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ORIGINAL ARTICLE

Moving forward on all fronts: impact, patterns, and barriers to exercise in cancer survivors and patients living with advanced disease

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Abstract

Introduction Exercise is recommended for all patients with cancer, but there has been limited study of exercise habits in patients across the spectrum of illness.

Purpose This pragmatic survey aimed to identify the unmet supportive care needs, self-reported symptoms, and exercise habits among both cancer survivors and patients living with advanced disease to determine adherence to exercise guidelines and to identify barriers and opportunities to improve exercise.

Methods An anonymous cross-sectional self-administered paper survey was distributed to patients with cancer presenting for oncology clinic visits at an academic cancer center. Survey measures included presence of symptoms and health problems in addition to weekly time spent exercising, change in exercise levels since diagnosis, interest in exercise, and self-reported barriers. Participants reporting at least 150 min of exercise per week were characterized as adherent to guidelines.

Results Among 640 survey respondents, 570 (89%) completed questions about exercise. Only 44% of cancer survivors and 34% of patients living with advanced disease met current guidelines. Survivors who met exercise guidelines had a lower prevalence of fatigue and memory impairments, but this finding was not seen among patients with advanced cancer. Over 70% of patients with advanced disease and 47% of survivors reported decreasing exercise post-diagnosis compared to pre-diagnosis. Prominent barriers to exercise among both groups included burden of illness and time constraints but interest in increasing exercise was high.

Conclusions There is an opportunity to improve exercise and related outcomes among a large percentage of both cancer survivors and patients living with advanced disease.

Keywords Exercise; cancer · Symptom burden · Functional status

Introduction

Cancer treatment in the form of surgery, radiation, or systemic therapy can adversely impact fitness and functional status, leading to worsening of quality of life and higher risk of comorbid conditions such as diabetes, cardiac, and pulmonary disease. [1] An emerging body of literature demonstrates that many of the detrimental effects of cancer therapy can be reduced or overcome by exercise among patients with cancer and guidelines have been developed to guide patient behavior and clinical practice. [2]

Historically, practitioners recommended rest for patients with cancer and limited exercise participation. However, in 2010, the American College of Sports Medicine (ACSM) published exercise guidelines for patients with cancer. [3, 4] After reviewing evidence for exercise in specific cancer populations including breast, prostate, colon, hematologic malignancies (including after stem cell transplant), and gynecology, the panel concluded that exercise is generally safe and can improve fitness and strength, generally reduce symptoms, and decrease

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fatigue. [3, 5]. The original ACSM guidelines recommend patients participate in at least 150 min of moderate-intensity aerobic exercise per week in addition to resistance exercises twice per week and stretching activities. [3–5] These guidelines were updated in 2019 and recommend specific exercise prescriptions for cancer types and impairment needs and recommend at least 30 min sessions of moderate-intensity aerobic training three times per week for at least 2–3 months. [5] The updated 2019 ACSM guidelines also recommend resistance training at least twice per week with at least two sets of 8–15 repetitions. [5] Additionally, the guidelines recommend disease-specific non-oncologic screening in addition to specific screening dependent on individual oncologic history prior to starting an exercise program. [4, 5] Similarly, the American Cancer Society published guidelines recommending at least 150 min of weekly exercise in addition to strength training twice per week and this recommendation was echoed by the National Comprehensive Cancer Network, who recommended at least 150 min of moderate intensity activity per week in addition to resistance exercise and stretching twice per week. [6, 7] In 2017, the Exercise for People with Cancer Guideline Development Group in Canada published similar guidelines supporting 150 min per week of moderate-intensity exercise including aerobic and resistance training spread over 3 or more days per week, including warm-up and cool-down sessions. [8]

There is now extensive literature on the beneficial effects of exercise for patients with cancer, including improvements in recurrence risk, symptom management, cognition, fatigue, quality of life, and even survival in some settings. [9–16] Exercise has also been correlated with ability to return to work for patients with cancer. [17] Despite growing awareness of the benefits of exercise, rates of obesity have been increasing steadily in the cancer population, potentially placing both cancer survivors and patients living with advanced disease at higher risk for cardiovascular-related morbidity and mortality. [18] Further, in breast and colorectal cancer survivors, adherence to 150 min per week of exercise is associated with reduced overall mortality [19, 20] Despite this evidence, among cancer survivors there are multiple reported barriers to exercise, including side effects from treatment, lack of time, and fatigue. [21, 22]

