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Development of a Risk-Screening Tool for Cancer Survivors to Participate in Unsupervised Moderate- to Vigorous-Intensity Exercise: Results from a Survey Study

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Abstract

Background—The health-benefits of exercise increase in dose-response fashion among cancer survivors. However, it is unclear how to identify cancer survivors who may require a pre-exercise evaluation prior to progressing from the common recommendation of walking, to unsupervised moderate- to vigorous-intensity exercise.

Objective—To clarify how to identify cancer survivors who should undergo a pre-exercise evaluation prior to progressing from the common recommendation of walking, to unsupervised moderate- to vigorous-intensity exercise.

Design—Electronic survey.

Participants—Forty seven (n=47) experts in the field of exercise physiology, rehabilitation medicine, and cancer survivorship.

Setting—Not Applicable.

Methods—We synthesized peer-reviewed guidelines for exercise and cancer survivorship and identified 82 health-factors that may warrant a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. The 82 health-factors were classified into three domains: 1) clinical health-factors; 2) comorbidity and device health-factors; and 3) medications. We surveyed a sample of experts asking them to identify which of the 82 health-factors among cancer survivors would indicate the need for a pre-exercise evaluation prior to engaging in moderate- to vigorous-intensity exercise.

Main Outcome Measurements—The response rate to our survey was 75% (n=47). Across the three domains of health-factors, acute symptoms, comorbidities, and medications related to cardiovascular disease were agreed to indicate a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. Other health-factors in the survey included hematologic, musculoskeletal, systemic, gastrointestinal, pulmonary, and neurological symptoms and comorbidities. Eighteen experts (38%) said it was difficult to provide absolute answers since no two patients are alike, and their decisions are made on a case-by-case basis.

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Conclusions—The results from this expert survey will help to identify which cancer survivors should undergo a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise.

Keywords

adverse event; screening; comorbidity; safety; cancer; exercise

INTRODUCTION

The American College of Sports Medicine (ACSM) [1], American Cancer Society (ACS) [2], and National Comprehensive Cancer Network (NCCN) [3], recommend all cancer survivors participate in regular physical activity such as walking, and progress to 150 min·wk⁻¹ of moderate-intensity or 75 min·wk⁻¹ of vigorous-intensity aerobic exercise. Cancer survivors are also advised to engage in muscle strengthening and flexibility exercises to maximize health-related fitness [1–3]. The recommended exercise prescription for cancer survivors is similar to that for healthy adults, which emphasize improving cardiovascular and musculoskeletal fitness [4–6]. Contemporary exercise prescription among cancer survivors has emphasized walking, with lesser emphasis placed on other components of exercise prescription essential for garnering physiologic benefits documented in randomized trials [7, 8], such as the progression of frequency, intensity, and duration of exercise [9–12]. Accordingly, the majority of cancer survivors who are active report engaging in walking [13], which may not be physiologically strenuous enough to constitute moderate- or vigorous-intensity aerobic exercise without progression [14].

Exercise is like medication [15, 16], such that larger doses of exercise (longer duration and/or higher intensity) associate with improved clinical outcomes, relative to smaller doses of exercise [5, 17]. This philosophy is analogous to the example that larger doses of cholesterol lowering statin medications associate with greater reductions in cardiovascular events, relative to smaller doses of statin medications [18, 19]. For example, among prostate cancer survivors, engaging in vigorous-intensity exercise associates with a significant reduction in prostate cancer-specific mortality, whereas engaging in light- or moderate-intensity exercise is not associated with a cancer-specific survival benefit [20]. Among colorectal cancer survivors, a dose-response relationship exists between volume of exercise (minutes-per-week) and reductions in cancer recurrence and colorectal cancer-specific mortality [21–23]. However, and similar to medication, exercise may have a therapeutic window, such that the risks associated with larger and/or more intense doses of exercise may outweigh the possible health benefits [15]. Therefore, it is of clinical interest to determine how to safely increase the dose of exercise beyond that of walking to reap additional health-benefits, and meet the recommended guidelines for exercise and cancer survivorship.

