January 2013

Exercise Barriers in Cancer Survivors: A Multi-Dimensional Approach

Morgan Lee
University of South Florida, mrl1@mail.usf.edu

Exercise Barriers in Cancer Survivors: A Multi-Dimensional Approach

by

Morgan Lee

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
Department of Psychology
College of Arts and Sciences
University of South Florida

Major Professor: Paul B. Jacobsen, Ph.D.
Committee Members:
Thomas H. Brandon, Ph.D.
Jamie L. Goldenberg, Ph.D.
Vani N. Simmons, Ph.D.

Date of Approval:
June 24, 2013

Keywords: Health Behavior, Physical Activity, Intention

Table of Contents

List of Tables

Abstract

The population of cancer survivors is rapidly expanding, and promotion of health and quality of life for these individuals is a priority. Exercise confers numerous general and cancer-specific benefits, yet many cancer survivors are insufficiently active. Research on perceived exercise barriers in cancer survivors has been limited by methodological and conceptual problems. Recent research suggests barriers may be multi-dimensional, and different types of barriers may be salient depending on whether or not a person intends to engage in a given behavior. Global (i.e., abstract) barriers may be negatively associated with intention, while practical (i.e., concrete) barriers may be positively associated with intention. The present study aimed to examine the utility of a multi-dimensional conceptualization of exercise barriers in cancer survivors and to develop an exercise barriers scale for this population. Participants were 170 breast, prostate, and colorectal cancer survivors (mean age = 60 years, 67% female) who had completed treatment 6-36 months before the study. The study was conducted online in a survey that included measures assessing current exercise behavior, perceived exercise benefits, exercise intention, and exercise barriers. Factor analysis of the exercise barriers measure revealed five factors, which were further condensed into global, practical, and health factors. Total barriers and global barriers negatively predicted exercise intention ($ps < 0.001$); practical and health barriers did not predict intention ($ps > 0.05$). Accounting for relevant demographic variables and current exercise behavior, total barriers and global barriers contributed significant amounts of unique variance in exercise

intention (4% and 7% respectively); however, when perceived benefits were included, only global barriers remained significant. These findings suggest that multi-dimensional conceptualizations of health behavior barriers are worthy of further study and that global barriers may be an important target for interventions designed to increase intention.

Introduction

Exercise has the potential to provide a range of benefits to cancer survivors, and research has begun to reveal the extent of these benefits. Evidence is accumulating to suggest that cancer survivors may experience not only the broadly applicable health benefits of exercise but also special benefits including reduced risk of recurrence and greater likelihood of surviving cancer. However, a plethora of barriers may influence cancer survivors' intention to exercise. While barriers have traditionally been conceived as solely negative in their relationship with intentions to engage in health-related behaviors, a new line of research suggests that different types of barriers may be differentially related to these intentions. The present study seeks to extend this line of research to exercise intention in cancer survivors.

In the past, a cancer diagnosis was essentially a death sentence. However, advances in prevention, detection, and treatment have led to better outcomes. With an aging population contributing to a high incidence of cancer and medical advances improving survival rates, the population of cancer survivors (a term used to describe any living person who has ever received a cancer diagnosis, regardless of his or her current disease status (National Cancer Institute, 2012)), is quickly expanding. Recent estimates suggest there are currently almost 12 million cancer survivors living in the United States (Howlader et al., 2011).

For the growing number of individuals for whom cancer is more akin to a chronic disease than a cause of mortality, promotion of health and quality of life is a priority. One

of the essential components of a healthy lifestyle is exercise. Engaging in regular exercise is associated with a number of benefits in cancer survivors including improved cardiovascular and muscular fitness, better physical functioning, higher quality of life, reduced fatigue, improved mood, and healthier body weight and composition (Schmitz et al., 2010). Evidence for exercise's impact on treatment side effects (e.g., pain), immune function (Schmitz et al., 2010), and bone health (Winters-Stone, Schwartz, & Nail, 2010) is mixed; further studies are needed before definitive conclusions can be drawn. Cancer survivors may also receive another significant benefit from regular exercise: reduced risk of cancer recurrence and greater likelihood of survival (e.g., Holick et al., 2008; Holmes, Chen, Feshanich, Kroenke, & Colditz, 2005; Meyerhardt, Giovannucci, et al. 2006; Meyerhardt, Heseltine, et al., 2006).

Despite the well-documented benefits of physical activity, most cancer survivors do not regularly participate in exercise. The American College of Sports Medicine (ACSM) advises adults to exercise for 30 minutes on 5 or more days per week or at least a total of 150 minutes per week (Garber et al., 2011), a recommendation that also applies to cancer survivors (Schmitz et al., 2010). Studies suggest that only 30-47% of cancer survivors meet the ACSM's exercise recommendation (Bellizzi, Rowland, Jeffery, & McNee, 2005; Blanchard, Courneya, & Stein, 2008). Furthermore, research has found that, while other health behaviors such as diet and smoking behavior tend to improve after a cancer diagnosis, exercise behavior typically declines (Blanchard et al., 2003) and does not tend to rebound back to pre-diagnosis levels after treatment ends (e.g., Courneya & Friedenreich, 1997b).

Exercise Intention

Intention is a heavily studied construct in the prediction of exercise behavior, due in part to its position as the most proximal determinant of behavior in the theory of planned behavior (TPB; Ajzen, 1991). Specifically, the TPB proposes that attitudes, subjective norms, and perceived behavioral control predict intention, which in turn predicts actual behavior. Intention represents motivation to complete a behavior or how much effort an individual plans to devote to taking action and is therefore expected to be positively associated with engaging in the behavior. Across health behaviors, intentions have been found to explain approximately 30% of the variance in behavior (Armitage & Conner, 2001; Godin & Kok, 1996; Sheeran, 2002). Studies examining the relationship between intention and exercise behavior in cancer survivors have produced results suggesting that intention explains anywhere from 10% to 26% of the variance in exercise behavior (Courneya & Friedenreich, 1997a; Courneya & Friedenreich, 1999; Courneya, Friedenreich, Arthur, & Bobick, 1999).

Perceived Exercise Barriers

Though the concept of perceived barriers has been defined in numerous ways, Glasgow (2008) offers a particularly insightful summary: "[A perceived barrier is] a person's estimation of the level of challenge of social, personal, environmental, and economic obstacles to a specified behavior or their desired goal status on that behavior." This definition recognizes the range of potential barriers and emphasizes the subjective nature of perceived barriers (i.e., the actual presence of the barrier is of lesser concern). Perceived barriers have often been used as a predictor of intention and are commonly thought to be negatively associated with intention, an assumption which has been

supported in several studies (e.g., Armitage & Conner, 2001; Godin & Kok, 1996; Godin, Valois, Jobin, & Ross, 1991; Sheeran, 2002). Perceived barriers have also been studied in relation to actual exercise behavior, and the results have consistently indicated a negative relationship (for a review, see Bauman, Sallis, Dzewaltowski, & Owen, 2002).

An extensive array of barriers has been reported in studies of exercise barriers. Some of the most commonly cited issues include lack of motivation or self-discipline, not being interested in or enjoying exercise, too little time, and fatigue (e.g., Lox, Martin, & Petruzzello, 2003, p. 11; Sallis et al., 1989). While cancer survivors report experiencing the barriers commonly endorsed by members of the general population, they also face unique barriers. Cancer survivors are similar to people without cancer in that lack of interest is their most frequently cited reason for refusing to participate in an exercise intervention (Maddocks, Mockett, & Wilcock, 2009). Cancer survivors in exercise interventions have noted common barriers to exercise adherence such as work responsibilities and travel but also cancer-specific hindrances such as hospitalizations and treatment side effects including but not limited to pain and nausea (Courneya et al., 2005; Courneya et al., 2008).

Unsurprisingly, health-related barriers are especially prevalent in the general cancer population (i.e., those not enrolled in exercise interventions). For example, in a recent study using a mixed cancers sample, the top four barriers were illness/other health problems, joint stiffness, fatigue, and pain (Blaney, Lowe-Strong, Rankin-Watt, Campbell, & Gracey, 2011). In a similar vein, Lynch, Owen, Hawkes, and Aitken (2010) assessed exercise barriers in colorectal cancer survivors at five and twelve months post-diagnosis and found that disease-specific barriers (e.g., difficulties with diarrhea or

incontinence) were the biggest hindrance, followed by personal attributes (e.g., fear of injury) at the five month measurement. Contrary to the authors' hypothesis that barriers reported by people without cancer would become most salient over time, disease-specific barriers remained dominant at the twelve month measurement, indicating that disease and treatment-related side effects persist well after active treatment has ended. Paradoxically, disease-specific barriers were positively associated with meeting exercise recommendations at the twelve month measurement. This finding suggests that the relationship between barriers and behavior might be more complex than is typically assumed, though a number of studies have shown the expected negative impact of barriers on exercise behavior in cancer survivors (see the review by Brawley, Culos-Reed, Angove, & Hoffman-Goetz, 2002).

Additional concerns have been revealed through qualitative studies of barriers to exercise in cancer survivors. In a recent study using a mixed cancers sample (Blaney et al., 2010), participants described struggles with physical deconditioning that made exercise more taxing, decreased their confidence in their ability to exercise independently, and made them fearful of falling or otherwise injuring themselves. These participants also revealed social (e.g., embarrassment) and physical (e.g., exercise mode limitations) barriers that stemmed from surgical cancer treatments. This speaks to an important point that has received little attention in past studies: Not only do cancer survivors face unique barriers in comparison to members of the general population, they may also experience a unique constellation of barriers depending upon their cancer type.

Issues in Barriers Assessment

A wide variety of strategies have been used to measure perceived barriers, and debates about which approach is most effective are ongoing. In research on health behaviors, the most common approaches have been to average across barriers (e.g., Courneya, Friedenreich, Arthur, & Bobick, 1999), sum the total number of barriers (e.g., Leddy, 1997), or simply report the percentage of participants who endorse each individual barrier (e.g., Rogers, Courneya, Shah, Dunnington, & Hopkins-Price, 2007). Some researchers argue that both intensity and frequency of a barrier should be assessed, but studies using such measures have not produced improvements in prediction of behavior compared to studies that simply assess frequency (Glasgow, Gillette, & Toobert, 2001). Given the wide variety of barriers that have been identified, scale development has proven challenging. Many researchers avoid the issue by using open-ended response options with later categorization of reported barriers or by adapting existing barriers measures that were not developed for their population of interest. A thorough search of the literature revealed no validated scales of exercise barriers designed specifically for cancer survivors, and some have argued that the methodologies used in studies of exercise barriers in cancer survivors have been particularly weak (Brawley et al., 2002).