While there is a growing literature on exercise habits among cancer survivors (patients with curable disease who have completed initial therapy), there is less understanding of exercise among patients living with advanced disease, defined as individuals who have incurable or metastatic disease. [5, 9–15, 23, 24] Increasingly, patients living with advanced disease may survive for years, and there is a need to better understand the role of exercise in this population and how they compare to patients who have traditionally been considered cancer survivors (defined as patients with curable disease who have completed initial therapy) who have been the focus of most oncology exercise studies. Several studies demonstrate that exercise can be safe and beneficial despite advanced cancer but attrition from structured programs may be high. [25–27] There is no discrete data on adherence to current exercise guidelines among patients living with advanced disease, and little understanding on the interaction between exercise and symptoms along with interest in exercise and perceived barriers among patients with advanced disease.

This study was conducted as part of a comprehensive evaluation of supportive care needs among patients presenting for routine care at an academic cancer center, intended to identify prevalent issues, unmet needs, and patient interest in addressing these issues, including exercise. In this analysis, we sought to evaluate the self-reported symptoms and exercise habits among both cancer survivors and patients living with advanced disease. We used the guideline recommendation of 150 min of weekly exercise as a threshold to characterize participants as adherent or non-adherent to guidelines and evaluated the correlation between symptoms and exercise among both populations of patients with cancer. We also sought to assess change in exercise habits before and after cancer diagnosis and interest in increasing exercise and self-reported barriers, which is of particular interest among the advanced disease population where there has been little attention to these issues.

Methods

Study design

We conducted a cross-sectional needs-assessment survey administered to patients presenting for routine oncology care at a large urban academic cancer center between February 2016 and July 2016. This study was approved by the Dana-Farber/Harvard Cancer Center Institutional Review Board. Anonymous self-administered paper surveys were distributed to a convenience sample of patients at the time of front desk check in by clinical staff. Surveys could be returned at the time of the visit or returned by mail. Eligible patients were English-speaking adults with any type and any stage of cancer presenting to the oncology clinic for care.

The survey was developed by a multi-disciplinary group which included patients and family members in addition to physicians, researchers, and other health care practitioners and included both validated and study specific instruments. The paper survey collected self-reported measures including demographic information and clinical information. Specifically, measures included age, gender, race, employment, and education. Clinical measures were self-reported and included cancer type, current and prior treatments, and disease status in addition to medical comorbidities and symptom prevalence. Daily function was characterized as the

ability to return to work or school. The survey was pilot tested and refined for comprehension and to ensure that it could be completed in 15 to 20 min.

Exercise was evaluated by self-report of the average times per week (in minutes) of cardiovascular activity and strength training, separately. However, for the purposes of characterizing participants as adherent or not to current exercise guidelines, we opted to combine the total numbers of minutes for cardiovascular and strength training. This summation was done in recognition of the overlap between aerobic and strength training activities and represents a potential overestimate of the percent of patients adhering to current guidelines calling for 150 min of exercise per week. Participants were also asked to compare their current individual level of physical activity to their pre-cancer diagnosis level of physical activity and to report whether their exercise level had increased, decreased, or was unchanged. Participants were also asked whether or not they were interested in receiving additional information about exercise ("How interested are you in receiving information regarding any of the following lifestyle services," specifically "Exercise and physical activity" with selection options including "Not at all interested," "A little interested," or "Very interested"), and what barriers to exercise they faced, if any, through nine pre-selected multiple-choice answers based on prior literature, including a category for "other" to collect unanticipated barriers. ("Which of the following are barriers or factors that reduce your chance of exercising?")

Statistical analysis

We characterized all participants as either "survivors" or "patients with advanced disease" based on self-reported disease status, including clinical details of current therapy and intent of treatment. Patients reporting curable illness or curative intent but who also reported undergoing chemotherapy or other systemic therapy, excluding endocrine therapy, beyond 2 years from diagnosis were categorized as living with advanced disease. After identifying patients as either survivors or patients with advanced disease, demographic information were summarized using descriptive statistics. *T* tests were used to compare mean weekly aerobic and strength minutes in the survivors versus patients with advanced disease groups. Fisher's exact tests were used to compare symptom rates by disease group as well as by meeting versus not meeting current exercise guidelines within the survivor group and within the advanced disease group. All statistical tests were two-sided, with statistical significance defined as $p < 0.05$. Finally, data regarding interest in exercise, change in exercise habits since the diagnosis of cancer, and identified barriers for exercise were summarized by disease status group.