However, cancer survivors are typically older, have multiple comorbid conditions, and frequently report late and long-term toxicities from cancer treatment [24]. Unlike cardiac and orthopedic rehabilitation, oncologists do not have an infrastructure where patients can be referred for supervised and progressive exercise training [25, 26]. The existing infrastructure in oncology (or lack thereof) channels cancer survivors to participate in

exercise with minimal guidance and limited or no supervision [27]. Therefore, physicians may be reluctant to prescribe larger doses of exercise (i.e., longer duration or higher intensity) to patients, or require patients to complete a cardiac stress test or other exercise screening evaluation prior to progressing to larger doses of exercise [28]. Researchers often conduct pre-exercise evaluations to screen cancer survivors prior to enrolling in clinical trials of exercise [29]. Translating findings from clinical trials into clinical practice may be challenging, given the absence of the routine pre-exercise evaluation in clinical practice [30]. Furthermore, there exists substantial variation in the content of the pre-exercise evaluation across clinical trials of exercise, which may further impede the translation of exercise into clinical practice [29].

The aim of this work is to generate movement towards the development of a standardized risk-screening algorithm for cancer survivors prior to engaging in an exercise program for research and clinical practice. This algorithm will identify physically-able cancer survivors who are able to safely progress to doses and modes of exercise beyond that of low-intensity exercise (i.e., walking), which have been documented to have added physiologic benefits [7, 8].

METHODS

We systematically examined peer-reviewed published guidelines for exercise prescription among cancer survivors to identify health-factors that warrant a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. We then surveyed a sample of experts in exercise and cancer survivorship to ask which health-factors in the peer-reviewed guidelines would indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise.

Participants

We invited participants by identifying those who have published exercise interventions in the peer-reviewed literature, or those who currently have exercise intervention grants funded by the National Institutes of Health (NIH), listed on the NIH RePORTER website (<http://projectreporter.nih.gov/reporter.cfm>). The invited study sample included physicians (surgeons, medical oncologists, and physiatrists), researchers (epidemiologists, and exercise physiologists), and other allied healthcare providers (physical and occupational therapists). Identified participants were encouraged to extend invitations to colleagues that were not initially invited and were thought to have expertise in the area of exercise and cancer survivorship, such as those who are members of the oncology sections of the American Physical Therapy Association and American Academy of Physical Medicine and Rehabilitation. We identified and invited 59 experts, and 44 participated in the survey (75% response rate). Six individuals, invited at the discretion of the initially-invited experts, also participated. Fifty experts in total participated in the survey. Among the 50 respondents, 11 had an M.D. (22%), 31 had a Ph.D. (62%), 6 had a P.T. degree (12%), and two did not disclose their name/degree (4%). One participant disclosed their degree, but did not disclose their name (2%). The three participants who did not disclose their name and/or degree were excluded, yielding 47 experts contributing to the analysis described herein.

Survey Development

The content of the survey was developed by synthesizing eight published peer-reviewed guidelines for exercise prescription among cancer survivors [1, 2, 9, 29, 31–34]. These guidelines were reviewed by two of the authors (XXX and XXX), and any health-factors that were listed were included in the survey.

Health-factors were classified into three domains: 1) clinical health-factors; 2) comorbidity and device health-factors; and 3) medications. Clinical health-factors were commonly acute symptoms, and were placed into one of seven sub-domains: 1) hematologic; 2) musculoskeletal; 3) systemic; 4) gastrointestinal; 5) cardiovascular; 6) pulmonary; and 7) neurological. Comorbidity and device health-factors included chronic conditions and devices used to treat the conditions, and were placed into one of four sub-domains: 1) cardiovascular disease history; 2) comorbidity; 3) implanted medical device; and 4) mobility device. Medications were classified into seven classes.

Data Collection

We identified 82 different health-factors that may indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. We placed each of these health-factors into an electronic survey using REDCap (Research Electronic Data Capture) software [35]. For each health-factor we asked the participants to select “yes” or “no” if they thought the presence of each health-factor would indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. For the clinical health-factor domain, we provided an additional option “not sure” given the acute and/or transient nature of many of these symptoms. Participants were allowed to select the “not sure” response if they required more information about the symptom (i.e., how long has it lasted, is it worsening, were other symptoms present, etc.), and were provided space for free-text comments at the end of the survey. The “not sure” option was not provided for the comorbidity, device, and medication health-factor domains because the conditions and medications are thought to be chronic in nature.

Statistical Analysis

Survey responses are summarized with counts and percentages. We were interested in the proportion of survey participants who thought each health-factor would indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. Therefore, we calculated the ratio of “yes” to “no” responses as a measure of strength of agreement. A ratio of one indicates an equivalent percentage of survey respondents selecting “yes” and “no” to indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. A ratio greater than one indicates the need for a pre-exercise evaluation prior to engaging unsupervised in moderate- to vigorous-intensity exercise, and vice versa. We tested the magnitude of the difference between proportions using the binomial exact method. Binomial probability tests were two-sided and $P < .05$ was the threshold for statistical significance. All statistical analyses were conducted using Stata 12.0 (College Station, TX).