Conceptualization of Barriers

A number of conceptual issues contribute to the challenges associated with research on perceived barriers. The question of whether a given item (e.g., "too little time" or "no one to teach me") is a barrier, an attribution, or an excuse and the significance of the difference between these constructs has been discussed repeatedly, with no consensus or solution (Brawley et al., 2002; Brawley, Martin, & Gyurcsik, 1998).

Additionally, researchers have grouped barriers in various ways. For example, Whitehead and Lavelle (2009) studied older breast cancer survivors and conceptualized barriers as practical, health-related, or psychological. In contrast, Baert et al. (2011) used the Social Ecological Model and regarded barriers as intrapersonal, interpersonal, or community-related. Numerous other examples could be cited, but the point is that researchers have grouped perceived barriers in a variety of ways, often without taking steps to determine whether these groupings are statistically sound. However, exceptions can be found. Some researchers (e.g., Courneya et al., 2008; Korkiakangas, Alahuhta, & Latinen, 2009) have gone a step beyond by performing content analysis to determine barriers categories, and others (e.g., Glasgow, Whitlock, Valanis, & Vogt, 2000) have advanced even further by using factor analysis to group barriers based on their shared variance. At the same time, some researchers (e.g., Rogers et al., 2007) prefer to assess each barrier individually and make no apparent effort to categorize barriers, regardless of how closely related those barriers may be.

Despite the frequent use of perceived barriers in a wide variety of health behavior studies and the debate over a number of methodological and conceptual issues, the question of whether perceived barriers should be considered one-dimensional or multi-dimensional has received little attention. Perceived barriers are often thought of in multi-dimensional terms in that individual barriers can be independent, increasing or decreasing without influencing other barriers and having greater or lesser effects on attitudes and behaviors. However, few researchers have considered whether different barriers could actually have opposing relationships with attitudes and behaviors.

A recent study by Gerend, Shepherd, and Shepherd (2012) addressed the possible multi-dimensional nature of barriers in a novel fashion. The authors theorized that a multi-dimensional view of perceived barriers would be superior to a one-dimensional perspective in explaining intention to engage in a health behavior and that different types of barriers would be salient to people who intend to engage in a health behavior compared to those who have no such intention. Based on research showing that mothers who intended to get their daughters vaccinated for human papillomavirus (HPV) endorsed more practical barriers than mothers who did not express this intention (McCree, Brewer, Reiter, Gottlieb, & Smith, 2010), Gerend et al. (2012) hypothesized that practical barriers would be positively related to intention while global barriers would be negatively related to intention. Consistent with what Gerend et al. (2012) have stated, practical barriers are concrete barriers for which an action plan can be designed to mitigate the barrier. Conversely, global barriers are abstract barriers with no obvious method for elimination. This postulation of differential salience of distinct types of barriers depending upon level of intention agrees with construal level theory (Trope & Liberman, 2003), which indicates that when events are psychologically distant, these events will be represented in abstract terms, but when events are psychologically close, they will be represented in concrete, specific terms.

In the Gerend et al. (2012) study, these ideas were tested in the context of HPV vaccination intention. The study included 703 young adult women (mean age = 21) who had not received any doses of HPV vaccine. Participants completed a baseline session and responded to a follow-up survey two months later. At baseline, participants watched an educational video about HPV vaccination and completed measures of intention (using

a multi-item scale) and perceived barriers to HPV vaccination (using both a 19-item scale created for the study and an open-ended query). At follow-up, participants reported whether they had received any doses of HPV vaccine. To determine the factor structure of the perceived barriers reported in the study, the sample was first split in half. Next, exploratory factor analysis of perceived barriers was performed on one half of the data. Finally, confirmatory factor analysis using the structure identified in the exploratory factor analysis was performed on the other half of the data. Five factors falling into practical (e.g., cost) and global (e.g., no need to vaccinate) dimensions were abstracted. MANOVA followed by ANOVA tests and post hoc comparisons showed that practical barriers were positively related to intention to receive HPV vaccine, while global barriers were negatively related to this intention. Furthermore, multiple regression analyses using the derived factors indicated that global and practical barriers accounted for 26% of the variance in intention, while a single composite barriers score accounted for just 3% of intention variance, thus supporting the hypothesis that a multi-dimensional conceptualization is superior to a singular one.

The Present Study

Though the Gerend et al. (2012) study supported the idea of a practical-global distinction in perceived barriers and found evidence of differential relationships with intention based on this distinction, this approach has yet to be applied to health behaviors other than HPV vaccination. The present study examined the utility of this distinction for exercise intention in cancer survivors. Because no perceived exercise barriers measures have yet been constructed specifically for cancer survivors, this study also involved the creation of such a measure.

This research is of particular importance to the cancer population for several methodological and applied reasons. In terms of methodology, since previous studies of cancer survivors' perceived barriers to exercise have been conducted atheoretically, this theory-grounded approach may advance the quality of the literature. Additionally, the majority of existing research on perceived exercise barriers in cancer survivors has focused on breast cancer survivors and survivors who are participating in exercise interventions. In order to obtain more generalizable results, this study recruited participants from the general cancer population (i.e., not those participating in an exercise intervention) who had been diagnosed with a variety of cancers.

Turning to application, the time period surrounding cancer diagnosis, treatment, and recovery has been recognized as a "teachable moment" for improving health behavior (Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005), and most cancer survivors express interest in health promotion efforts (Demark-Wahnefried, Peterson, McBride, Lipkus, & Clipp, 2000) . Furthermore, the literature suggests that tailored interventions may produce superior outcomes in comparison to generic interventions (Noar, Benac, & Harris, 2007). The findings of this research may inform tailored interventions geared toward (1) reducing the perceived barriers that are most salient to each individual cancer survivor and (2) producing exercise-related behavior change. Cancer survivors are generally not meeting exercise recommendations, yet they stand to gain more from exercise than people without cancer because they can receive not only general health *benefits* but also cancer-related benefits in the contexts of symptom reduction and reduced recurrence and mortality risk. Much potential exists to increase exercise participation amongst cancer survivors, and a more nuanced, multi-dimensional

perspective on perceived exercise barriers can help address both methodological and practical issues in this area.

Aims and Hypotheses

Aim 1. Determine the factor structure of a new measure designed to assess barriers to exercise in cancer survivors.

Hypothesis 1.1. The exercise barriers measure will be found to reflect two primary dimensions: a global dimension and a practical dimension.

Aim 2. Evaluate the relationship between the factors represented in the exercise barriers measure and intention to exercise in a sample of breast, colorectal, and prostate cancer survivors.

Hypothesis 2.1. Global exercise barriers will be negatively associated with intention to exercise, while practical exercise barriers will be positively associated with intention to exercise.

If the analyses do not yield the predicted factor structure, the relationship between intention and the factors that do emerge when the barriers scale is factor analyzed will still be assessed. In this instance, there will be no specific hypotheses.

Aim 3. Assess the unique variance in exercise intention attributable to exercise barriers, taking into account other relevant variables including perceived benefits, past behavior, comorbidities, and demographic factors (e.g., age, gender, etc.).

Hypothesis 3.1. Exercise barriers will contribute a significant amount of unique variance in exercise intention after accounting for perceived benefits, past behavior, comorbidities, and demographic factors.

Method

Participant Eligibility and Recruitment

Following institutional review board approval, study participants were recruited between October 2012 and April 2013. To be included in this study, potential participants had to meet the following criteria: (a) be able to speak and read English; (b) be able to provide informed consent; (c) be between the ages of 18 and 75; (d) have been diagnosed with non-metastatic breast, prostate, or colorectal cancer; and (e) have completed treatment (surgery, chemotherapy, and/or radiotherapy) between 6 and 36 months prior to eligibility screening. Ongoing adjuvant hormonal therapy did not preclude participation.

Potential participants were identified from a list obtained from the H. Lee Moffitt Cancer Center Tumor Registry. The list was limited to breast, prostate, and colorectal cancer patients diagnosed between July 2009 and July 2012. Following medical record review to determine eligibility, individuals meeting eligibility criteria were contacted by email with an invitation to participate in the study. A written description of the study was provided, and potential participants could chose to complete a consent form and participate in the study or to indicate that they did not wish to participate by calling a toll-free phone number. If a potential participant's email address on file was invalid, he or she was called to obtain the correct information. If a potential participant did not respond to the initial invitation within one week, a reminder was sent. If an additional week passed with no action by the potential participant, he or she received a final email as well as a

phone call. Individuals who did not respond to any of the attempted contacts were assumed to be uninterested in participating.

Out of 721 cancer survivors screened, 607 met eligibility criteria and were invited to participate in the study. The majority of those who were deemed ineligible were excluded because their treatment had been completed less than 6 months or more than 36 months or less prior to the date of screening. Twenty of the invitees were never able to be contacted due to erroneous contact information (both email and phone number) in the registry. Out of 587 invitees who were assumed to have received their invitations, 170 individuals (29% of those contacted) provided consent, and all of those who consented completed the study measures. Common reasons for declining to participate were lack of time and interest. Some invitees also expressed concern regarding their current exercise status (typically that they did not engage in exercise); though every effort was made to assure invitees that their response was important regardless of their exercise status, this factor was still a barrier in some cases.

Procedure

Individuals who screened eligible and wished to participate used a unique link in their invitation email to access an online consent form. After indicating their agreement to the terms on the consent form, they were directed immediately to the study measures. The measures could be completed in a single session or saved and finished at a later time. In total, the measures required approximately 10-15 minutes to complete.

Measures

Demographic characteristics. The following demographic characteristics were assessed using a standardized self-report form: age, height, weight, race, ethnicity,

marital status, living arrangement (e.g., alone, with spouse/partner, etc.), education, employment status, occupation, and yearly income. Smoking behavior, alcohol use, and female participants' menopausal status was evaluated using standardized self-report items, and a generic question about the overall quality of the participant's diet (taken from the Diet Behavior and Nutrition section of the 2011-2012 National Health and Nutrition Examination Survey) was included. The items related to smoking, alcohol use, and diet were presented in a separate section called the "Health Behaviors Questionnaire" and were used to provide a temporary distraction from exercise-related subject matter before assessing barriers to exercise.