Results

In total, a convenience sample of 640 patients completed the needs assessment survey between February and July 2016. Seventy patients did not complete questions on exercise and a total of 570 surveys (89%) were used in the analysis.

Participant characteristics

Participants' characteristics are presented in Table 1. Among 570 patients, we classified 51.6% (294 patients) as survivors and 48.4% (276 patients) as living with advanced disease. More than half of survivors (56.7%) and patients living with advanced disease (59.1%) were in the age range of 50 to 69 and more than half were women.

A greater percentage of survivors (41.1%) worked full time compared to those with advanced disease (27.0%, $p = 0.0005$), whereas a higher percentage of patients living with advanced disease reported inability to work due to illness/disability (21.2%) compared to survivors (8.6%, $p < 0.0001$). More than 30% in both the survivor (33.2%) and advanced disease (38.7%) groups were retired. Survivors were more likely to have a history of breast (30.3%) and hematologic (18.4%) malignancies; however, in patients living advanced disease, 16.3% reported breast, 12.3% reported hematologic, 10.5% reported gastrointestinal, and 10.9% reported thoracic malignancies ($p < 0.0001$ for distribution of cancer type between groups). The most common self-reported comorbidities were obesity: 20.8% for survivors and 19.9% among patients with advanced disease; and heart disease: 22.8% for survivors and 19.2% among those with advanced disease.

Adherence to current exercise guidelines

Combining both the survivor and advanced disease groups, a total of 39% of the patients ($n = 222$) fulfilled the current guidelines for exercise of 150 min per week. More survivors ($N = 128$, or 44%) fulfilled the exercise guidelines compared to 34% ($N = 94$) of patients with advanced disease ($p = 0.02$).

Survivors reported an average of 123.5 min of aerobic activity and 37.3 min of strength activity per week. Patients living with advanced disease reported an average of 103.1 min of aerobic activity and 27.9 min of strength activity per week ($p = 0.12$ (aerobic) and $p = 0.10$ (strength) for comparison between groups). Compared to pre-cancer diagnosis levels, 36.3% of survivors reported no change in exercise levels, 47.6% reported decreased levels and 16.1% reported an increase in exercise. In contrast, among patients with advanced disease, 71.5% reported decrease in exercise following diagnosis, 21.9% no change, and only 6.6% increased exercise compared to pre-cancer activity.