RESULTS

Of the 82 health-factors, the mean number recommended was 51 ± 20 , and did not differ by degree ($P=.36$; data not shown). The completion rate of the survey was $99.8 \pm 6.2\%$, and did not differ by professional degree ($P=.81$; data not shown). Among the 47 experts surveyed 13 (28%) were co-authors on one or more of the synthesized peer-reviewed guidelines for exercise prescription among cancer survivors.

Specific Health-Factors

Clinical Factors—We identified 36 clinical health-factors recommended to indicate the need for a pre-exercise evaluation (Table 1). Among the 36 individual health-factors, there was statistically significant agreement for 27 (75%). Among the 27 significant clinical health-factors, all were thought to indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise (i.e., ratios larger than one). The frequency of “not sure” answers ranged from 2% (chest pain at rest) to 31% (ankle edema). Among the 36 health-factors, the mean number of “not sure” answers was 7.0 ± 5.6 , and did not differ by professional degree ($P=.97$; data not shown).

Comorbidities and Devices—We identified 39 comorbidity and device health-factors recommended to indicate the need for a pre-exercise evaluation (Table 2). Among the 39 individual health-factors, there was statistically significant agreement for 19 (49%). Among the 19 significant comorbidity and device health-factors, 14 (74%) were thought to indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise (i.e., ratios larger than one). The remaining five (26%) comorbidity and device health-factors were agreed to not indicate the need for a pre-exercise evaluation before engaging in unsupervised moderate- to vigorous-intensity exercise (i.e., ratios smaller than one).

Medications—We identified seven classes of medications recommended to indicate the need for a pre-exercise evaluation (Table 3). Among the seven classes of medications, there was statistically significant agreement for four (63%). Among the four significant medication classes, only the use of cardiac agents were thought to indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise (i.e., a ratio of 2.6). The remaining medication classes, high-dose steroids, immunosuppressive therapy, and pulmonary agents, were agreed to not indicate the need for a pre-exercise evaluation before engaging in unsupervised moderate- to vigorous-intensity exercise.

Health-Factor Recommendations & Nature of Free-Text Comments by the Experts

At the end of our survey, we asked experts to list additional health-factors that should be considered in the decision to indicate a pre-exercise evaluation that were not included in our list. Twenty-one factors were recommended (Table 4). The most frequently cited health-factor not listed in our survey was thromboembolism. In the free-text comments section, 18 experts (38%) said it was difficult to provide absolute answers because no two patients are similar, and their decisions are made on a case-by-case basis. Ten experts (21%) thought

some degree of screening was necessary for all cancer survivors, but were uncertain if all survivors could be thoroughly screened, given the lack of staff and resources in many cancer centers. There was diversity in comments on the need for risk-screening; three experts (6%) thought standardized risk-screening would help to harmonize medical clearance procedures across clinical trials of exercise (particularly multi-institution trials), whereas 7 others (15%) thought the current guidelines [1, 9], were sufficient to evaluate cancer survivors prior to engaging in unsupervised moderate- to vigorous-intensity exercise.

DISCUSSION

This study obtained expert opinion to identify health-factors described in the peer-reviewed guidelines for exercise prescription among cancer survivors thought to indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. Among our sample of experts, there was statistically significant agreement for 50 of the 82 health-factors identified (61%). Among the 50 health-factors, 41 (82%) were agreed to indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. The remaining 9 (18%) were agreed to not indicate the need for a pre-exercise evaluation. To promote the use of risk-screening in clinical and research practice we synthesized the health-factors into a printable checklist (Figure 1). It is noteworthy that a variety of clinical factors elicited answers of “not sure”, suggesting these symptoms may be relative indications, rather than absolute indications to a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. Collectively, these findings will help to inform the development of a standardized risk-screening algorithm for research and clinical practice. These findings underscore the need for ongoing surveillance to detect and treat physical and psychosocial impairments along the continuum of cancer survivorship [26, 36].