Clinical characteristics. The following clinical characteristics were assessed by reviewing participants' medical charts: type of cancer, cancer stage, date of cancer diagnosis, types of treatment(s) received, dates treatment(s) were completed, and presence or absence of a lymphedema diagnosis (for breast cancer only).

Comorbidities. A self-report version of the Charlson comorbidity index was used to assess comorbidities (Katz, Chang, Sangha, Fossel, & Bates, 1996). Though medical record review is a common method for obtaining comorbidity data, this approach is problematic because it (1) requires a chart abstractor with clinical training and (2) is dependent upon the accuracy and thoroughness of the patient's medical record, which can vary greatly. In recognition of these limitations, a questionnaire form of the Charlson index, a widely used comorbidity instrument that is based upon medical chart review, was designed. This questionnaire contains 11 items that assess for a wide range of health problems. The questionnaire demonstrated excellent test-retest reliability of 0.91 and correlated 0.63 with the chart-based Charlson index (Katz et al., 1996). Because the

Charlson index questionnaire does not ask about certain surgeries that can impede physical movement, the following question was added: "Have you had a hip or knee replacement surgery?" Participants answering in the affirmative were asked to list (in years) how long it had been since the surgery was conducted. This question was evaluated separately (i.e., it was not included in the summary comorbidity index score).

Exercise behavior. Participation in exercise was assessed using the self-administered short form of the International Physical Activity Questionnaire (IPAQ; Craig et al., 2003). The IPAQ is a validated measure of physical activity and sedentary behavior that is available in several forms and has been used in countries throughout the world. In the initial development study, test-retest reliability for the self-administered short form of the IPAQ was 0.75, and the IPAQ correlated 0.30 with accelerometer data (Craig et al., 2003). These results are similar to those obtained by other self-report physical activity measures (for a review, see Sallis & Saelens, 2000). The IPAQ self-administered short form contains a total of seven questions that ask about vigorous, moderate, and walking activity (both the number of days per week that the participant engages in that type of activity and the duration in hours and minutes of a typical bout of that type of activity) as well as time spent sitting on a usual week day. Respondents are asked to report physical activity bouts only if these sessions last for at least 10 minutes at a time.

Responses to the IPAQ questions were scored in accordance with guidelines distributed by the measure's creators (IPAQ Research Committee, 2005). To account for differences in intensity between vigorous, moderate, and walking activity, minutes spent in each activity were converted to MET-minutes as follows: walking = 3.3, moderate

physical activity = 4.0, and vigorous physical activity = 8.0. Each type of activity was calculated as the MET-minutes for that activity times the number of minutes per bout times the number of days per week. The three values were added together to determine a total number of MET-minutes for each participant.

In addition to the continuous measure, responses to the IPAQ questions were used to divide participants into three groups: low, moderate, and high. The ACSM recommends that adults engage in exercise of moderate intensity for at least 30 minutes per day, at least five days per week, or vigorous intensity for at least 20 minutes per day, at least three days per week (Garber et al., 2011). The "moderate" category requires this level of activity, which is a basic minimum for achieving health benefits from exercise. In recognition of the low standards set by these recommendations, the IPAQ creators also designed criteria for a "high" level of activity: (1) at least 3 days of vigorous intensity exercise totaling at least 1500 MET-minutes per week or (2) 7 or more days of any combination of intensity levels totaling at least 3000 MET-minutes per week. The "low" category includes any amount of exercise that does not meet the requirements for either of the other levels.

Exercise intention. Participants reported their intention to exercise by responding to two items: (1) "On average during the next 2 months, my goal is to exercise the following number of days per week," with response options ranging from zero to seven; and (2) "On average during the next 2 months, I intend to exercise at least every other day," with response options ranging from one (strongly disagree) to seven (strongly agree). These items were closely modeled after items used successfully in previous studies (e.g., Rhodes & Courneya, 2003) and were designed in accordance with

suggestions made by Courneya and McAuley (1993), who examined methodological issues in the assessment of physical activity intention. The correlation between the two items was $r = 0.55$. Both items were converted to a 100-point scale, and the average of the two was used as the measure of intention.

Perceived exercise benefits. The Outcome Expectations for Exercise Scale (OEE) was used to measure perceived benefits of exercise (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000). The OEE was designed for the older adult population with reference to other established measures of exercise outcome expectations and benefits as well as empirical studies examining the older adults' perceptions regarding the benefits of exercise. The scale contains a total of nine items, with five items devoted to physical benefits and four items concentrating on psychological benefits. Participants' answer choices are: (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, and (5) strongly agree. Validity and reliability of the OEE were first established in two samples of older adults (Resnick et al., 2000), and the measure has since been used in a large number of studies. Four additional cancer-specific items addressing both physical and psychological benefits were added at the end of the OEE for the present study. These items were adapted from a previous study that assessed perceived exercise benefits in cancer survivors (Courneya, Jones, Mackey, & Fairey, 2006). Separate averages were calculated for the original items and the cancer-specific items. These values were highly correlated ($r = 0.75$); thus, the overall average of all 13 items was used in the analyses.

Perceived exercise barriers. Though numerous exercise barriers measures are available, no validated measures of exercise barriers designed specifically for cancer survivors could be located. Thus, a new measure was created to be used and validated in

the present study. The following steps were taken to create the measure. First, an extensive review of existing exercise barriers measures was completed. From this review, an exhaustive list of over 200 potential items was developed. Quantitative and qualitative studies of barriers to physical activity and exercise in the cancer population were then reviewed. With the aid of an expert who has decades of experience in psychosocial research with the cancer population, the pool of items was reduced, and several items specific to cancer survivors were designed. After several rounds of revisions, the proposed measure was presented to a panel of experts, who offered further suggestions. A final draft of the scale was pilot tested for comprehensibility and completeness with three cancer patients participating in other research studies at Moffitt Cancer Center. The final version of the measure contains 34 items. Participants are asked to rate on a scale of zero (not at all) to three (a lot) the extent to which each item could impact their exercising during the next two months.

Statistical Analyses

General. Prior to analyzing participants' responses to the study measures, participants were compared to study invitees who declined to participate on items obtained from the tumor registry. Before conducting the main analyses, descriptive statistics including means and standard deviations were calculated for the demographic, clinical, psychological, and behavioral variables measured in the study. Correlations and t-tests were used to determine whether any of the demographic, clinical, psychological, or behavioral variables were associated with exercise intention. Any variables that correlated significantly ($p < 0.05$) with exercise intention were used in later analyses for Aim 3 and Hypothesis 3.1.

Aim 1 & Hypothesis 1.1. Before analyzing the barriers data, items endorsed by less than 10% of the participants were dropped from the barriers scale. The initial plan to address the first aim and hypothesis was to first split the sample through stratified random sampling by gender into two equal size groups. Then, each group's barriers data was to be submitted to an exploratory factor analysis using methods recommended by Fabrigar, Wegener, MacCallum, and Strahan (1999). The number of factors present was to be determined by way of inspection of the factor eigenvalues and the scree plots for each analysis, and both orthogonal and oblique rotation schemes were to be explored in order to assess the correlations between the factors. Next, the coefficient of congruence between the two sets of results was to be evaluated to determine how closely the factor structures from the two groups were related. Finally, the replicability of the factor structure revealed through the exploratory factor analyses was to be evaluated via confirmatory factor analysis of the barriers data from the entire sample. Factor scores were to be taken from this final confirmatory factor analysis for use in later regression analyses.

Attempts at establishing a stable factor structure using this method were unsuccessful. That is, the factor structure was unstable: Cross-loadings and insufficient loadings remained no matter which items were retained or how many factors were included in the model, and the confirmatory factor analysis suggested a very poor fit. Through consultation with an expert statistician, an alternative strategy was formulated. In this plan, an exploratory factor analysis using the methods described above was conducted with the barriers data from the entire sample. Factor scores for later regression analyses were taken from the best attainable factor structure as determined by using an

orthogonal rotation scheme (to minimize factor complexity and enhance factor interpretability), employing the eigenvalue and scree plot methods described above, and minimizing cross-loadings and insufficient loadings (in some cases by removing additional items from the scale). Though the factor structure obtained from the exploratory factor analysis of the entire sample's barriers data was not expected to meet criteria for a good fit due to the presence of a number of unavoidable remaining cross-loadings and moderate (rather than strong/high) loadings, a confirmatory factor analysis was conducted.

Aim 2 & Hypothesis 2.1. To address the second aim and hypothesis, a series of linear regression analyses was conducted on the entire sample. Prior to carrying out the regressions, distributions of the relevant variables were examined to ensure the absence of significant skew. The first set of regressions was used to determine the relationship between perceived exercise barriers and exercise intention. The first regression in this set regressed the total barriers score on exercise intention. Subsequent regressions regressed each perceived exercise barriers factor derived from the factor analysis on exercise intention. Next, a series of hierarchical regressions were used to explore whether disease type (breast, prostate, or colorectal cancer) interacted with perceived exercise barriers to predict exercise intention. In the first block, dummy coded disease variables were entered. In the second block, a perceived exercise barriers variable (first total barriers, then each individual factor in subsequent analyses) was entered. In the third block, interaction terms representing the product of the disease variables and the perceived exercise barriers variable were entered. The dependent variable in each of these regressions was exercise intention.

Aim 3 & Hypothesis 3.1. To address the third aim and hypothesis, another set of hierarchical regression analyses was conducted. Each regression contained four blocks. Demographic and clinical factors related to exercise intention (as determined in the preliminary analyses) were entered in the first block. Current exercise behavior (as assessed by the IPAQ) was entered in the second block. Perceived benefits of exercise (as assessed by the OEE) were entered in the third block. Finally, a perceived exercise barriers variable (first total barriers, then each individual factor in subsequent analyses) was entered in the fourth block. The dependent variable was exercise intention in each of these regressions. Results were analyzed to determine whether barriers added significantly to intention variance prediction when accounting for the other relevant constructs.

Exploratory analysis. To further test the proposition that a multi-dimensional conceptualization of barriers is superior to viewing barriers as a singular construct, a multiple regression was constructed using the factors derived from the factor analysis as independent variables and intention as the dependent variable. The amount of variance accounted for was compared to that of the first regression in the analyses for Aim 2 (regressing the total barriers score on intention). A statistically significant difference in favor of the regression using the factors would suggest that a multi-dimensional conceptualization is superior to a singular one.