Table 1 Demographic information of all participants

		Total *N* (%)	Survivors *N* (%)	Advanced disease *N* (%)
Age (years)	<50	117 (20.7)	66 (22.7)	51 (18.6)
	50–69	327 (57.9)	165 (56.7)	162 (59.1)
	70 and older	121 (21.4)	60 (20.6)	61 (22.3)
Gender	Male	221 (39.8)	96 (33.7)	125 (46.3)
	Female	334 (60.2)	189 (66.3)	145 (53.7)
Race/ethnicity	American Indian or Alaska Native	2 (0.4)	1 (0.3)	1 (0.4)
	Asian	15 (2.7)	6 (2.1)	9 (3.3)
	Black or African American	9 (1.6)	4 (1.4)	5 (1.8)
	White, non-Hispanic	503 (89.0)	258 (88.7)	245 (89.4)
	Hispanic or Latino origin	18 (3.2)	12 (4.1)	6 (2.2)
	Other	11 (2.0)	7 (2.4)	4 (1.5)
	Multiple races reported	7 (1.2)	3 (1.0)	4 (1.5)
Level of education	<4 years of college	207 (36.6)	95 (32.5)	112 (40.9)
	College graduate	173 (30.6)	92 (31.5)	81 (29.6)
	Advanced degree (masters', doctoral, medical, or law degree)	186 (32.9)	105 (36.0)	81 (29.6)
Employment status	Employed—full time	194 (34.3)	120 (41.1)	74 (27.0)
	Employed—part time	46 (8.1)	28 (9.6)	18 (6.6)
	Unemployed and looking for work	7 (1.2)	5 (1.7)	2 (0.7)
	Unable to work due to caring for home or family	9 (1.6)	4 (1.4)	5 (1.8)
	Unable to work due to illness or disability	83 (14.7)	25 (8.6)	58 (21.2)
	Retired	203 (35.9)	97 (33.2)	106 (38.7)
	Student	4 (0.7)	3 (1.0)	1 (0.4)
	Other	20 (3.5)	10 (3.4)	10 (3.7)
Cancer type	Breast	134 (23.5)	89 (30.3)	45 (16.3)
	Gynecologic	29 (5.1)	22 (7.5)	7 (2.5)
	Neurologic	10 (1.8)	3 (1.0)	7 (2.5)
	Gastrointestinal	51 (9.0)	22 (7.5)	29 (10.5)
	Genitourinary	24 (4.2)	9 (3.1)	15 (5.4)
	Thoracic	34 (6.0)	4 (1.4)	30 (10.9)
	Head+neck	15 (2.6)	12 (4.1)	3 (1.1)
	Melanoma	34 (6.0)	13 (4.4)	21 (7.6)
	Sarcoma	17 (3.0)	5 (1.7)	12 (4.4)
	Heme	88 (15.4)	54 (18.4)	34 (12.3)
	Site not specified	17 (3.0)	5 (1.7)	12 (4.4)
	Site unknown	55 (9.7)	24 (8.2)	31 (11.2)
	Multiple primaries	62 (10.9)	32 (10.9)	30 (10.9)
Past treatment	Surgery	345 (60.5)	196 (66.7)	149 (54.0)
	Radiation therapy	254 (44.6)	133 (45.2)	121 (43.8)
	IV chemo	328 (57.5)	163 (55.4)	165 (59.8)
	PO chemo	94 (16.5)	15 (5.1)	79 (28.6)
	Hormonal or endocrine therapy	50 (8.8)	21 (7.1)	29 (10.5)
	Complementary or alternative therapy	23 (4.0)	7 (2.4)	16 (5.8)
	Other	34 (6.0)	12 (4.1)	22 (8.0)
	Do not know	2 (0.4)	1 (0.3)	1 (0.4)

Table 1 (continued)

		Total *N* (%)	Survivors *N* (%)	Advanced disease *N* (%)
Current treatment	Surgery	53 (9.3)	27 (9.2)	26 (9.4)
	Radiation therapy	48 (8.4)	25 (8.5)	23 (8.3)
	IV chemo	168 (29.5)	55 (18.7)	113 (40.9)
	PO chemo	88 (15.4)	9 (3.1)	79 (28.6)
	Hormonal or endocrine therapy	48 (8.4)	26 (8.8)	22 (8.0)
	Complementary or alternative therapy	14 (2.5)	4 (1.4)	10 (3.6)
	Other	67 (11.8)	23 (7.8)	44 (15.9)
	Do not know	9 (1.6)	2 (0.7)	7 (2.5)
Other medical problems	Diabetes	61 (10.7)	29 (9.9)	32 (11.6)
	Kidney disease	15 (2.6)	6 (2.0)	9 (3.3)
	Overweight/obesity	116 (20.4)	61 (20.8)	55 (19.9)
	Underweight	7 (1.2)	5 (1.7)	2 (0.7)
	Liver disease	14 (2.5)	5 (1.7)	9 (3.3)
	Lung disease	38 (6.7)	17 (5.8)	21 (7.6)
	Heart disease	120 (21.1)	67 (22.8)	53 (19.2)
How has your activity level changed before/after cancer	No change	166 (29.3)	106 (36.3)	60 (21.9)
	Decreased	335 (59.2)	139 (47.6)	196 (71.5)
	Increased	65 (11.5)	47 (16.1)	18 (6.6)

Symptom prevalence and exercise guideline adherence in survivors and patients with advanced disease

Table 2 presents the prevalence of self-reported symptoms in both survivors and patients living with advanced disease in patients who did and did not meet the current exercise guidelines. More patients living with advanced disease reported fatigue (44.6%) than survivors (28.2%, $p < 0.0001$). Interestingly, comparable percentages of survivors and patients living with advanced disease reported the same symptoms except diarrhea, which was significantly different between groups ($p = 0.02$) and lymphedema/swelling was borderline significant ($p = 0.06$). Within the survivor group, those who met the current exercise guidelines reported significantly less fatigue (16.4%) and memory difficulty (14.1%) than those who did not meet the exercise guidelines (37.4% and 27.1%, respectfully, with p values of <0.0001 and 0.01). The prevalence of other symptoms in the survivor group was not significantly different based on meeting versus not meeting current exercise guidelines. In the advanced disease group, adherence to the current exercise guidelines was not significantly associated with prevalence of any of the listed symptoms.