One caveat to our analysis is that there may have been health-factors that did not reach statistical significance, but may be of clinical importance. For example, clinical health-factors such as low white blood cell count ($P=.078$), and irregular pulse ($P=.055$) did not reach the threshold for statistical significance, but may be clinically important to screen. The need for screening these clinical health-factors should be considered by physicians and researchers. In addition, it is important to note that a variety of the clinical health-factors elicited answers of “not sure”. This pattern supports the qualitative responses by the experts that many symptoms are difficult to make absolute decisions, and are made on a case-by-case basis. However, several health-factors that are contraindications to exercise, such as chest pain at rest or with exertion, elicited 1–2 “not sure” responses, which were qualified in free-text as requiring information about the frequency, history, and etiology of the health-factor prior to requiring pre-exercise evaluation. A similar caveat exists for comorbidity and health device health-factors. For example, cardiac comorbidities such as hypertension, or metabolic comorbidities such as diabetes may warrant consideration if newly diagnosed or poorly controlled. Health-devices such as a pacemaker may not contraindicate participation in exercise, but may warrant discussion with a physician regarding precautions related to these devices and the specific exercise prescription planned. We asked experts to list any other health-factors that were not described in the peer-reviewed guidelines for exercise prescription among cancer survivors and received a variety of responses. The most

frequently cited health-factor not listed in our survey was thromboembolism. Thrombotic complication is common in cancer survivors [37], particularly in the first few months after diagnosis, and in the presence of metastatic disease [38]. Therefore, physicians and researchers may consider screening for thrombotic complication [39].

The role of exercise in oncology has evolved over the past two decades [40]. Previously, oncologists advised patients to conserve energy by avoiding overexertion. There now exists a growing body of evidence that moderate- to vigorous-intensity exercise, during and after curative treatment, helps to improve a variety of patient-reported outcomes, and clinical outcomes, such as chemotherapy completion rates, recurrence, and survival [1, 2]. However, as previously noted, exercise prescription among cancer survivors has emphasized walking for exercise [1–3], with less emphasis placed on advising patients that exercise should be progressive, such that as fitness improves, the frequency, duration, and intensity of exercise should increase [9]. Focusing on the progressive components of exercise are important given the documented relationships between exercise dose and risk-reduction of coronary heart disease, stroke, type 2 diabetes, cancer-specific mortality of the breast, colon, and prostate, and all-cause mortality [4, 20, 21, 41–43]. The walking-focused method of exercise prescription may be the result of the lack of infrastructure to guide cancer survivors in dynamic or progressive aspects of exercise prescription [25, 27]. This approach to exercise prescription may help to explain why 74% of breast cancer survivors report regular walking [44], yet using objective measures of activity only engage in 8.2 min·d⁻¹ of moderate-intensity and 0.3 min·d⁻¹ of vigorous-intensity exercise [45].

Given the known dose-response benefits of exercise on health among cancer survivors, it is of interest to increase the prescribed dose of exercise beyond that of walking. Clinicians are reminded that regular walking is an efficacious modality to improve quality of life [46], depressive symptoms [47], and cancer-related fatigue [48], but is likely insufficient to improve cancer-specific mortality, unless prescribed in doses (i.e., minutes or hours per week) that are 2 to 3-fold larger than recommended guidelines [20, 21]. For example, among non-metastatic prostate cancer survivors, 10 h·wk⁻¹ of light- to moderate-intensity exercise was associated with a non-significant 21% reduction in prostate cancer-specific mortality, whereas 3 h·wk⁻¹ of vigorous-intensity exercise was associated with a significant 61% reduction in prostate cancer-specific mortality [20]. Similarly, colon cancer survivors would need to participate in 6–9 h·wk⁻¹ of walking to reduce colon cancer-specific mortality [21].

The ACSM guidelines note a balance between reducing barriers to participation in exercise and ensuring those who participate in exercise are safe [1]. It is known that cancer survivors have more comorbid conditions than age-matched persons without cancer [49]; 90% of cancer survivors have at least one comorbid condition, and 39% have cardiac-specific comorbid conditions [50]. Approximately 53% of cancer survivors have functional limitations as a result of comorbid conditions [51], and 63% of cancer survivors report a need for rehabilitation [52]. The ACSM guidelines note that cancer survivors with peripheral neuropathy, musculoskeletal morbidity, bone metastases, and known cardiac conditions, undergo a medical evaluation prior to participating in progressive exercise [1]. Our data support these recommendations (all $P < .05$), with exception of requiring patients with peripheral neuropathy to undergo a pre-exercise evaluation prior to engaging in

