PHYSICAL ACTIVITY AMONG CANCER SURVIVORS REFERRED FOR EXERCISE TRAINING – A LONGITUDINAL EVALUATION

APPROVED BY SUPERVISORY COMMITTEE

Heidi Hamann, Ph.D., M.S.

Chad Rethorst, Ph.D.

Martin Deschner, Ph.D.

Melissa Roop, Ph.D.

Julie Germann, Ph.D.

DEDICATION

To my parents

PHYSICAL ACTIVITY AMONG CANCER SURVIVORS REFERRED FOR EXERCISE TRAINING – A LONGITUDINAL EVALUATION

by

CASSIDY ALLYN CISNEROS

DISSERTATION

Presented to the Faculty of the Graduate School of Biomedical Sciences

The University of Texas Southwestern Medical Center at Dallas

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

The University of Texas Southwestern Medical Center at Dallas

Dallas, Texas

August, 2015

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to Dr. Heidi Hamann, my committee chair, mentor and supervisor, for her expertise, guidance and sustained encouragement throughout my graduate career. The completion of this dissertation would not have been possible without her incredible patience and support. In addition I would like to thank my committee members, Dr. Chad Rethorst, Dr. Martin Deschner, Dr. Julie Germann, and Dr. Melissa Roop, whose time, support, and insight were invaluable. I would also like to thank Dr. Richard Robinson for his commitment to seeing me succeed and offering additional assistance and encouragement when most needed.

I am appreciative for the assistance of Dr. Hong Zhu who helped me to navigate difficult statistical decisions. I wish to thank Dr. Joanne Sanders who provided vital assistance with data access. Additionally, I greatly appreciate the staff at Moncrief Cancer Institute, including Dr. Keith Argenbright, Paula Anderson, Bonnie Rose, Emily Berry, and Sharon Wolff. Additionally, I would like to acknowledge all the cancer survivors who participated in this program and make this research possible.

I want to thank my parents to whom this dissertation is dedicated. Your generosity and support has been more than I can fully realize. Your core values, the importance of education and an undying work ethic have been invaluable in

completing my education. Thank you for encouraging me in all of my pursuits and inspiring me to follow my dreams. To my sisters, Sonya and Tara, for always believing in me and providing inspiration and strength when most needed. I cannot thank you enough and am truly blessed.

Finally and most importantly, I wish to thank my fiancé Davidson Liland for his patience, love, and unwavering support as I pursued my dream. I am forever grateful.

PHYSICAL ACTIVITY AMONG CANCER SURVIVORS REFERRED FOR EXERCISE TRAINING – A LONGITUDINAL EVALUATION

CASSIDY ALLYN CISNEROS, Ph.D.

The University of Texas Southwestern Medical Center at Dallas, 2015

HEIDI A. HAMANN, Ph.D., M.S.

Background: Physical activity (PA) is a crucial component of cancer survivorship care, but the majority of cancer survivors do not meet National Comprehensive Cancer Network (NCCN) guidelines for weekly activity levels. Supervised exercise training is a growing component of clinical survivorship programs, but little is known about their long-term effects. *Objective:* The primary aim of this study was to examine longitudinal changes (up to 12-months)

in self-reported physical activity among cancer survivors enrolled in a community survivorship program and referred for exercise training. A second aim focused on evaluating whether quality of life and session attendance were predictive of these changes, and a third aim identified demographic and clinical predictors of exercise program attendance. *Method:* Participants included 158 cancer survivors referred supervised exercise training through the Fort Worth Program for Community Survivorship at the University of Texas Southwestern Moncrief Cancer Institute. Self-reported physical activity was measured by the International Physical Activity Questionnaire-Short Form (IPAQ-SF), with data gathered at Baseline, plus 3-, 6- and 12-months post-referral. *Analysis:* Data related to study aims were analyzed using generalized estimating equations (GEE). *Results:* Significant increases in self-reported physical activity were noted for participants over the 12-month analysis period; increases were noted at each post-baseline assessment. Participants who had normal BMI at baseline, were married, and had more education reported consistently greater physical activity across timepoints. Baseline global quality of life and exercise session attendance were also positively associated with consistently greater physical activity across timepoints. Emotional well-being at baseline and history of secondary cancer or cancer recurrence were both significant predictors of attending at least 12 exercise sessions. *Discussion:* Results indicate that in general, the cancer survivorship program was effective in promoting physical activity. A pattern of sustained

improvement suggests that even though most participants completed their exercise sessions early in the study period, benefits of the training remained for months afterward. Whether benefits are sustainable in less resource-rich settings and with less intensive exercise interventions should be further explored.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF DEFINITIONS