Determination of Sample Size

Appropriate sample size for factor analysis is debated. Based on recommendations from Fabrigar et al. (1999) and MacCallum, Widaman, Zhang, and Hong (1999), a sample size of 150 was determined to be adequate. Using a sample size of

150, Power and Precision, Version 2 was used to determine power for the other analyses to be performed in the study. Regarding the regression analyses used to address Aim 2, this sample size would have 80% power at $p < 0.05$ (two-tailed) to detect a correlation of 0.23, which is a small to medium effect and equates to explaining 5% of the variance in the dependent variable. At the same power and significance level, increments of as little as 4% of variance would be identifiable in the hierarchical regression analyses used in Aim 3. The recruited sample size (N = 170) slightly exceeds the planned sample size due to unexpectedly higher rates of participation among study invitees recruited in the final months of data collection.

Results

Participants

Participant characteristics are displayed in Table 1. The mean age of the study's participants was 60 years. The majority of participants were female (67%), white and non-Hispanic (91% and 94% respectively), and married (77%). Just over half of participants were college graduates (58%), and the majority lived in households earning at least $40,000 per year (68%). The majority of participants were breast cancer survivors (61%). Participants' mean body mass index (BMI) was 27.45, and nearly two-thirds of the participants (63%) were either overweight or obese (i.e., BMI $\geq$ 25). Most participants were at least moderately active (i.e., meeting the ACSM's minimal exercise recommendations), with only 21% reporting little to no physical activity. The mean for exercise intention was 70.95 out of 100, and the mean for perceived exercise benefits was 4.01 out of 5.00. Study invitees who declined to participate did not differ from participants in age, gender, or cancer type (all *p*s > 0.10); no other characteristics were available for comparison.

Table 1
Participants' demographic, medical, and study characteristics (N = 170)

Variable	Mean	SD	Range
Age (years)	60.15	9.38	33-75
Years since diagnosis	2.59	0.56	1-4
Body mass index	27.45	5.68	18-50
Perceived exercise benefits	4.01	0.67	1-5
Exercise intention	70.95	19.95	0-100
Variable	*N*	%	
Gender			
Female	114	67.1	
Male	56	32.9	
Ethnicity			
Hispanic	10	5.9	
Non-Hispanic	160	94.1	
Race			
White	155	91.2	
Non-white	15	8.8	
Marital Status			
Currently married	131	77.1	
Not currently married	39	22.9	
Education			
< College graduate	71	41.8	
≥ College graduate	99	58.2	
Total Household Income			
< $40,000	35	20.6	
≥ $40,000	115	67.6	
Declined to answer	20	11.8	
Cancer Type			
Breast	104	61.2	
Prostate	41	24.1	
Colorectal	25	14.7	
Weight Status			
Underweight/normal weight	63	37.1	
Overweight	61	35.8	
Obese	46	27.1	
Physical Activity			
Sedentary	35	20.6	
Moderately active	66	38.8	
Very active	69	40.6	

Preliminary Analyses

Evaluation of the relationships between demographic and medical characteristics and intention revealed a significant relationship between income and exercise intention such that participants with a household income of at least $40,000 per year endorsed stronger exercise intention than participants with a household income less than $40,000 per year ($t = 2.32$, $p = 0.02$). Consequently, income was entered into the first block of the hierarchical regressions used to evaluate Aim 3 and Hypothesis 3.1. Other demographic and medical characteristics including age, BMI/weight status, gender, race, ethnicity, education, marital status, type of cancer, time since cancer diagnosis, and comorbidities were not significantly related to exercise intention (ps > 0.05). Because the values for skewness (= 1.27) and kurtosis (= 1.82) for the continuous exercise variable were greater than one, a square root transformed version of this variable was created. Analyses for Aim 3 and Hypothesis 3.1 were run first using the untransformed variable and then again using the transformed variable.

Aim 1 & Hypothesis 1.1

The first aim of the study was to determine the factor structure of the exercise barriers measure, with the hypothesis that the factors would reflect a global dimension and a practical dimension. Items from the exercise barriers measure are listed in order of descending frequency of endorsement in Table 2.

Table 2
Exercise Barriers in Order of Descending Reporting Frequency

	Frequency	
Barrier	*N*	%
Lack of motivation	97	57.1
Lack of time	83	48.8
Fatigue	76	44.7
Social or family responsibilities	74	43.5
Exercise not enjoyable	73	42.9
Lack of interest	73	42.9
Other health problems besides cancer	63	37.1
Weather conditions	59	34.7
Other preferences for leisure activities	58	34.1
Unpleasant sensations or symptoms caused by exercise	54	31.8
Cancer-related weakness	45	26.5
Lack of convenient facilities	45	26.5
Fear of injury	41	24.1
Cancer-related numbness or tingling	41	24.1
Cancer-related joint stiffness	40	23.5
Exercise not important to me	40	23.5
No one to exercise with	40	23.5
No instructor to guide me	28	16.5
Fear of making other health problems worse	27	15.9
Financial cost/fees	27	15.9
Other cancer-related symptoms or treatment side effects	27	15.9
Cancer-related pain	25	14.7
Embarrassment	21	12.4
Lack of support from others	19	11.2
Lack of equipment or proper clothing	16	9.4
Do not know how to exercise	15	8.8
Doctor's recommendation not to exercise	13	7.7
Do not see the need to exercise	12	7.1
Fear of making cancer-related symptoms worse	11	6.5
No safe place to exercise	10	5.9
Having been diagnosed with cancer	9	5.3
Transportation problems	8	4.7
Lack of doctor's permission	6	3.5
Cancer-related nausea	3	1.8

Note. Percentages listed indicate the proportion of participants endorsing the item (i.e., rating the item higher than "not at all").

The most frequently reported barriers were lack of motivation, lack of time, fatigue, social/family responsibilities, lack of enjoyment from exercise, and lack of interest in exercise. Ten items were dropped from the scale for purposes of further analyses because fewer than 10% of study participants endorsed these items (i.e., rated them higher than "not at all"). An additional four items were dropped because they loaded onto multiple factors: These items (see the barriers measure in the Appendix for exact phrasing) included unpleasant sensations during exercise, other leisure-time preferences, no exercise partner, and fatigue. Loadings for the factors and items retained in the final model are presented in Table 3. A five-factor model was obtained, and this model partially confirmed Hypothesis 1.1: One factor encompassed global barriers, two factors were related to practical barriers, and two factors contained health-related barriers. As expected due to the instability of the factor structure, the results of the confirmatory factor analysis did not indicate adequate fit ($X^2(160) = 336.00$, $p < .001$; CFI = 0.85, RMSEA = 0.08, SRMR = 0.08). Nonetheless, the fit of the five-factor model was notably better than the fit of a single-factor model ($X^2(170) = 785.86$, $p < .001$; CFI = 0.47, RMSEA = 0.15, SRMR = 0.13).

Table 3
Exercise Barrier Factor Loadings

Item	Loading
Factor 1: Health, Cancer	
Cancer-related pain	0.785
Cancer-related joint stiffness	0.784
Cancer-related weakness	0.802
Cancer-related numbness or tingling	0.638
Other cancer-related symptoms or treatment side effects	0.744
Factor 2: Attitudes (Global)	
Exercise not enjoyable	0.658
Embarrassment	0.648
Lack of support from others	0.657
Exercise not important to me	0.649
Lack of interest	0.660
Lack of motivation	0.622
Factor 3: Resources (Practical)	
Lack of convenient facilities	0.602
No instructor to guide me	0.669
Financial cost/fees	0.804
Factor 4: Health, Other	
Fear of injury	0.648
Other health problems besides cancer	0.816
Fear of making other health problems worse	0.815
Factor 5: Situational Constraints (Practical)	
Weather conditions	0.600
Lack of time	0.765
Social or family responsibilities	0.663

Aim 2 & Hypothesis 2.1

The second aim of the study was to evaluate the relationship between the factors represented in the exercise barriers measure and intention to exercise, with the hypothesis that global barriers would be negatively related to intention and practical barriers would be positively related to intention. The "cancer" factor and the "other health" factor from the factor analysis were conceptually similar and performed comparably in the regression

analyses, so these two factors were collapsed into a general "health" factor for the reporting of results. One difference in the pattern of significant results emerged between these two factors in subsequent analyses: The cancer factor interacted with cancer type in predicting exercise intention such that, among prostate cancer survivors, barriers were positively related to intention ($\beta = 0.40$, $t(40) = 2.69$, $p < 0.05$), while among breast and colorectal cancer survivors, there was not a significant relationship between barriers and intention ($\beta = -0.16$, $t(128) = -1.88$, $p = 0.06$). Similarly, the two "practical" factors (i.e., "resources" and "situational constraints") were collapsed for the purposes of results reporting due to their conceptual similarity and comparable performance in the analyses. No differences in the pattern of significant results were evident between these two factors in subsequent analyses.

Results of the separate regression analyses assessing the prediction of exercise intention from total barriers, global barriers, practical barriers, and health barriers are reported in Table 4. In agreement with Hypothesis 2.1, global barriers significantly predicted intention such that greater endorsement of global barriers was associated with lower intention. However, in contrast to expectations, practical barriers were not a predictor (positive or negative) of intention. Additional findings indicated that total barriers negatively predicted intention, and health barriers were unrelated to intention.

Table 4
Summary of Separate Simple Linear Regression Analyses Predicting Exercise Intention From Total Barriers and Individual Factors (N = 170)

Variable	*B*	*SE B*	β	R^2	*F*	*p*
Total Barriers	-0.77	0.19	-0.30	0.09	16.44	< .001
Global Barriers	-5.55	1.48	-0.28	0.08	14.07	< .001
Practical Barriers	-1.66	1.08	-0.18	0.01	2.37	0.13
Health Barriers	-1.53	1.08	-0.11	0.01	1.99	0.16

Results of the regression analyses exploring the interaction of cancer type and the different types of barriers are reported in Tables 5-8. Cancer type alone was not a predictor of exercise intention ($p = 0.71$). A interaction was observed between total barriers and cancer type (see Table 5): Among prostate cancer survivors, intention decreased as total barriers increased ($\beta = -0.52$, $t(40) = -3.78$, $p < 0.001$); among breast and colorectal cancer survivors, intention also decreased as total barriers increased, but to a somewhat lesser degree ($\beta = -0.27$, $t(128) = -3.21$, $p < 0.01$). Similarly, global barriers and cancer type interacted (see Table 6) such that prostate cancer survivors demonstrated a large decrease in intention as global barriers increased ($\beta = -0.60$, $t(40) = -4.65$, $p < 0.001$), while breast and colorectal cancer survivors reported a smaller decrease ($\beta = -0.17$, $t(128) = -1.98$, $p = 0.05$). Practical barriers and health-related barriers did not interact with cancer type in predicting exercise intention (see Tables 7 and 8).

