 95% CI: 0.93, 0.99) and greater peak oxygen consumption (OR 0.97; 95% CI: 0.95, 0.99) were associated with a decreased likelihood of not attending a 12-week follow-up assessment.

Demographic Factors

There was no significant association between not attending a 12-week follow-up assessment and age, race, ethnicity, or medical insurance status in this sample ($P > .05$; see Table 4). Both travel time and travel distance were significantly associated with not attending a 12-week follow-up assessment. Compared to survivors with an estimated travel time to the wellness center that was <25 minutes, those with a travel time of 25 to 45 minutes or ≥ 45 minutes were 1.5 times (OR 1.51; 95% CI: 1.06, 2.14) and 2.7 times (OR 2.69; 95% CI: 1.83, 3.96) more likely not to attend a 12-week follow-up assessment, respectively (see Table 4). Similarly, when compared to an estimated driving distance of <10 mi, survivors with an estimated driving distance of 10 to 25 mi or >25 mi were 1.4 times (OR 1.44; 95% CI: 1.00, 2.08) and 2.4 times (OR 2.37; 95% CI: 1.61, 3.49) more likely not to attend a 12-week follow-up assessment, respectively. These relationships were also significant for the subset of survivors who lived within the catchment area (ie, Utah, Wyoming, Montana, Idaho, and Nevada; n = 820). Survivors living within the catchment area that had a travel time of 24 to 42 minutes or >42 minutes were 1.5 times (OR 1.49; 95% CI: 1.03-2.16) and 2.4 times (OR 2.42; 95% CI: 1.67, 3.50) more likely not to attend a 12-week follow-up assessment than survivors with a travel time <24 minutes, respectively. When compared to survivors within the catchment area who had a travel distance of <10 mi, those who had to travel 10 to 26 mi or >26 mi were 1.5 times (OR 1.50; 95% CI: 1.04-2.17) and 2.3 times (OR 2.31; 95% CI: 1.59, 3.36) more likely not to attend a 12-week follow-up assessment.

Discussion

We aimed to identify predictors of not attending a 12-week follow-up assessment in POWER, a hospital-based exercise oncology program. We identified 3 demographic (sex, travel time, and travel distance) and 7 clinical factors (cancer type, immunotherapy treatment, waist circumference, BMI, baseline cardiorespiratory fitness, and baseline quality of life) that predicted not attending a 12-week follow-up assessment in the present study. Multivariate analysis revealed 4 clinical factors: endometrial cancer type, multiple myeloma cancer type, sex, and peak aerobic capacity at the start of the program that

Table 2. Clinical Characteristics of Survivors Who Did Not Complete a 12-Week Follow-Up Assessment (n = 610).

Characteristic	n	%	
Cancer stage			
Not staged	72	11.8	
I	138	22.6	
II	132	21.6	
III	112	18.4	
IV	123	20.2	
Unknown	33	5.4	
Cancer type			
Brain	20	3.3	
Breast	193	31.6	
Colorectal	27	4.4	
Endometrial	15	2.5	
Leukemia	29	4.8	
Lung	25	4.1	
Lymphoma	28	4.6	
Multiple myeloma	60	9.8	
Other	107	17.5	
Ovarian	18	3.0	
Prostate	88	14.4	
Recent treatment history			
Chemotherapy	No	397	65.1
	Yes	213	34.9
Hormone therapy	No	460	75.4
	Yes	150	24.6
Immunotherapy	No	522	85.6
	Yes	88	14.4
Radiation	No	433	71.0
	Yes	177	29.0
Surgery	No	473	77.5
	Yes	137	22.5
Number of recent treatment types			
None	267	43.8	
Unimodal	102	16.7	
Bimodal	114	18.7	
Multimodal	127	20.8	
Abdominal Obesity (n = 595)			
Yes	363	61.0	
No	232	39.0	
	Mean	SD	
Body mass index (kg/m ²)	28.5	6.3	
Waist circumference (cm)	98.0	16.3	
Peak oxygen consumption (ml/kg/min)	29.0	7.7	
Peak METs	8.3	2.2	
Fatigue (FACIT-fatigue score)	30.1	11.0	
Quality of life (FACT-G7 score)	15.5	5.0	

Abbreviations: SD, standard deviation; METs, metabolic equivalents; Abdominal obesity, waist circumference >40 in for men and >35 in for women; FACIT, Functional Assessment of Chronic Illness Therapy; FACT, Functional Assessment of Cancer Therapy.

predicted not attending a 12-week follow-up assessment in the POWER program.