Interest in improving exercise

Table 3 gives information regarding patients' interest in receiving information about exercise and physical therapy. A sizeable majority of both survivors and patients living with advanced disease reported interest in increasing exercise. In the survivor group, 67.6% reported interest in improving exercise levels, while among patients living with advanced disease, 72.4% reported such interest. Survivors who had decreased their exercise levels post-cancer diagnosis also expressed interest (64.6%) in increasing exercise and physical activity. Similarly, patients living with advanced disease who had decreased their exercise levels post-cancer diagnosis also expressed a high level of interest (78.6%) in obtaining more information about exercise and physical activity. Both survivors and patients living with advanced disease who had not changed their level of physical activity or had increased their exercise level also expressed interest in obtaining more information about exercise.

Barriers to exercise

The most common barriers to exercise for cancer survivors were limitations by other conditions/illnesses (27.2%), not enough free time (26.5%), and a sentiment that exercise is boring (10.9%). Patients living with advanced disease felt they were limited by other conditions/illnesses (35.9%) while 15.9% felt they did not have enough free time. A comprehensive list of exercise barriers for both survivors and advanced disease patients is given in Table 4.

Table 2 Symptoms reported in patients who did or did not meet recommended exercise guidelines

Symptom reported	Disease status	Total *N* (%)	Met ACSM guideline *N* (%)	Not ACSM met *N* (%)	*p* value
Pain	Survivors	71 (24.2)	25 (19.5)	46 (27.7)	0.13
	Advanced disease	78 (28.3)	23 (24.5)	55 (30.2)	0.33
Fatigue	Survivors	83 (28.2)	21 (16.4)	62 (37.4)	<0.0001
	Advanced disease	123 (44.6)	40 (42.6)	83 (45.6)	0.70
Swelling/lymphedema	Survivors	34 (11.6)	18 (14.1)	16 (9.6)	0.27
	Advanced disease	48 (17.4)	14 (14.9)	34 (18.7)	0.50
Numbness and tingling	Survivors	79 (26.9)	30 (23.4)	49 (29.5)	0.29
	Advanced disease	72 (26.1)	21 (22.3)	51 (28.0)	0.39
Bone health/osteoporosis	Survivors	42 (14.3)	23 (18.0)	19 (11.5)	0.13
	Advanced disease	47 (17.0)	11 (11.7)	36 (19.8)	0.09
Trouble swallowing	Survivors	35 (11.9)	13 (10.2)	22 (13.3)	0.47
	Advanced disease	39 (14.1)	10 (10.6)	29 (15.9)	0.28
Constipation/diarrhea	Survivors	59 (20.1)	20 (15.6)	39 (23.5)	0.11
	Advanced disease	79 (28.6)	23 (24.5)	56 (30.8)	0.33
Bowel and bladder	Survivors	42 (14.3)	16 (12.5)	26 (15.7)	0.50
	Advanced disease	39 (14.1)	9 (9.6)	30 (16.5)	0.15
Memory difficulty	Survivors	63 (21.4)	18 (14.1)	45 (27.1)	0.01
	Advanced disease	50 (18.1)	12 (12.8)	38 (20.9)	0.10
Concentration difficulty	Survivors	57 (19.4)	18 (14.1)	39 (23.5)	0.05
	Advanced disease	46 (16.7)	13 (13.8)	33 (18.1)	0.40
Balance, mobility, coordination	Survivors	42 (14.3)	14 (10.9)	28 (16.9)	0.18
	Advanced disease	42 (15.2)	9 (9.6)	33 (18.1)	0.08
Difficulty in returning to work	Survivors	27 (9.2)	13 (10.2)	14 (8.4)	0.69
	Advanced disease	26 (9.4)	9 (9.6)	17 (9.3)	1.00