Table 5
Summary of Hierarchical Regression Analysis Examining the Interaction of Total Exercise Barriers and Disease Type in Predicting Exercise Intention (N = 170)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.00	0.00	0.71
Cancer Type - BC	0.07			
Cancer Type - PC	0.09			
Step Two:		0.10	0.10	<0.01
Total Barriers	-0.32			
Step Three:		0.05	0.15	0.01
BCvsOther x Total Barriers	-0.07			
PCvsOther x Total Barriers	0.62			

[a]*p* value for ΔR^2; BC = breast cancer, PC = prostate cancer

Table 6
Summary of Hierarchical Regression Analysis Examining the Interaction of Global Exercise Barriers and Disease Type in Predicting Exercise Intention (N = 170)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.00	0.00	0.71
Cancer Type - BC	0.07			
Cancer Type - PC	0.09			
Step Two:		0.08	0.08	<0.01
Global Barriers	-0.28			
Step Three:		0.08	0.16	<0.01
BCvsOther x Global Barriers	0.20			
PCvsOther x Global Barriers	0.88			

[a]*p* value for ΔR^2; BC = breast cancer, PC = prostate cancer

Table 7
Summary of Hierarchical Regression Analysis Examining the Interaction of Practical Exercise Barriers and Disease Type in Predicting Exercise Intention (N = 170)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.00	0.00	0.71
Cancer Type - BC	0.07			
Cancer Type - PC	0.09			
Step Two:		0.02	0.02	0.13
Practical Barriers	-0.12			
Step Three:		0.04	0.02	0.16
BCvsOther x Practical Barriers	-0.23			
PCvsOther x Practical Barriers	-0.22			

[a]*p* value for ΔR^2; BC = breast cancer, PC = prostate cancer

Table 8
Summary of Hierarchical Regression Analysis Examining the Interaction of Health Exercise Barriers and Disease Type in Predicting Exercise Intention (N = 170)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.00	0.00	0.71
Cancer Type - BC	0.07			
Cancer Type - PC	0.09			
Step Two:		0.02	0.02	0.14
Health Barriers	-0.12			
Step Three:		0.00	0.02	0.58
BCvsOther x Health Barriers	-0.07			
PCvsOther x Health Barriers	-0.34			

[a]*p* value for ΔR^2; BC = breast cancer, PC = prostate cancer

Aim 3 & Hypothesis 3.1

The third aim of the study was to assess the unique variance in exercise intention attributable to exercise barriers, taking into account other relevant variables including perceived benefits, current exercise behavior, and participant characteristics that related significantly ($p < 0.05$) to exercise intention; the hypothesis for this aim was that barriers would contribute a significant amount of unique variance after accounting for the aforementioned variables. As noted previously, the continuous exercise behavior variable demonstrated large skewness and kurtosis values, so this set of regression analyses was conducted twice: once with the untransformed exercise variable and once with a square root transformed version of the exercise variable. Because the two sets of analyses produced nearly equivalent results, only the analyses using the untransformed exercise variable are reported in full. Where a minor difference was observed, it is noted in the following description of results. Because perceived benefits of exercise was found to correlate highly with exercise intention ($r = 0.52$, $p < .001$), this set of regressions was

conducted both with and without the block containing the perceived benefits variable. Again, for these analyses, the cancer and other health factors were combined into a single health factor, and the resources and situational constraints factors were combined into a single practical factor.

Results of the hierarchical regression analyses without the perceived benefits variable are presented in Tables 9-12. As noted previously, income was the only participant characteristic that was significantly related to exercise intention; thus, the first block of these regressions contained only the income variable. Results indicated that income alone predicted 4% of the variance in exercise intention ($p = 0.02$). The second block included a continuous variable representing participants' current exercise behavior; this variable predicted an additional 4% of the variance in exercise intention, a significant increase ($p < 0.01$). The third and final block in these models contained an exercise barriers variable (total barriers, global barriers, practical barriers, and health barriers in separate regression analyses). In their respective analyses, total barriers (Table 9) and global barriers (Table 10) accounted for significant amounts of additional variance in exercise intention (total = 4%, global = 7%; both ps ≤ 0.01); practical barriers (Table 11) and health barriers (Table 12) were not significant predictors in this set of analyses. Since some but not all types of barriers were significant predictors of exercise intention after the inclusion of relevant variables, the results from this set of regressions partly confirmed Hypothesis 3.1.

Table 9
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, and Total Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.04	0.12	0.01
Total Barriers	-0.22			

[a]*p* value for ΔR^2

Table 10
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, and Global Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.07	0.15	<0.01
Global Barriers	-0.27			

[a]*p* value for ΔR^2

Table 11
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, and Practical Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.00	0.08	0.74
Practical Barriers	-0.03			

[a]*p* value for ΔR^2

Table 12
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, and Health Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.00	0.08	0.60
Health Barriers	-0.04			

[a]*p* value for ΔR^2

Results of the hierarchical regression analyses with the perceived benefits variable are presented in Tables 13-16. Again, income was included in the first block (predicting 4% of variance in exercise intention), and current exercise behavior was included in the second block (predicting an additional 4% of variance in exercise intention). When perceived benefits of exercise was included as the third block, predicted variance in exercise intention increased to 30%; this represented a 22% increase due to the addition of perceived benefits, which was significant ($p < 0.001$). The addition of the perceived benefits variable rendered the previously entered variables insignificant, with the exception that the transformed version of the exercise variable remained significant ($t(149) = 2.04$, $p = 0.04$); the untransformed version of this variable was not significant ($t(149) = 1.87$, $p = 0.06$). In this group of regression analyses, only the global exercise barriers variable contributed a significant amount of additional variance in exercise intention ($\Delta R^2 = 0.02$, $p = 0.03$; see Table 14); total barriers, practical barriers, and health barriers were not significant predictors when entered after perceived benefits (see Tables 13, 15, and 16). Similar to the previous set of regressions, these analyses partially

confirmed Hypothesis 3.1 because global barriers contributed unique variance in intention accounting for all relevant variables.

Table 13
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, Perceived Exercise Benefits, and Total Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.22	0.30	<0.01
Perceived Benefits	0.49			
Step Four:		0.01	0.31	0.34
Total Barriers	-0.08			

[a]*p* value for ΔR^2

Table 14
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, Perceived Exercise Benefits, and Global Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.22	0.30	<0.01
Perceived Benefits	0.49			
Step Four:		0.02	0.32	0.03
Global Barriers	-0.16			

[a]*p* value for ΔR^2

Table 15
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, Perceived Exercise Benefits, and Practical Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.22	0.30	<0.01
Perceived Benefits	0.49			
Step Four:		0.00	0.30	0.53
Practical Barriers	0.05			

[a]*p* value for ΔR^2

Table 16
Summary of Hierarchical Regression Analysis Predicting Exercise Intention from Income, Current Exercise Behavior, Perceived Exercise Benefits, and Health Exercise Barriers (N = 150)

Variable	β	ΔR^2	Cumulative R^2	p^a
Step One:		0.04	0.04	0.02
Income	0.19			
Step Two:		0.04	0.08	0.01
Current Exercise Behavior	0.21			
Step Three:		0.22	0.30	<0.01
Perceived Benefits	0.49			
Step Four:		0.00	0.30	0.99
Health Barriers	0.00			

[a]*p* value for ΔR^2

Exploratory Analysis

The exploratory analysis aimed to further investigate the proposition that a multi-dimensional conceptualization of barriers is superior to viewing barriers as a singular construct by comparing the amount of variance in exercise intention explained by a single

barriers variable to the amount of variance explained by the barriers factors. The single-factor model explained 9% of the variance in exercise intention, while the five-factor model explained 11% of the variance in exercise intention; this difference was not significant ($t(167) = 0.70$, $p = 0.48$).

Discussion

The present study evaluated the utility of a global-practical distinction in perceived barriers to exercise in predicting exercise intention among cancer survivors and reported on the creation of a perceived exercise barriers measure tailored to cancer survivors. Results partially supported the study's hypotheses. As predicted, barriers fell roughly into global (e.g., embarrassment and lack of motivation) and practical (e.g., lack of resources and situational constraints) dimensions; however, a health-related dimension also emerged. Also as predicted, global barriers were negative predictors of exercise intention. Contrary to predictions, none of the other types of barriers were positive predictors of exercise intention. Finally, as predicted, total and global barriers remained significant predictors of intention when relevant demographic characteristics and current exercise behavior were controlled; however, the addition of perceived benefits of exercise rendered all but global barriers non-significant in predicting exercise intention.

The data presented challenges with respect to the factor analytic method used to assess the perceived exercise barriers measure. The original plan was to split the sample in half, perform an EFA on each half, and submit the best factor structure from the EFAs to a CFA in order to evaluate model fit. Unfortunately, the measure's factor structure was very unstable when the sample was split in half, making it necessary to revise the analysis plan. Even using the full sample's data, a completely satisfactory model could not be obtained. However, this matter may be subject to interpretation, as the fit statistics for the factor structure observed in the present study were comparable to those of the earlier

study by Gerend et al. (2012) in which the authors described their structure as a good fit, even though it failed to meet some of the standard cutoff points for adequate performance. Interestingly, the three broad categories of barriers found in the present study (i.e., global, practical, and health-related) are similar to the domains found in comparable studies that have assessed cancer survivors' exercise barriers using open-ended questions (Courneya et al., 2008) and qualitative approaches (Whitehead & Lavelle, 2009).

As noted above, the results of the simple linear regression analyses predicting exercise intention from total, global, practical, and health-related barriers partially confirmed Hypothesis 2.1. Global exercise barriers were associated with lower intention to exercise. In contrast, practical and health-related barriers were essentially unrelated to exercise intention, with each predicting only 1% of the variance in exercise intention. These results indicate that the observed negative relationship between total exercise barriers and exercise intention was driven by global barriers and not practical or health-related constraints. Though the non-significant relationships between practical and health-related barriers and intention were contrary to the study hypotheses, these findings are not unprecedented. Studies of exercise barriers in cancer survivors that have analyzed barriers individually have found that only some barriers are significantly correlated with stage of change (Rogers et al., 2007) and intention (Courneya & Friendenreich, 1997a). Due to the small number of studies reporting this information and the variations between these studies in terms of methodology and barriers items, it is not yet possible to evaluate whether specific types of barriers are consistently significant or non-significant in predicting exercise intention.