The follow-up assessment is an integral component of survivors' engagement in hospital-based exercise oncology programs. The term engagement is comprised of various components of the exercise program including: program enrollment, initial assessments, exercise session attendance, exercise compliance, and follow-up assessments. Previous research has examined factors related to exercise attendance and compliance in cancer-specific exercise programs; however, this is the first study to our knowledge to focus on the follow-up assessment. The follow-up assessment is an indispensable component of an exercise oncology program as it provides information regarding survivor progress, side effects interfering with survivors' ability to exercise, and program effectiveness. This information allows for the revision of the exercise prescription to optimally meet the survivors needs, promote continued improvements in fitness and function, and sustained engagement in exercise. Moreover, cancer survivors have expressed a desire for regular check-ins from structured programs to support long-term exercise adherence.²⁵

Our finding that a greater travel distance and time were significant predictors of not attending a 12-week follow-up assessment contrasts with previous work examining other factors of exercise program engagement, including exercise compliance and attendance.^{18,26} Kampshoff et al²⁶ found no significant association between travel distance and exercise compliance (ie, how much of the prescribed exercise session was completed) in a sample of mixed cancer types. Moreover, Bland et al¹⁸ found no significant relationship between travel distance and exercise session attendance in breast cancer survivors. The geographic location of the hospital-based exercise oncology program may have contributed to the differences in findings. The catchment area of HCI is large, including 5 states. These 5 states cover 17% of the continental United States landmass, which is largely rural. The large catchment area that HCI serves may necessitate that survivors commute long distances to receive care. The POWER program does offer 3 modalities (ie, in-person, telehealth, and home-based), although over 85% of the survivors in our sample (n = 849) chose to complete their training in-person at the HCI wellness center gym. Thus, travel distance and time may play a larger role in barriers to attending a 12-week follow-up assessment for survivors living in rural areas compared to survivors in more urban areas.¹⁸ Further, the recent increase in the use of telehealth to deliver exercise programs due to the COVID-19 pandemic^{27,28} has demonstrated the potential of alternative exercise delivery modes to engage survivors in exercise. Future research may be beneficial to investigate how telehealth delivery can be utilized to

Table 3. Odds of Not Returning for a 12-Week Follow-Up Assessment Across Clinical Factors.