Discussion

Historically, healthcare practitioners and physicians counseled patients with cancer to be physically inactive, but this recommendation has changed in recent years. Currently, the ACSM, American Cancer Society, the National Comprehensive Cancer Network, and the Exercise for People with Cancer Guideline Development Group guidelines now recommend that all patients with cancer participate in 150 min of physical activity per week along with strengthening exercises. [3–8] Some guidelines allow for lesser time spent in more vigorous exercise, but the threshold of 150 min per week for most patients is otherwise consistent. In this study, we investigated both cancer survivors and patients living with advanced disease. Despite proven benefits of exercise, only 44% of survivors and 34% of patients living with advanced disease at our center were characterized as adherent to current exercise guidelines. As noted, above, this finding likely represents an overestimate of current exercise given that we combined reported aerobic and strength training minutes. In addition, more than 70% of patients living with advanced disease and close to 50% of survivors report decreased levels of exercise after diagnosis of cancer. This study demonstrates both a substantial opportunity to improve the fitness of our patients and a high level of interest in obtaining more information about exercise. High interest in addressing exercise was reported among both those who were exercising and among patients who reported a decline in physical activity following diagnosis. Almost 70% of patients, regardless of disease status or post-cancer diagnosis exercise levels, wanted more information about exercise and physical activity. Importantly, patients living with advanced disease expressed even higher levels of interest in

Table 3 Interest in getting information about exercise and physical activity based upon age and prior activity categories

	Total *N* (%)	Survivors *N* (%)	Advanced disease *N* (%)
<50	26 (28.9)	12 (25.0)	14 (33.3)
50–69	51 (56.7)	28 (58.3)	23 (54.8)
70 and older	13 (14.4)	8 (16.7)	5 (11.9)
Decrease	64 (71.1)	31 (64.6)	33 (78.6)
No change	17 (18.9)	12 (25.0)	5 (11.9)
Increase	9 (10.0)	5 (10.4)	4 (9.5)

improving exercise and physical activity than cancer survivors, who have traditionally been the focus of exercise studies in oncology. This finding suggests an opportunity to identify and address this issue in clinic and provide counseling regarding exercise guidelines tailored to the individual patient regardless of disease status, provided there are no medical contraindications.

There is limited research examining exercise habits in the advanced disease/metastatic cancer populations while there is a growing body of literature examining exercise in cancer survivors. To our knowledge, this study is the first to examine exercise and symptom burden among a cohort of patients living with advanced disease and cancer survivors from a single cancer center. It is notable that cancer survivors who met current exercise guidelines reported significantly less fatigue and memory difficulty compared to those who did not meet these exercise guidelines. Symptom prevalence was not significantly different in patients living with advanced disease who did and did not meet exercise guidelines, which is surprising. The ability to return to work or school in this study was used as a proxy for functional outcome in the survey as it can reflect an overall function. In this study, the adherence to exercise guidelines was not associated with ability to return to work or school for survivors or patients living with advanced disease.

Part of this study investigated barriers to exercise. Common barriers to exercise in patients with cancer include side effects from treatment, lack of time, and fatigue. [20] Both disease and other health limitations and time constraints were identified by survivors and patients living with advanced disease as the most common reasons not to exercise, which supports findings from other investigations. [21, 28] In all patients with cancer, exercise adherence is related to exercise history rather than demographic factors. [19] In clinical practice, patients with advanced disease are not usually assessed for exercise habits despite the existence of exercise guidelines and screening recommendations. [22] If symptoms limit the ability to exercise, screening for these symptoms followed by symptom management by oncology and physiatry teams should help reduce this barrier. [22] Improving the access to exercise and its benefits through provider and patient education along with designing and allowing accessible exercise programs for patients with cancer, potentially through telehealth or online portals, should be a goal of future research. [22, 29]

There was an approximately 20% prevalence of both self-reported obesity/overweight status and heart disease in both survivors and patients living with advanced disease in this study. Rates of obesity have been increasing in patients with cancer thereby increasing the risk of cardiovascular-related morbidity and mortality. [18] Patients with cancer can be at higher risk for obesity, cardiovascular disease, and related mortality based upon specific oncologic treatments; recommendations exist to improve exercise to the level of current guidelines. [30–34] These findings highlight the need for attention toward improving cardiovascular health and reducing obesity in the general cancer population to reduce morbidity and mortality.