Several differences in study design and in the health behavior of interest may explain why Gerend et al.'s (2012) global-negative, practical-positive pattern of relationships between barriers and intention did fully materialize in the present study. This study analyzed intention continuously, whereas the prior study categorized participants into intenders, non-intenders, and those who were undecided. Differences between exercise behavior and vaccination behavior may also have played a role. Exercise is a health behavior that must be performed regularly, whereas vaccination is a one-time action. It is possible that barriers impact intention differently for one-time versus ongoing behaviors. Furthermore, barriers to exercise explained notably less of the variance in exercise intention (11% for the multi-dimensional conceptualization) when compared to the variance in vaccination intention explained by HPV vaccination barriers in the prior study (21% for the multi-dimensional conceptualization), suggesting that barriers may not be equally relevant to intention for different types of health behaviors.

Although no hypotheses were offered with regard to cancer type, interactions were observed between cancer type and some types of barriers. Specifically, cancer type interacted with total barriers, global barriers, and cancer-specific barriers such that prostate cancer survivors demonstrated different relationships between barriers and intention when compared to breast and colorectal cancer survivors. The meaningfulness of these interactions is difficult to determine because, due to the small number of colorectal cancer participants, cancer type and gender were largely conflated. Given that most of the observed differences were a matter of degree rather than suggesting opposing patterns on the basis of cancer type, these interactions are unlikely to play a substantial role in exercise intention.

Desire for symptom relief may explain the seemingly paradoxical finding that cancer-specific barriers were associated with higher exercise intention in the prostate cancer participants. Perhaps these participants had received information from their doctors or some other source indicating that exercise can positively impact cancer-related symptoms. Consequently, they may have intended to use exercise to provide relief for the cancer-related symptoms they reported as barriers. This theory has not been tested directly, but qualitative research showing that desire to overcome symptoms and regain a sense of normality is a motivator for exercise among cancer survivors (Blaney et al., 2010) supports the plausibility of this explanation. Since this and other possible mechanisms have not yet been studied, cancer-specific barriers to exercise may be worthy of closer evaluation in future research.

The study hypothesis suggesting that exercise barriers would remain significant predictors of exercise intention when other relevant constructs were controlled was affirmed with respect to global barriers but not to practical or health-related barriers. Given the miniscule, insignificant amount of variance in exercise intention predicted by practical and health-related barriers when these types of barriers were evaluated individually, it is unsurprising that they would not explain significant amounts of unique variance after the inclusion of other predictors. Additional analyses revealed that perceived benefits was an especially strong predictor, rendering all but global barriers (and the transformed version of the exercise behavior variable) non-significant in the prediction of exercise intention. Barriers and perceived benefits were correlated (r = -0.39, $p < 0.01$), but not so highly as to raise concerns about multicollinearity. The relationship between perceived benefits and intention (r = 0.52) was notably strong but

not extraordinary. Previous studies of cancer survivors have reported correlations between behavioral beliefs (the TPB's equivalent to perceived benefits) and exercise intention that are comparable to that found in the present study: $r = 0.48$ (Courneya & Friendenreich, 1997a) and $r = 0.43$ (Courneya & Friedenreich, 1999). Furthermore, research suggests that most cancer survivors are interested in health promotion (Demark-Wahnefried et al. 2000). In the spirit of the "teachable moment" concept mentioned earlier, cancer survivors may be obtaining information about the benefits of exercise for symptom relief and recurrence prevention, making these benefits particularly salient and influential in the context of their intention to exercise.

Strengths and Limitations

Strengths of this study include its use of a barriers measure designed specifically for the cancer survivor population, its theory-based approach to study design and hypothesis generation, and its inclusion of participants representing multiple cancer types. Several characteristics also limit the present investigation. Participants' mean score for exercise intention was high (70.95 out of a maximum of 100), suggesting a possible ceiling effect. The limited variance in exercise intention may have negatively impacted the analyses' ability to detect relationships between barriers and intention. Self-selection by study participants is also a concern. Though no differences in gender, age, or cancer type were found between participants and study invitees who chose not to participate, the low participation rate (29%) raises the possibility that participants differed from non-participants in some other way. No attempt was made to conceal this study's focus on exercise. It is possible that making this focus less transparent could reduce participant self-selection and increase variability in exercise-related constructs including intention.

Furthermore, though the sample size of the present study compares favorably with other exercise-related studies of cancer survivors, it was small for the purposes of factor analysis. This feature may have contributed to the lack of stability in the exercise barriers measure's factor structure. A larger sample size would have also allowed for the interactions between cancer type and exercise barriers to be more effectively explored because the number of colorectal cancer patients would increase, permitting analyses that distinguish the impact of gender from that of cancer type. Finally, the barriers measure used a narrow 4-point scale and might perform better in the future with a wider 6- or 7-point scale.

Future Directions

The results of the present study suggest several avenues for future research and application. Given the less than desirable performance of the perceived barriers to exercise measure used in this study, additional research is clearly required to gain a more complete understanding of the exercise barriers faced by cancer survivors. Furthermore, because global barriers and practical barriers related differently to exercise intention, it appears worthwhile to conduct further research using a multi-dimensional conceptualization of exercise barriers, perhaps utilizing a stage model such as the transtheoretical model to categorize individuals into distinct stages of behavior change (for an example of this approach, see Rogers et al., 2007) in which different types of barriers may be more or less salient. Additionally, this exploration should be extended from intention to actual exercise behavior using a longitudinal research design. Finally, future research should evaluate the utility of this multi-dimensional conceptualization of barriers as applied to other health behaviors such as diet.

With respect to application, the present study's findings suggest that global barriers should be given special attention when enhancement of exercise intention is desired. Because global barriers tend to involve motivational issues (e.g., "exercise not important to me"), motivation-related approaches such as motivational interviewing (e.g., Milne, Wallman, Guilfoyle, Gordon, & Courneya, 2008) or interventions based on protection motivation theory (e.g, Milne, Orbell, & Sheeran, 2002) may be particularly efficacious. Attempting to address practical and health-related barriers at this point in the behavior change process is unlikely to be a fruitful path, given the observed weak-to-nonexistent relationships between these types of barriers and exercise intention. Problem-solving approaches targeting practical barriers are often included in the protocols of randomized controlled trials, but these trials typically only involve people who have made a commitment to pursuing a physically active lifestyle (as indicated by their enrollment in the trial). On the other hand, interventions addressing motivational issues pertinent to global barriers may be beneficial for the larger group of inactive individuals who are not currently pursuing behavior change. Such interventions can be carried out in community and primary health care settings at a minimal cost in terms of both time and money.

Conclusion

The present study represents one of the few examinations of a multi-dimensional conceptualization of perceived barriers to health behaviors and is the first to explicitly test this approach in the context of exercise. Although none of the types of barriers were positively associated with exercise intention, global barriers were a significant negative predictor of exercise intention and explained unique variance beyond that accounted for

by relevant demographic characteristics, current exercise behavior, and perceived benefits of exercise. These findings suggest that further research should be undertaken to explore the multi-dimensionality of barriers to health behaviors and how this may differ across various health behaviors. Furthermore, the current results suggest that global barriers, rather than practical or health-related barriers, should receive attention in motivation-oriented interventions to increase exercise intention. A better understanding of how cancer survivors' exercise barriers influence their intention to exercise and ultimately their exercise behavior has the potential to aid in the promotion of a healthy lifestyle that ultimately improves health and quality of life for these survivors.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50,* 179-211.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40,* 471–499.

Baert, V., Gorus, E., Mets, T., Geerts, C., & Bautmans, I. (2011). Motivators and barriers for physical activity in the oldest old: A systematic review. *Ageing Research Reviews, 10,* 464-474.

Bauman, A.E., Sallis, J.F., Dzewaltowski, D.A., & Owen, N. (2002). Toward a better understanding of the influences on physical activity: The role of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine, 23*(2S), 5-14.

Bellizzi, K.M, Rowland, J.H., Jeffery, D.D., & McNeel, T. (2005). Health behaviors of cancer survivors: Examining opportunities for cancer control intervention. *Journal of Clinical Onoclogy, 23*, 8884-8893.

Blanchard, C.M., Courneya, K.S., & Stein, K. (2008). Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: Results from the American Cancer Society's SCS-II. *Journal of Clinical Oncology, 26,* 2198-2204.

Blaney, J.M., Lowe-Strong, A., Rankin, J., Campbell, A., Allen, J., & Gracey, J.H. (2010). The cancer rehabilitation journey: Barriers to and facilitators of exercise among patients with cancer-related fatigue. *Physical Therapy, 90*, 1135-1148.

Blaney, J.M., Lowe-Strong, A., Rankin-Watt, J., Campbell, A., & Gracey, J.H. (2013). Cancer survivors' exercise barriers, facilitators and preferences in the context of fatigue, quality of life and physical activity participation: A questionnaire–survey. *Psycho-Oncology.* Advance online publication. doi: 10.1002/pon.2072

Brawley, L.R., Culos-Reed, S.N., Angove, J., & Hoffman-Goetz, L. (2002). Understanding the barriers to physical activity for cancer patients: Review and recommendations. *Journal of Psychosocial Oncology, 20*, 1-21.

Brawley, L.R., Martin, K.A., & Gyurcsik, N.C. (1998). Problems in assessing perceived barriers to exercise: Confusing obstacles with attributions and excuses. In Duda, J.L. *Advances in Sport and Exercise Psychology Measurement* (pp. 337-359). Morgantown, WV: Fitness Information Technology, Inc.

Courneya, K.S., & Friedenreich, C.M. (1997a). Determinants of exercise during colorectal cancer treatment: An application of the theory of planned behavior. *Oncology Nursing Forum, 24*, 1715-1723.

Courneya, K.S., & Friedenreich, C.M. (1997b). Relationship between exercise pattern across the cancer experience and current quality of life in colorectal cancer survivors. *The Journal of Alternative and Complementary Medicine, 3*, 215-226.

Courneya, K.S., & Friedenreich, C.M. (1999). Utility of the theory of planned behavior for understanding exercise during breast cancer treatment. *Psycho-Oncology, 8*, 112-122.