unsupervised moderate- to vigorous-intensity exercise ($P=.687$). The NCCN provides additional recommendations as to who should undergo a medical evaluation prior to engaging in exercise [3]. The NCCN recognizes patients as high-, moderate-, or low-risk of having an exercise-induced adverse event. Patients classified as high-risk require a physician evaluation, patients classified as moderate-risk encourage a physician evaluation, and patients classified as low-risk require no medical evaluation prior to participating in progressive exercise. High-risk encompasses any cancer survivor with an ostomy, chronic obstructive pulmonary disease, congestive heart failure, coronary artery disease, cardiomyopathy, breast cancer survivors with lymphedema, and those with extreme fatigue. Experts who responded to our survey suggest the presence of an ostomy does not indicate the need for a pre-exercise evaluation prior to engaging in moderate- to vigorous-intensity exercise ($P=.884$), nor do breast cancer survivors with lymphedema ($P=.663$), patients with fatigue ($P=.182$), and those with chronic obstructive pulmonary disease ($P=.068$). Comorbidities including congestive heart failure ($P<.001$), coronary artery disease ($P<.001$), and cardiomyopathy ($P<.001$), warrant a pre-exercise evaluation prior to engaging in moderate- to vigorous-intensity exercise. As we move forward with the development of a standardized risk-screening algorithm, combining clinical expertise with health-factors empirically associated with exercise-induced adverse events will be a priority to reduce barriers and promote the safety of progressive exercise among cancer survivors. To accomplish this goal, clinical trials of exercise should collect and publish systematic safety data from all study participants, and not rely on participant self-report [29, 30].

Several randomized controlled clinical trials have examined moderate- or vigorous-intensity aerobic and muscle strengthening exercise among cancer survivors [53–56]. A review of the inclusion and exclusion criteria of these studies demonstrate a spectrum of how investigators screen clinical trial participants, listing specific exclusions such as Adamsen *et al.* [53], to more general exclusions such as Schmitz *et al.* [55, 56]. The safe translation of any of these above-described interventions into the standard of clinical care would require a sustainable method of screening patients [57], to optimize the allocation of behaviorally-intensive resources, such as staff time.

Planning the derivation of a risk-screening algorithm to identify cancer survivors who require a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise requires consideration of who will conduct the screening, interpret the results, provide recommendations, and/or refer to allied healthcare providers such as physical therapists or clinical exercise physiologists. A goal of the pre-exercise evaluation is for a clinical expert to evaluate the potential benefits garnered from progressing to larger doses of exercise (i.e., higher intensity or longer volume), versus the potential risks or adverse events that may be experienced with larger doses of exercise [3]. Approximately 1 in 3 office visits by cancer survivors are provided by primary care physicians [58]. Primary care physicians have expressed willingness to assume responsibility for cancer survivorship care [59], and are more comfortable than oncologists in providing general preventive care [60], such as prescribing exercise [61]. If primary care physicians are the best equipped healthcare providers to prescribe exercise, embedding this risk-screening algorithm into survivorship care plans [62], may be one means to reduce burden among primary care

physicians, allowing providers to focus on risk-specific exercise counseling, and the provision of care for other health conditions. Primary care physicians have expressed desire to obtain cancer survivorship care plans to enable the delivery of subsequent follow-up care for cancer-related health issues [59].

There are limitations to our study that should be acknowledged. It is possible that experts replying to our survey answered our questions adhering to the guidelines for exercise testing for cancer survivors, rather than providing their own expert opinion. If this were the case, our survey may have acted as a test of knowledge of the current guidelines for exercise and cancer survivorship. However, given the diversity of answers, this scenario is unlikely. Furthermore, these findings are not meant to provide a definitive list of what conditions would indicate the need for a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise. For example, there may be other medications that indicate the need for a pre-exercise evaluation.

Conclusion

It is widely acknowledged and agreed that all cancer survivors should avoid inactivity and engage in regular walking [1–3]. When in doubt, clinicians should prescribe walking to nearly all of their patients [3]. But there is evidence that levels of exercise beyond that of walking are required to improve clinical outcomes, particularly among survivors of breast, prostate, and colon cancer [20, 21, 41, 63]. In addition, it is known that participation in progressive exercise reduces the risk of cardiovascular disease and all-cause mortality [5, 64]. Currently, it is unclear how to best identify the subset of cancer survivors who should undergo a pre-exercise evaluation prior to having a physician increase their exercise dose to that of a moderate- or vigorous-intensity. These findings will inform the empirical development of psychometrically valid standardized risk-screening tools to better assist clinicians in identifying individuals that warrant further evaluation prior to engaging in progressive exercise that includes moderate- or vigorous-intensity activities, and ultimately will be part of the process for ensuring that cancer survivors are able to safely progress in their exercise program.