Table 4 Barriers for exercise

	Total *N* (%)	Survivors *N* (%)	Advanced disease *N* (%)
Limited by other conditions/illnesses	179 (31.4)	80 (27.2)	99 (35.9)
Not enough free time	122 (21.4)	78 (26.5)	44 (15.9)
Not sure how much to exercise	33 (5.8)	10 (3.4)	23 (8.3)
Not sure how to exercise	19 (3.3)	10 (3.4)	9 (3.3)
Afraid to exercise	21 (3.7)	8 (2.7)	13 (4.7)
Too expensive	14 (2.5)	9 (3.1)	5 (1.8)
Exercise is boring	45 (7.9)	32 (10.9)	13 (4.7)
No barriers	123 (21.6)	66 (22.5)	57 (20.7)
Other	128 (22.5)	54 (18.4)	74 (26.8)

Overall, less than 50% of both cancer survivors and patients living with advanced disease met the current exercise guideline recommendations in this study. While there has been increasing amounts of literature investigating benefits of exercise in cancer survivors, there is less research on the safety and benefits of exercise in the advanced and metastatic cancer population. Generally, exercise is felt to be safe and well tolerated in the advanced cancer population. [27, 35] However, as demonstrated in this study, there is a high rate of non-adherence to exercise guidelines (66%) with exercise barriers related to illness and time constraints. One recent study in patients with metastatic breast cancer found that while exercise is safe, feasibility of a structured training program is poor given a high lost to follow-up rate. [26] As a result, implementation of exercise into the advanced disease population should address barriers and the specific exercise program should be tailored in order to allow participation. For example, an ongoing trial is using a mobile phone application to achieve 150 min/week of moderate exercise through a personalized activity program in patients with metastatic breast cancer. [36]

Because this study is a self-administered survey, a major limitation is self-reporting bias and estimates of exercise are likely under- or over-estimated. Some of the guidelines differentiate the 150-min recommendation for only aerobic activity while separately adding strengthening exercises; in this study, we combined the self-reported minutes of aerobic and strength activity with the belief that patients may not be able to decipher between strictly aerobic or strength exercise during a 30- or 60-min exercise class or program. Despite this combination of aerobic and strengthening activities, less than 50% of survivors and patients with advanced disease met the current exercise guidelines; if we restricted the analysis to only self-reported aerobic activity, this percentage would be even lower. Because this manuscript reports on a secondary analysis of a comprehensive needs-assessment survey, we did not use validated physical activity or symptom burden assessment tools, which is a limitation of this study. Additionally, the responses may be biased based upon who participated in the study; while it was available at numerous disease clinics at check-in, individuals experiencing significant symptoms may have been more likely to participate than those who had limited to no symptoms; conversely, individuals who felt better or were healthier may have been more likely to participate in the survey. Direction of bias in terms of over or underreporting exercise in this population is difficult to assess, but we can say that adherence was low among a significant percentage of survey respondents, which suggests a clear opportunity to improve patient care and outcomes, even if the actual population prevalence of adherence to exercise guidelines is somewhat higher. Despite these limitations, this study is particularly important in highlighting the fact that low adherence to current guidelines and high interest in improving exercise is prevalent among patients living with advanced cancer, just as it is for cancer survivors.

Exercise is known to have multiple health benefits and reduce morbidity and mortality. [16] By assessing current exercise activity, symptoms, and barriers separately identified by survivors and advanced disease patients, we hope to provide a basis for future interventions to target both groups to improve exercise guideline adherence. All patients with cancer should be educated about the importance of exercise with appropriate medical screening by physicians, along with screening for the previously mentioned barriers. The findings in this study add important information to the existing literature regarding exercise levels in patients with advanced disease. Future study should investigate more exercise-specific details and certain exercise programs that can target the barriers identified by participants in this study and also provide education for patients and healthcare practitioners.

Conclusions

This cross-sectional survey of a heterogeneous population of cancer survivors and patients living with advanced disease demonstrates that less than 50% are meeting current exercise guidelines despite significant interest in improving physical activity levels. Reducing barriers to exercise should be a focus of future study to enable both survivors and advanced disease patients with cancer to be more physically active. All patients with cancer, including survivors and those with advanced disease, can and should be screened for current exercise levels. Patients without a contraindication should be encouraged to meet exercise guidelines, educated on the benefits of exercise, and ideally directed toward activities or programs that may help them meet these goals. For patients living with advanced disease, tailored exercise programs are needed to help motivated patients overcome limitations imposed by illness or treatment. Across all patient populations, further behavioral health research is needed to optimize adherence to exercise guidelines and to help sustain the benefits documented in short term programs. These issues can be addressed on an individual basis in clinic and with further research we can identify strategies to help more patients with cancer obtain the potential benefits of exercise.

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