Variable	Unadjusted model			Model 1 ^a			Model 2 ^b			
	OR (95% CI)			OR (95% CI)			OR (95% CI)			
Cancer stage										
Unknown	1.0 (REF)			1.0 (REF)			1.0 (REF)			
I	0.70 (0.33-1.47)			0.84 (0.39-1.78)			0.82 (0.38-1.77)			
II	0.88 (0.41-1.87)			0.95 (0.44-2.03)			0.93 (0.43-2.02)			
III	0.83 (0.39-1.78)			0.93(0.43-2.02)			0.91 (0.42-1.99)			
IV	1.17 (0.54-2.55)			1.17 (0.53-2.58)			1.12 (0.50-2.47)			
Not staged	0.75 (0.34-1.67)			0.75 (0.34-1.69)			0.77 (0.34-1.73)			
Cancer type										
Other	1.0 (REF)			1.0 (REF)			1.0 (REF)			
Brain	1.94 (0.63-6.03)			1.82 (0.58-5.70)			1.83 (0.59-5.74)			
Breast	0.79 (0.51-1.22)			0.91 (0.55-1.49)			0.92 (0.62-2.17)			
Colorectal	1.50 (0.61-3.71)			1.27 (0.51-3.20)			1.24 (0.49-3.14)			
Endometrial	0.39 (0.18-0.87)*			0.43 (0.18-1.00)			0.41 (0.18-0.97)*			
Leukemia	1.13 (0.51-2.52)			1.10 (0.49-2.46)			1.07 (0.48-2.42)			
Lung	1.62 (0.62-4.23)			1.73 (0.66-4.55)			1.63 (0.62-4.31)			
Lymphoma	0.70 (0.34-1.45)			0.73 (0.35-1.52)			0.73 (0.35-1.52)			
Multiple myeloma	2.33 (1.09-4.98)*			2.23 (1.04-4.79)*			2.32 (1.07-5.02)*			
Ovarian	0.78 (0.32-1.87)			0.90 (0.36-2.24)			0.87 (0.35-2.17)			
Prostate	1.32 (0.75-2.31)			1.17 (0.63-2.19)			1.16 (0.62-2.17)			
Recent treatment history										
Chemotherapy	No	1.0 (REF)			1.0 (REF)			1.0 (REF)		
	Yes	1.24 (0.90-1.72)			1.29 (0.92-1.79)			1.25 (0.78-1.99)		
Hormone therapy	No	1.0 (REF)			1.0 (REF)			1.0 (REF)		
	Yes	1.02 (0.72-1.44)			1.02 (0.71-1.45)			0.86 (0.54-1.36)		
Immunotherapy	No	1.0 (REF)			1.0 (REF)			1.0 (REF)		
	Yes	1.66 (1.02-2.72)*			1.54 (0.93-2.54)			1.68 (0.93-3.04)		
Radiation	No	1.0 (REF)			1.0 (REF)			1.0 (REF)		
	Yes	1.12 (0.80-1.56)			1.16 (0.83-1.64)			1.06 (0.66-1.71)		
Surgery	No	1.0 (REF)			1.0 (REF)			1.0 (REF)		
	Yes	0.79 (0.56-1.12)			0.87 (0.61-1.25)			0.66 (0.41-1.06)		
Number of treatment types										
None	1.0 (REF)			-			-			
Unimodal	1.37 (0.87-2.14)			-			-			
Bimodal	1.33 (0.87-2.03)			-			-			
Multimodal	1.12 (0.76-1.66)			-			-			
Body mass index (kg/m²)										
Normal weight (18.5-24.99 kg/m ²)	1.01 (0.99-1.03)			-			-			
Underweight (<18.5 kg/m ²)	1.0 (REF)			-			-			
Underweight (<18.5 kg/m ²)	2.73 (0.77-9.62)			-			-			
Overweight (25.0-29.99 kg/m ²)	1.62 (1.11-2.38)*			-			-			
Obese (≥30.00 kg/m ²)	1.31 (0.91-1.89)			-			-			
Abdominal obesity										
No	1.0 (REF)			-			-			
Yes	1.33 (0.97-1.80)			-			-			
Waist circumference (cm)										
	1.01 (1.00-1.02)*			-			-			
Peak oxygen consumption (ml/kg/min)										
	0.97 (0.95-0.99)*			0.97 (0.94-0.99)*			-			
Fatigue Score at Initial Assessment (FACIT-fatigue score)										
	0.99 (0.98-1.01)			-			-			
Quality of life Score at Initial Assessment (FACT-G7 score)										
	0.96 (0.93-0.99)*			-			-			

Abbreviations: CI, Confidence interval; Abdominal obesity, a waist circumference >88 cm for women and >102 cm for men; FACIT, Functional Assessment of Chronic Illness Therapy; FACT, Functional Assessment of Cancer Therapy.

*P value <.05.

^aControlled for sex, age, and body mass index.

^bControlled for sex, age, body mass index, and number of different cancer treatment types.

Table 4. Odds of Not Returning for a 12-Week Follow-Up Assessment Across Demographic Factors.

Variable	OR (95% CI)
Age (y)	
18-64	1.0 (REF)
45-64	0.88 (0.53-1.44)
>65	0.84 (0.51-1.38)
Sex	
Females	1.0 (REF)
Males	1.70 (1.23-2.35)*; 1.73 (1.24-2.41)* ^a
Ethnicity	
Unknown	1.0 (REF)
Hispanic	0.40 (0.08-2.06)
Non-Hispanic	0.36 (0.08-1.58)
Race	
Other	1.0 (REF)
White	0.68 (0.35-1.31)
African American	••
Asian	1.54 (0.30-7.89)
Native Hawaiian Pacific Islander	••
American Indian or Alaskan Native	••
Travel time	
<25 min	1.0 (REF)
25-45 min	1.51 (1.06-2.14)*
>45 min	2.69 (1.83-3.96)*
Travel distance	
<10 mi	1.0 (REF)
10-25 mi	1.44 (1.00-2.08)*
>25 mi	2.37 (1.61-3.49)*
Medical insurance status	
Private insurance	1.0 (REF)
Medicare	1.23 (0.89-1.69)
Medicaid	0.84 (0.41-1.73)
Uninsured	2.10 (0.24-18.16)

Abbreviation: CI, confidence interval.

^aControlled for body mass index and age.

*P value <.05.

••Insufficient sample size in this category to obtain an odds ratio.

optimize attendance at follow-up assessments in exercise oncology programs.