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Subject ID/Patient MRN: _____

Screening Cancer Survivors for Unsupervised Moderate- to Vigorous-Intensity Exercise

YES		NO				YES		NO			
Hematological Labs						Cardiovascular Disease History					
☐	☐	1.	Platelets <50,000	☐	☐	28.	Ventricular Ectopy				
☐	☐	2.	Hemoglobin <10g/dl	☐	☐	29.	Myopericarditis				
Musculoskeletal				☐	☐	30.	Significant ECG arrhythmias				
☐	☐	3.	Bone, Back, or Neck Pain	☐	☐	31.	Cardiomyopathy				
☐	☐	4.	Metastatic Bone Disease	☐	☐	32.	Congestive Heart Failure				
☐	☐	5.	Unusual Muscular Weakness	☐	☐	33.	Aortic Stenosis				
☐	☐	6.	Cachexia	☐	☐	34.	Myocardial Infarction				
☐	☐	7.	Karnofsky ≤60% or ECOG ≤2	☐	☐	35.	Coronary Angioplasty				
Systemic				☐	☐	36.	Valvular Disease				
☐	☐	8.	Acute Infection	☐	☐	37.	Heart Transplant				
☐	☐	9.	Fever >100F	☐	☐	38.	Congenital Heart Disease				
Gastrointestinal				☐	☐	Comorbidities					
☐	☐	10.	Severe Nausea	☐	☐	39.	Cardiac Disease (other)				
☐	☐	11.	Vomiting/Diarrhea	☐	☐	40.	Peripheral Vascular Disease				
☐	☐	12.	Dehydration								
☐	☐	13.	Inadequate Food/Fluid Intake								
Cardiovascular Symptoms				Implanted Medical Device							
☐	☐	14.	Chest Pain at Rest	☐	☐	41.	Pacemaker				
☐	☐	15.	Chest Pain with Exertion	Medication							
☐	☐	16.	SPB>145 or DBP>95	☐	☐	42.	Cardiac Agent				
☐	☐	17.	Systolic Blood Pressure <85	☐	☐	43.	_____ (other)				
☐	☐	18.	Irregular Pulse	☐	☐	44.	_____ (other)				
Pulmonary Symptoms											
☐	☐	19.	Severe Dyspnea								
☐	☐	20.	Chest Pain with Deep Breath								
☐	☐	21.	Exercise-Induced Bronchospasm								
Neurologic Symptoms											
☐	☐	22.	Dizziness/Lightheaded								
☐	☐	23.	Disorientation								
☐	☐	24.	Blurred Vision								
☐	☐	25.	Ataxia								
☐	☐	26.	Orthostatic Hypotension								
☐	☐	27.	Recent Concussion								

☐ If you answered **YES** to one or more of the above-listed questions it is recommended that you undergo a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise.

☐ If you answered **NO** to all of the above-listed questions it is not required that you undergo a pre-exercise evaluation prior to engaging in unsupervised moderate- to vigorous-intensity exercise, but may elect to do so on the basis of the recommendation of a healthcare professional or if you have concerns about the safety of moderate- or vigorous-intensity exercise.

Figure 1.
Risk-screening printable checklist

Table 1

Clinical factors that may indicate the need for a pre-exercise evaluation before engaging in unsupervised moderate- or vigorous-intensity exercise