Courneya, K.S., Friedenreich, C.M., Arthur, K., & Bobick, T.M. (1999). Understanding exercise motivation in colorectal cancer patients: A prospective study using the theory of planned behavior. *Rehabilitation Psychology, 44*, 68-84.

Courneya, K.S., Friedenreich, C.M., Quinney, H.A., Fields, A.L.A., Jones, L.W., Vallance, J.K.H., & Fairey, A.S. (2005). A longitudinal study of exercise barriers in colorectal cancer survivors participating in a randomized controlled trial. *Annals of Behavioral Medicine, 29*, 147-153.

Courneya, K.S., Jones, L.W., Mackey, J.R., & Fairey, A.S. (2006). Exercise beliefs of Breast cancer survivors before and after participation in a randomized controlled trial. *International Journal of Behavioral Medicine, 13,* 259-264.

Courneya, K.S., McKenzie, D.C., Reid, R.D., Mackey, J.R., Gelmon, K., Friedenreich, C.M, … Segal, R.J. (2008). Barriers to supervised exercise training in a randomized controlled trial of breast cancer patients receiving chemotherapy. *Annals of Behavioral Medicine, 35*, 116-122.

Craig, C.L., Marshall, A.L., Sjostrom, M., Bauman, A.E., Booth, M.L., Ainsworth, B.E., … Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise, 35,* 1381-1395.

Demark-Wahnefried, W., Aziz, N.M., Rowland, J.H., & Pinto, B.M. (2005). Riding the crest of the teachable moment: Promoting long-term health after the diagnosis of cancer. *Journal of Clinical Oncology, 23*, 5814-5830.

Demark-Wahnefried, W., Peterson, B., McBride, C., Lipkus, I., & Clipp, E. (2000). Current health behaviors and readiness to pursue life-style changes among men and women diagnosed with early stage prostate and breast carcinomas. *Cancer, 88*, 674-684.

Fabrigar, L.R., Wegener, D.T., MacCallum, R.C., & Strahan, E.J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*, 272-299.

Garber, C.E., Blissmer, B., Deschenes, M.R., Franklin, B.A., Lamonte, M.J., Lee, I.-M., … Swain, D.P. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine & Science in Sports & Exercise, 43*, 1334-1359.

Gerend, M.A., Shepherd, M.A., & Shepherd, J.E. (2011). The multidimensional nature of perceived barriers: Global versus practical barriers to HPV vaccination. *Health Psychology.* Advance online publication. doi: 10.1037/a0026248

Glasgow, R.E. (2008). Perceived barriers to self-management and preventive behaviors. Retrieved from the National Cancer Institute website: http://dccps.cancer.gov/brp/constructs/barriers/barriers.pdf

Glasgow, R.E., Gillette, C., & Toobert, D. (2001). Psychosocial barriers to diabetes self-management and quality of life. *Diabetes Spectrum, 14*, 33-41.

Glasgow, R. E., Whitlock, E. P., Valanis, B. G., & Vogt, T. M. (2000). Barriers to mammography and Pap smear screening among women who recently had neither, one or both types of screening. *Annals of Behavioral Medicine, 22*, 223-228.

Godin, G., & Kok, G. (1996). The theory of planned behavior: A review of its applicaions to health- related behaviors. *American Journal of Health Promotion, 11,* 87–98.

Godin, G., Valois, P., Jobin, J., & Ross, A. (1991). Prediction of intention to exercise of individuals who have suffered from coronary heart disease. *Journal of Clinical Psychology, 47*, 762-772.

Holick, C. N., Newcomb, P. A., Trentham-Dietz, A., Titus-Ernstoff, L., Bersch, A. J., Stampfer, M. J., … Willett, W.C. (2008). Physical activity and survival after diagnosis of invasive breast cancer. *Cancer Epidemiology, Biomarkers & Prevention*, *17*, 379-386.

Holmes, M.D., Chen, W.Y., Feshanich, D., Kroenke, C.H., & Colditz, G.A. (2005). Physical activity and survival after breast cancer diagnosis. *JAMA, 293,* 2479–2486.

Howlader, N., Noone, A.M., Krapcho, M., Neyman, N., Aminou, R., Waldron, W., … Edwards, B.K. (Eds). *SEER cancer statistics review, 1975-2008.* Retrieved from National Cancer Institute website: http://seer.cancer.gov/csr/1975_2008/

IPAQ Research Committee. (2005). Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ): Short and long forms. Retrieved from http://www.ipaq.ki.se/scoring.pdf

Katz, J.N., Chang, L.C., Sangha, O., Fossel, A.H., & Bates, D.W. (1996). Can comorbidity be measured by questionnaire rather than medical record review? *Medical Care, 34*, 73-84.

Korkiakangas, E.E., Alahuhta, M.A., & Laitinen, J.H. (2009). Barriers to regular exercise among adults at high risk or diagnosed with type 2 diabetes: A systematic review. *Health Promotion International, 24*, 416-427.

Leddy, S. K. (1997). Incentives and barriers to exercise in women with a history of breast cancer. *Oncology Nursing Forum*, *24*, 885-890.

Lox, C.L., Martin, K.A., & Petruzzello, S.J. (2003). *The psychology of exercise: Integrating theory and practice.* Scottsdale, AZ: Holcomb Hathaway Publishers.

Lynch, B.M., Owen, N., Hawkes, A.L., & Aitken, J.F. (2010). Perceived barriers to physical activity for colorectal cancer survivors. *Supportive Care in Cancer, 18*, 729-734.

MacCallum, R.C., Widaman, K.F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods, 4*, 84-99.

Maddocks, M., Mockett, S., & Wilcock, A. (2009). Is exercise an acceptable and practical therapy for people with or cured of cancer? A systematic review. *Cancer Treatment Reviews, 35*, 383-390.

Meyerhardt, J. A., Giovannucci, E. L., Holmes, M. D., Chan, A. T., Chan, J. A., Colditz, G. A., & Fuchs, C. S. (2006). Physical activity and survival after colorectal cancer diagnosis. *Journal of Clinical Oncology*, *24*, 3527-3534.

Meyerhardt, J. A., Heseltine, D., Niedzwiecki, D., Hollis, D., Saltz, L. B., Mayer, R. J., … Fuchs, C.S. (2006). Impact of physical activity on cancer recurrence and survival in patients with stage III colon cancer: Findings from CALGB 89803. *Journal of Clinical Oncology*, *24*, 3535-3541

Milne, S., Orbell, S. and Sheeran, P. (2002), Combining motivational and volitional interventions to promote exercise participation: Protection motivation theory and implementation intentions. *British Journal of Health Psychology, 7*, 163–184.

Milne, H. M., Wallman, K. E., Guilfoyle, A., Gordon, S., & Corneya, K. S. (2008). Self-determination theory and physical activity among breast cancer survivors. *Journal of Sport & Exercise Psychology*, *30*, 23-38.

National Cancer Institute. (2012). Survivorship. In *National Cancer Institute: Dictionary of cancer terms.* Retrieved from http://www.cancer.gov/dictionary?cdrid=445089

Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological Bulletin, 133,* 673– 693.

Resnick, B., Zimmerman, S.I., Orwig, D., Furstenberg, A.-L., & Magaziner, J. (2000). Outcome expectations for exercise scale: Utility and psychometrics. *Journal of Gerontology: SOCIAL SCIENCES, 55B*, S352-S356.

Rhodes, R.E., & Courneya, K.S. (2003). Investigating multiple components of attitude, subjective norm, and perceived control: An examination of the theory of planned behaviour in the exercise domain. *British Journal of Social Psychology, 42,* 129-146.

Rogers, L.Q., Courneya, K.S., Shah, P., Dunnington, G., & Hopkins-Price, P. (2007). Exercise stage of change, barriers, expectations, values and preferences among breast cancer patients during treatment: A pilot study. *European Journal of Cancer Care, 16*, 55-66.

Sallis, J.F., & Saelens, B.E. (2000). Assessment of physical activity by self-report: Status, limitations, and future directions. *Research Quarterly for Exercise and Sport, 71*, 1-14.

Schmitz, K.H., Courneya, K.S., Matthews, C., Demark-Wahnefried, W., Galvao, D.A., Pinto, B.M., … Schwartz, A.L. (2010). American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. *Medicine & Science in Sports & Exercise 42*, 1409-1426.

Sheeran, P. (2002). Intention-behavior relations: A conceptual and empirical review. *European Review of Social Psychology, 12,* 1–36.

Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological Review, 110,* 403-421.

Whitehead, S., & Lavelle, K. (2009). Older breast cancer survivors' views and preferences for physical activity. *Qualitative Health Research, 19*, 894-906.

Winters-Stone, K.M., Schwartz, A., & Nail, L.M. (2010). A review of exercise interventions to improve bone health in adult cancer survivors. *Journal of Cancer Survivorship, 4*, 187-201.

Appendices

Appendix A: Demographics Questionnaire

1. Today's date: ☐☐/ ☐☐ /☐☐ (month/day/year)

2. Birth date: ☐☐ / ☐☐/ ☐☐ (month/day/year)

3. Ethnic group (check one):

☐ Hispanic/Spanish/Latino ☐ Not Hispanic/Spanish/Latino

4. Racial Background:

☐ American Indian or Alaskan Native ☐ Native Hawaiian/Pacific Islander
☐ Asian ☐ White
☐ Black or African American
☐ Other (specify_____)

5. Marital status (check one):

☐ Never married ☐ Divorced
☐ Currently married ☐ Widowed
☐ Separated

6. Level of school completed (check one)

☐ Less than 7th grade ☐ Partial college or specialized training
☐ Junior high school (7th, 8th & 9th grade) ☐ College or university graduate
☐ Partial high school (10th or 11th grade) ☐ Graduate professional training
☐ High School graduate (graduate degree)

Appendix A (Continued)

7. Current employment situation (check the one box that applies the most):

A. WORKING	☐ Full time at job
	☐ Part time at job
B. ON LEAVE	☐ On leave with pay
	☐ On leave without pay
C. NOT EMPLOYED	☐ Disabled
	☐ Seeking work
	☐ Retired
	☐ Homemaker
	☐ Student

8. Which category best describes your usual occupation? If you are not currently employed, which category best describes your LAST job? (check one):

☐ Professional (e.g., teachers/professors, nurses, lawyers, physicians, & engineers)
☐ Manager/Administrator (e.g., sales managers)
☐ Clerical (e.g., secretaries, clerks, or mail carriers)
☐ Sales (e.g., sales persons, agents, or brokers)
☐ Service (e.g., police, cooks, waiters, or hairdressers)
☐ Skilled Crafts, Repairer (e.g., carpenters)
☐ Equipment or Vehicle Operator (e.g., truck drivers)
☐ Laborer (e.g., maintenance or factory workers)
☐ Farmer (e.g., owners, managers, operators, or tenants)
☐ Member of the military
☐ Homeworker (with no job outside the home)
☐ Other (please describe) _____

9. Approximate annual gross income for your **household**: (check one)
(Remember all information you provide will remain completely confidential)

☐ Less than $ 10,000	☐ $40,000 - $59,999	☐ Prefer not to answer
☐ $10,000 - $19,999	☐ $60,000 - $100,000	
☐ $20,000 - $ 39,999	☐ Greater than $100,000	

Appendix A (Continued)

10. What is your height?

☐ feet ☐ inches

11. What is your weight?

☐☐☐ pounds

12. (For women only) Have you had a menstrual period within the past 12 months?