Two cancer types were identified as significant predictors of not attending a 12-week follow-up assessment in the current study: endometrial and multiple myeloma. Endometrial survivors were more likely to complete a 12-week follow-up assessment, while multiple myeloma survivors were less likely to complete a 12-week follow-up assessment. Differences in treatment complexity between the 2 cancer types may have influenced our findings. Almost half (46%) of multiple myeloma survivors received multimodal therapy (ie, 3 or more treatment types) compared to

only 23% of endometrial cancer survivors. Although adherence to physical activity guidelines is generally low in both endometrial²⁹ and multiple myeloma survivors,³⁰ there may be a difference in the benefits of exercise across survivorship by cancer type. Evidence demonstrates positive effects of exercise for endometrial cancer survivors,³¹⁻³³ but the evidence is less conclusive for multiple myeloma survivors.³⁴ Therefore, endometrial survivors may receive more encouragement to participate in exercise throughout survivorship, which may influence follow-up rate. Further research in large samples of diverse cancer types is needed to better understand the relationship between cancer types and attending a follow-up assessment in an exercise oncology program.

Previous research of sex and exercise oncology program engagement is limited, as previous research is predominantly in female breast cancer survivors.^{17,18,35} Our findings demonstrate that males were nearly twice as likely to not attend a 12-week follow-up assessment than females after controlling for age and BMI. This finding suggests that it may be important to provide male cancer survivors with support to attend follow-up assessments in exercise programs. However, it is important to consider that 62% of the survivors in this study were female, which may have influenced our sample and findings.

Our findings demonstrate that survivors with a BMI classified as overweight, but not obese, are at an increased risk of not attending a 12-week follow-up assessment than normal-weight survivors. This finding may have been influenced by a greater motivation in survivors with obesity to improve their health and alleviate treatment-related side-effects. Survivors with obesity had reported poorer physical functioning, quality of life, and ratings of general health compared to survivors with a BMI classified as overweight at the start of an exercise program.³⁶ Therefore, survivors with obesity may be more likely to attend a follow-up assessment in order to determine their progress and receive a revised exercise prescription to promote continued improvements in quality of life. Previous exercise oncology program engagement research has investigated BMI as a continuous variable^{17,18,26} and found a negative relationship between BMI and exercise attendance in breast cancer survivors.^{17,18} Future research should examine BMI categorically with engagement across exercise oncology programs (ie, participation, attendance, follow-up, etc.) to elucidate the relationship between weight status and exercise engagement.

We found that both a higher baseline quality of life and cardiorespiratory fitness predicted survivors who were less likely not to attend a follow-up assessment., although the relative reduction in likelihood to not attend a 12-month follow-up assessment was small. Baseline quality of life has been shown to predict exercise oncology program attendance^{18,19} which supports our findings. However,

baseline quality of life may not be a significant predictor of exercise compliance, defined as the percentage of prescribed exercises completed, among cancer survivors.²⁶ Differences in findings may be due to differences in the instrument used to measure quality of life (FACT-G7 vs European Organisation Research and Treatment of Cancer—Quality of Life Questionnaire). Future research should determine if baseline quality of life can be used to screen and identify survivors who are at greater risk for lower attendance, compliance, and follow-up in exercise programs. Evidence regarding cardiorespiratory fitness as a predictor for exercise engagement (ie, attendance, compliance, follow-up) is less conclusive. Cardiorespiratory fitness, as measured by a graded exercise test, was not a significant predictor of exercise attendance in breast cancer survivors.^{17,18} Yet, cardiorespiratory fitness predicted compliance with aerobic exercise in breast cancer survivors.¹⁷ This discrepancy in findings may be attributed to exercise oncology programs commonly incorporating home-based aerobic exercise into the program.^{16,18} Additional research is needed to determine if cardiorespiratory fitness is a predictor across all exercise types and phases of an exercise oncology program (ie, initial assessment, attendance, follow-up assessment, etc.).

Strengths of the current study include a large, diverse sample of cancer types, the flexibility of the exercise program, and a focus on attending a 12-week follow-up assessment. The inclusion of 28 distinct cancer types across multiple phases of the cancer care continuum and inclusion of all cancer stages strengthens the external validity of this study. Additionally, 75% of the cancer survivors in this sample lived in a rural setting.¹⁶ The urban or rural nature of the municipalities in which cancer survivors live merit consideration, as rural cancer survivors have distinct exercise preferences.³⁷ Thus, findings from studies in primarily urban settings may not be generalizable to rural locations. Additionally, the focus on the follow-up assessment is a strength. Previous research has investigated factors related to attendance and compliance to exercise in cancer survivors^{17-19,26}; however, this is the first study to our knowledge to examine factors related to not attending a follow-up assessment in a hospital-based exercise oncology program. It is essential to understand each component of exercise oncology program engagement including enrollment, attendance, compliance, and follow-up. Each component may have unique correlates that impact sustained participation in exercise and behavior change. Last, all variables included in this study were collected as part of standard of care, which will enable the translation of the findings into clinical practice.