	Yes	No	Not Sure	Ratio (yes/no) ^a	<i>p</i> ^b
Hematological Labs					
Platelets <50,000	27 (61%)	7 (16%)	10 (23%)	3.8	.032
White Blood Cells <3,000	25 (57%)	11 (25%)	8 (18%)	2.3	.078
Hemoglobin <10g/dl	25 (58%)	7 (16%)	11 (26%)	3.6	.050
Musculoskeletal					
Bone, Back, or Neck Pain	36 (80%)	2 (4%)	7 (16%)	18.0	.015
Metastatic Bone Disease	40 (87%)	2 (4%)	4 (9%)	20.0	.002
Unusual Muscular Weakness	33 (72%)	8 (17%)	5 (11%)	4.1	.005
Cachexia	31 (67%)	8 (17%)	7 (15%)	3.9	.011
Fatigue	15 (33%)	25 (54%)	6 (13%)	0.6	.182
Karnofsky=60%, ECOG PS=2	27 (63%)	9 (21%)	7 (16%)	3.0	.029
Systemic					
Acute Infection	39 (85%)	3 (7%)	4 (8%)	13.0	.001
Fever > 100F	39 (85%)	3 (7%)	4 (8%)	13.0	.001
Malaise	14 (30%)	19 (42%)	13 (28%)	0.7	.522
Gastrointestinal					
Severe Nausea	33 (72%)	7 (15%)	6 (13%)	4.7	.005
Vomiting/Diarrhea	31 (69%)	6 (13%)	8 (18%)	5.2	.011
Dehydration	36 (78%)	5 (11%)	5 (11%)	7.2	.002
Inadequate Food/Fluid Intake	32 (70%)	7 (15%)	7 (15%)	4.6	.008
Cardiovascular Symptoms					
Chest Pain at Rest	44 (96%)	1 (2%)	1 (2%)	44.0	<.001
Chest Pain with Exertion ^c	45 (96%)	0 (0%)	2 (4%)	45.0	<.001
Pulse >100 or <50 beats/minute	26 (56%)	9 (20%)	11 (24%)	2.9	.055
Systolic Blood Pressure > 145 or Diastolic Blood Pressure >95	31 (70%)	7 (16%)	6 (14%)	4.4	.008
Systolic Blood Pressure <85	33 (72%)	7 (15%)	6 (13%)	4.7	.005
Irregular Pulse	30 (65%)	6 (13%)	10 (22%)	5.0	.018
Ankle Edema	20 (43%)	12 (26%)	14 (31%)	1.7	.324

	Yes	No	Not Sure	Ratio (yes/no) ^a	<i>p</i> ^b
Pulmonary					
Severe Dyspnea	40 (87%)	2 (4%)	4 (9%)	20.0	.002
Cough, Wheezing	16 (35%)	11 (24%)	19 (41%)	1.5	.546
Chest Pain with Deep Breath	36 (78%)	2 (4%)	8 (17%)	18.0	.012
Asthma	12 (26%)	20 (43%)	14 (31%)	0.6	.324
Exercise-Induced Bronchospasm	28 (61%)	5 (11%)	13 (28%)	5.6	.039
Neurological					
Decline in Cognitive Status	23 (50%)	14 (30%)	9 (20%)	1.6	.243
Dizziness/Lightheaded	28 (61%)	6 (13%)	12 (26%)	4.7	.033
Disorientation	36 (80%)	5 (11%)	4 (9%)	7.2	.001
Blurred Vision	32 (69%)	5 (11%)	9 (20%)	6.4	.012
Ataxia	36 (78%)	5 (11%)	5 (11%)	7.2	.002
Neuropathies in Hands/Feet	20 (43%)	17 (37%)	9 (20%)	1.2	.687
Orthostatic Hypotension	29 (64%)	7 (16%)	9 (20%)	4.1	.021
Recent Concussion	36 (80%)	4 (9%)	5 (11%)	9.0	.002

^a Ratios of 1, <1, and >1 indicate equivalence, majority exclusion, and majority inclusion of a characteristic as part of a pre-exercise screening, respectively.

^b Binomial *P*-value comparing the proportion who answered yes to the proportion who answered no.

^c Assumed 1 person said "no" to calculate binomial *P*-value.

Table 2

Comorbidities and devices that may indicate the need for a pre-exercise evaluation before engaging in unsupervised moderate- or vigorous-intensity exercise