☐ NO ☐ Don't know
☐ YES

Appendix B: Charlson Comorbidity Index

1. Have you ever had a heart attack? …… No ☐ Yes ☐

2. Have you ever been treated for heart failure? (You may have been short of breath and the doctor may have told you that you had fluid in your lungs or that your heart was not pumping well.) …… No ☐ Yes ☐

3. Have you had an operation to unclog or bypass the arteries in your legs? No ☐ Yes ☐

4. Have you had a stroke, cerebrovascular accident, blood clot or bleeding in the brain, or transient ischemic attack (TIA)? …… No ☐ Yes ☐

   4a. **IF YES**, Do you have difficulty moving an arm or leg as a result of the stroke or cerebrovascular accident? ……...No ☐ Yes ☐

5. Do you have asthma? ……..No ☐ Yes ☐

   5a. **IF YES**, do you take medicines for your asthma?
   - ☐ No
   - ☐ Yes, only with flare-ups
   - ☐ Yes, I take medicines regularly, even when I'm not having an attack

6. Do you have emphysema, chronic bronchitis, or chronic obstructive lung disease?
   No ☐ Yes ☐

   6a. **IF YES**, do you take medicines for your lung disease?
   - ☐ No
   - ☐ Yes, only with flare-ups
   - ☐ Yes, I take medicines regularly, even when I'm not having an attack

7. Do you have stomach ulcers, or peptic ulcer disease?

   7a. **IF YES**, has this condition been diagnosed by endoscopy (where a doctor looks into your stomach through a scope) or an upper GI or barium swallow study (where you swallow chalky dye and then xrays are taken)? …… No ☐ Yes ☐

Appendix B (Continued)

8. Do you have diabetes (high blood sugar)?

☐ No
☐ Yes, treated by modifying my diet
☐ Yes, treated by medications taken by mouth
☐ Yes, treated by insulin injections

8a. **IF YES,** Has the diabetes caused problems with your kidneys? … No ☐ Yes ☐

8b. **IF YES,** Has the diabetes caused problems with your eyes, treated by an ophthalmologist? …… No ☐ Yes ☐

9. Have you ever had the following problems with your kidneys?

Poor kidney function (blood tests show high creatinine) …… No ☐ Yes ☐

Have used hemodialysis or peritoneal dialysis …… No ☐ Yes ☐

Have received kidney transplantation …… No ☐ Yes ☐

10. Do you have rheumatoid arthritis? …… No ☐ Yes ☐

10a. **IF YES,** Do you take medications for it regularly? …… No ☐ Yes ☐

11. Do you have lupus (systemic lupus erythematosus)? …… No ☐ Yes ☐

12. Do you have polymalgia rheumatica? …… No ☐ Yes ☐

13. Do you have any of the following conditions?

Alzheimer's Disease, or another form of dementia …… No ☐ Yes ☐

Cirrhosis, or serious liver damage …… No ☐ Yes ☐

Leukemia or polycythemia vera …… No ☐ Yes ☐

Lymphoma …… No ☐ Yes ☐

AIDS ……No ☐ Yes ☐

14. Have you had a hip or knee replacement surgery? …… No ☐ Yes ☐

14 a. **IF YES**, How long has it been since your surgery took place? ☐☐ years

Appendix C: International Physical Activity Questionnaire

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

Appendix C (Continued)

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Appendix D: Exercise Intention Measure

The following are statements about your plans to exercise. Exercise can be defined as physical activity lasting for 10 minutes or more that makes your heart beat considerably faster than normal. Activities such as brisk walking, swimming laps in the pool, dancing, playing tennis, and riding a bike are considered to be exercise. Activities such as housework, gardening, and playing golf are <u>not</u> considered to be exercise.

1. On average during the next two months, my goal is to exercise the following number of days per week……

☐	☐	☐	☐	☐	☐	☐	☐
0	1	2	3	4	5	6	7

2. On average during the next two months, I intend to exercise at least every other day……

☐	☐	☐	☐	☐	☐	☐
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Nor Disagree	Slightly Agree	Agree	Strongly Agree

Appendix E: Outcome Expectations for Exercise Scale

The following are statements about the benefits of exercising, which can be defined as physical activity lasting for 10 minutes or more that makes your heart beat considerably faster than normal. Activities such as brisk walking, swimming laps in the pool, dancing, playing tennis, and riding a bike are considered to be exercise. Activities such as housework, gardening, and playing golf are not considered to be exercise.

For each item below, please check the box that best describes how you feel about the benefits of exercise.

Exercise.....

1. Makes me feel better physically

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

2. Makes my mood better in general

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

3. Helps me feel less tired

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

4. Makes my muscles stronger

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

5. Is an activity I enjoy doing

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

6. Gives me a sense of personal accomplishment

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

Appendix E (Continued)

Exercise…..

7. Makes me more alert mentally

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

8. Improves my endurance in performing my daily activities

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

9. Helps to strengthen my bones

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

10. Reduces my risk of cancer recurrence

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

11. Improves the functioning of my immune system

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

12. Helps get my mind off cancer

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

13. Makes me feel more like I am living a normal lifestyle

Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

Appendix F: Health Behaviors Questionnaire

1. During your lifetime, have you smoked at least 100 cigarettes (5 packs or more)?

NO ☐ YES ☐

IF YES:

a). How many cigarettes do/did you typically smoke each day?

☐☐☐ (# cigarettes)

b). Have you smoked in the past month:

Yes, approximately ☐☐☐ cigarettes per day

No, I quit about ☐☐ years **OR** ☐☐ months ago

c). How many years in total have you smoked, or if you have quit, how many years did you smoke?

☐☐ (Number of years)

2. Have you had any alcoholic drinks in the past month?

NO ☐ YES ☐

IF YES:

a). Which of the following best describes the number of alcoholic drinks you had in the past month? (check one)

☐ 1-3 times a month
☐ 1-3 times a week
☐ 4-6 times a week
☐ 1 time a day
☐ 2 times a day
☐ 3 or more times a day

3. In general, how healthy is your overall diet? Would you say it is....

☐ Excellent
☐ Very good
☐ Good
☐ Fair
☐ Poor
☐ Don't know

Appendix G: Cancer Survivors' Perceived Exercise Barriers Scale

Definition of Exercise:
For the purpose of completing the following items, exercise can be defined as physical activity lasting for 10 minutes or more that makes your heart beat considerably faster than normal. Activities such as brisk walking, swimming laps in the pool, dancing, playing tennis, and riding a bike are considered to be exercise. Activities such as housework, gardening, and playing golf are not considered to be exercise.

Instructions:
Please indicate the extent to which you agree or disagree that each item could keep you from exercising during the next two months. If you have not experienced an item (e.g., cancer-related pain), please consider whether it might become a problem for you in the next two months and answer accordingly.

		In the next two months, I expect this barrier to impact my exercise….			
		Not at all	**A little**	**Some**	**A lot**
1.	Lack of convenient facilities	☐	☐	☐	☐
2.	Fear of injury	☐	☐	☐	☐
3.	Exercise not enjoyable	☐	☐	☐	☐
4.	Cancer-related pain	☐	☐	☐	☐
5.	Doctor's recommendation not to exercise	☐	☐	☐	☐
6.	Embarrassment	☐	☐	☐	☐
7.	Cancer-related joint stiffness	☐	☐	☐	☐
8.	Unpleasant sensations or symptoms caused by exercise	☐	☐	☐	☐
9.	No instructor to guide me	☐	☐	☐	☐
10.	Cancer-related weakness	☐	☐	☐	☐
11.	Fear of making cancer-related symptoms worse	☐	☐	☐	☐
12.	Lack of support from others	☐	☐	☐	☐
13.	Cancer-related numbness or tingling	☐	☐	☐	☐

Appendix G (Continued)

		In the next two months, I expect this barrier to impact my exercise….			
		Not at all	A little	Some	A lot
14.	Exercise not important to me	☐	☐	☐	☐
15.	Weather conditions	☐	☐	☐	☐
16.	Cancer-related nausea	☐	☐	☐	☐
17.	Do not know how to exercise	☐	☐	☐	☐
18.	Lack of interest	☐	☐	☐	☐
19.	Transportation problems	☐	☐	☐	☐
20.	Other cancer-related symptoms or treatment side effects	☐	☐	☐	☐
21.	Other health problems besides cancer	☐	☐	☐	☐
22.	Lack of equipment or proper clothing	☐	☐	☐	☐
23.	Fear of making other health problems worse	☐	☐	☐	☐
24.	Financial cost/fees	☐	☐	☐	☐
25.	Lack of doctor's permission	☐	☐	☐	☐
26.	Other preferences for leisure activities	☐	☐	☐	☐
27.	No one to exercise with	☐	☐	☐	☐
28.	Fatigue	☐	☐	☐	☐
29.	Lack of time	☐	☐	☐	☐
30.	Having been diagnosed with cancer	☐	☐	☐	☐

Appendix G (Continued)

		In the next two months, I expect this barrier to impact my exercise….			
		Not at all	**A little**	**Some**	**A lot**
31.	No safe place to exercise	☐	☐	☐	☐
32.	Lack of motivation	☐	☐	☐	☐
33.	Social or family responsibilities	☐	☐	☐	☐
34.	Do not see the need to exercise	☐	☐	☐	☐