Despite the strengths of this study, it is not without limitations. First, travel time and distance were estimated using the epicenter of survivors' home zip codes which may skew the accuracy of a survivors' travel time to the Wellness

Center at HCI. Further, it was assumed participants would be driving if living within the HCI catchment area and flying if they lived outside this area which may have influenced our estimations. However, previous research has utilized similar methods to estimate travel distance,¹⁸ and employing parallel methods allows for comparability amongst findings. Second, we did not have access to information concerning the socioeconomic or marital status of survivors; therefore, we were unable to consider socioeconomic or marital status in this study. However, we were able to utilize medical insurance status as a proxy for socioeconomic status. Future research should further investigate the role of socioeconomic status concerning attendance at follow-up assessments. Last, our sample was generally homogeneous regarding race and ethnicity, which may limit the generalizability of our findings. It is important to note that our sample's race and ethnicity distribution was representative of the geographic area in which the study was conducted.³⁸

The current study adds to our understanding of factors influencing survivors' interaction with hospital-based exercise oncology programs by evaluating factors related to attending a 12-week follow-up assessment. Furthering our understanding in this area is meaningful as survivors have expressed that they prefer exercise programs associated with a cancer hospital and staff with expertise specific to exercise in cancer survivors.¹⁰ We found that both clinical (cancer type, waist circumference, BMI, baseline cardiorespiratory fitness, and baseline quality of life) and demographic factors (sex, travel time, and travel distance) were significantly associated with not attending 12-week follow-up assessment. Our findings have both clinical and research significance given the low levels of exercise participation among cancer survivors. Clinicians may utilize our findings to identify survivors at greater risk of not attending a 12-week follow-up assessment. Of the factors we investigated quality of life, cancer type, travel time, and travel distance may be the most pertinent factors for clinicians to consider when concerned with follow-up assessment attendance. By identifying those at greater risk of not attending a 12-week follow-up assessment, clinicians may be able to direct those survivors to additional resources, if available, to optimize follow-up rate within cancer-specific exercise programs. The specific resources that could support survivors to attend a follow-up assessment will vary across individuals; however, transportation services or a telehealth follow-up assessment option may help improve survivors' access to attending a follow-up assessment. Additionally, other wellness services such as physical therapy, occupational therapy, massage therapy, and nutrition counseling, may address survivors' unmet needs and help them stick with their exercise program. From a research perspective, our findings may be applied to inform the development, and evaluation, of interventions to promote attendance at

follow-up assessments in exercise oncology programs. Targeting interventions to survivors most at risk of not returning for follow-up may help improve follow-up rate, thereby, optimizing the determination of intervention effectiveness and continuing to promote sustained engagement in exercise.

Conclusions

Hospital-based exercise oncology programs, such as the POWER program, are one resource survivors can utilize to help them be active across the cancer care continuum; however, follow-up rate in these programs can be low. When survivors do not complete a follow-up assessment, they miss out on an opportunity to see their progress, receive revisions to their exercise prescription, and obtain support for continued participation in exercise. The present study adds to our current understanding of engagement in hospital-based exercise oncology programs by identifying factors that may indicate survivors are at higher risk of not attending a follow-up assessment. This is critical information to help improve exercise oncology programs, particularly as survivors that do not complete a follow-up assessment in an exercise program are often not represented in research. Strategies such as scheduling the follow-up assessment at the initial assessment, providing a telehealth follow-up assessment option, and directing survivors to other available supportive care resources when needed may help to improve attendance at follow-up assessments. Targeting such strategies to survivors most at risk of not attending a follow-up assessment may help support exercise participation in cancer survivors who could benefit from exercise the most.

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Ethics Approval and Consent to Participate

This retrospective study was approved by the University of Utah Institutional Review Board (00072431) and was performed in accordance with the Declaration of Helsinki. Waiver of informed consent for this retrospective study was approved by the University of Utah Institutional Review Board.

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