	Yes	No	Ratio (yes/no) ^a	<i>P</i> ^b
Cardiovascular Disease History				
Ventricular Ectopy	35 (74%)	12 (26%)	2.9	.003
Myopericarditis	38 (81%)	9 (19%)	4.2	<.001
Significant ECG Arrhythmias	45 (96%)	2 (4%)	22.5	<.001
Cardiomyopathy	43 (91%)	4 (9%)	10.8	<.001
Congestive Heart Failure	41 (87%)	6 (13%)	6.8	<.001
Aortic Stenosis	37 (79%)	10 (21%)	3.7	<.001
Myocardial Infarction	41 (87%)	6 (13%)	6.8	<.001
Cardiac Catheterization	29 (62%)	18 (38%)	1.6	.118
Coronary Angioplasty	34 (72%)	13 (28%)	2.6	.005
Valvular Disease	33 (70%)	14 (30%)	2.4	.010
Heart Transplant	40 (85%)	7 (15%)	5.7	<.001
Congenital Heart Disease	36 (77%)	11 (23%)	3.3	.001
Comorbidities				
Hypertension	22 (46%)	25 (54%)	0.9	.663
Heart Murmur	24 (49%)	23 (51%)	1.0	.885
Other Cardiac Disease	39 (83%)	8 (17%)	4.9	<.001
Diabetes	16 (34%)	31 (66%)	0.5	.037
Arthritis	10 (21%)	37 (79%)	0.3	<.001
Osteoporosis	19 (40%)	28 (60%)	0.7	.197
Chronic Obstructive Pulmonary Disease	30 (64%)	17 (36%)	1.8	.068
Depression	7 (15%)	40 (85%)	0.2	<.001
Lymphedema/Shoulder Morbidity	25 (53%)	22 (47%)	1.1	.663
Prior Bone Marrow Transplant	20 (43%)	27 (57%)	0.7	.312
Morbid Obesity	24 (49%)	23 (51%)	1.0	.884
Hernia	18 (38%)	29 (62%)	0.6	.118
Peripheral Vascular Disease	33 (70%)	14 (30%)	2.4	.010
Hyperlipidemia	8 (17%)	39 (83%)	0.2	<.001
Thyroid Disorder	12 (25%)	35 (75%)	0.3	.003
Renal Disease	20 (43%)	27 (57%)	0.7	.312
Hepatic Disease	19 (40%)	28 (60%)	0.7	.197
Autoimmune Disease/HIV-AIDS	19 (40%)	28 (60%)	0.7	.197
Implanted Medical Device				
Pacemaker	31 (66%)	16 (34%)	1.9	.037
Central Venous Catheter	28 (60%)	19 (40%)	1.5	.197
Drain Tubes	30 (64%)	17 (36%)	1.8	.068
Feeding Tubes	29 (62%)	18 (38%)	1.6	.118
Stoma	23 (49%)	24 (51%)	1.0	.884

	Yes	No	Ratio (yes/no) ^a	<i>P</i> ^b
Cardiac Shunt	29 (62%)	18 (38%)	1.6	.118
Mobility Device				
Walker	24 (51%)	23 (49%)	1.0	.884
Cane	21 (45%)	26 (55%)	0.8	.468
Wheelchair	27 (57%)	20 (43%)	1.4	.312

^aRatios of 1, <1, and >1 indicate equivalence, majority exclusion, and majority inclusion of a characteristic as part of a pre-exercise screening, respectively.

^bBinomial *P*-value comparing the proportion who answered yes to the proportion who answered no.

Table 3

Medications that may indicate the need for a pre-exercise evaluation before engaging in unsupervised moderate- or vigorous-intensity exercise

Medications	Yes	No	Ratio (yes/no) ^a	<i>P</i> ^b
High-Dose Steroids	26 (55%)	21 (45%)	1.2	.468
Immunosuppressive Therapy	17 (36%)	30 (64%)	0.6	.068
Aromatase Inhibitor	10 (22%)	37 (78%)	0.3	<.001
Cardiac Agent	34 (72%)	13 (28%)	2.6	.005
Pulmonary Agents	20 (43%)	27 (57%)	0.7	.312
Anti-diabetic Agents	13 (28%)	34 (72%)	0.4	.005
Appetite Suppressant	10 (21%)	37 (79%)	0.3	<.001

^a Ratios of 1, <1, and >1 indicate equivalence, majority exclusion, and majority inclusion of a characteristic as part of a pre-exercise screening, respectively.

^b Binomial *P*-value comparing the proportion who answered yes to the proportion who answered no.

Table 4

Other clinical parameters not listed above that you would require a cancer survivor to obtain a pre-exercise evaluation before engaging in unsupervised moderate- or vigorous-intensity exercise

1	Recent thromboembolism
2	Baroreceptor failure
3	Family history of cardiac disease
4	Creatinine
5	Joint replacement, orthopedic limitations, osteoarthritis
6	Sarcopenia
7	Surgery with a muscle flap procedure
8	Recent musculoskeletal injury or history or self-report of focal musculoskeletal issues
9	Brain metastases
10	Recent traumas
11	Amputation
12	Glucose levels
13	Insulin levels
14	Red blood cells
15	History of excessive bleeding, bleeding disorders
16	Cluster migraines
17	Bladder/Bowel disease
18	Bells Palsy, Autism, Parkinson's
19	Sleep apnea
20	Use of prosthetics
21	Orthopnea/paroxysmal nocturnal dyspnea