PA – Physical activity

ACSM – American College of Sports Medicine

QOL – Quality of life

IPAQ-SF – International Physical Activity Questionnaire-Short Form

CHQ – Confidential Health Questionnaire

FACT-G – Functional Assessment of Cancer Therapy-General

CPRIT – Cancer Prevention Research Institute of Texas

ACS – American Cancer Society

EMR – Electronic Medical Record

MET – Metabolic Equivalent Task

NHIS – National Health Interview Survey

IOM – Institute of Medicine

KPS – Karnofsky Performance Status

GLM – Generalized Linear Models

GEE – Generalized Estimating Equations

MCI – Moncrief Cancer Institute

UTSW – University of Texas Southwestern Medical Center

NCCN – National Comprehensive Cancer Network

NCCS – National Coalition for Cancer Survivorship

NCI – National Cancer Institute

OCS – Office of Cancer Survivorship

ProComS – Fort Worth Program for Community Survivorship

PAG – Physical Activity Guidelines

CHAPTER ONE

Introduction

STATEMENT OF THE PROBLEM

For the over 14 million cancer survivors in the United States, physical activity (PA) is a crucial component of survivorship self-care. In multiple intervention trials, PA has been associated with improvements in physical functioning (e.g., anthropometric measures, biomarkers) and psychosocial adjustment (e.g., quality of life, mood) for cancer survivors (e.g., Speck, Courneya, Masse, Duval, & Schmitz, 2010). Observational studies have noted that PA after cancer diagnosis is associated with reduced risk of cancer recurrence and improved overall mortality among cancer survivors (e.g., Holmes, Chen, Feskanich, Kroenke, & Colditz, 2005; Meyerhardt et al., 2006). In response to these findings, numerous national organizations, including the National Comprehensive Cancer Network (NCCN), American College of Sports Medicine (ACSM), and American Cancer Society (ACS), recently noted that physical activity is generally safe for cancer survivors. The ACSM recommends a minimum of 75 minutes of vigorous-intensity activity or 150 minutes of moderate-intensity activity per week (Rock et al., 2012), consistent with the US Department of Health and Human Services 2008 Physical Activity Guidelines

(PAG) for Americans (US Department of Health and Human Services, 2008). Although much of the research on PA and cancer survivorship is in its early stages, PA has well-established benefits for the general population (e.g., preventing diseases such as diabetes, cardiovascular disease, and osteoporosis). Indeed, the beneficial effects of PA are especially relevant to cancer survivors due to the increased risk of comorbid medical conditions after a cancer diagnosis, in addition to the many side effects from cancer and its treatment.

Despite the significant, empirically supported benefits of PA, most cancer survivors (70%) do not meet NCCN guidelines for weekly activity levels, and engage in less PA than the general population (51% not meeting aerobic guidelines) (Bellizzi, Rowland, Jeffery, & McNeel, 2005; Coups & Ostroff, 2005; National Comprehensive Cancer Network, 2015; Schiller, Ward, Freeman, & Clarke, 2014). Not only are a large number of cancer survivors not meeting current PA guidelines, research demonstrates that PA levels decline substantially after cancer treatment completion and fail to return to pre-diagnosis levels for many cancer survivors (Daley, Crank, Mutrie, Saxton, & Coleman, 2007). In response to these needs, supervised exercise training is a growing component of cancer survivorship programming (Giovannucci, 2012; Oeffinger et al., 2013; McCabe, Faithfull, Makin, & Wengstrom, 2013). Program components often include specialized assessment, exercise training, and follow-up for cancer survivors with ultimate goals of increasing long-term physical activity levels

(Kampshoff et al., 2014; Broderick et al., 2013; Bourke et al., 2013; Cheifetz et al., 2014; Courneya et al., 2014).

Although data from well-controlled clinical trials are promising in determining the efficacy of exercise training for cancer survivors, little is known about the outcomes (especially longer-term outcomes) and their correlates of exercise training for cancer survivors in the clinical setting. Thus, there is a strong need to address this gap in pragmatic research to determine "effectiveness" (i.e., understanding how empirically supported interventions work in uncontrolled, often clinical settings; Phillips, Alfano, Perna, & Glasgow, 2014). Furthermore, there are needs to understand barriers and facilitators of exercise adherence and maintenance for cancer survivors in these real world clinical and community settings. The proposed analysis fills these gaps by examining the relationship between a 12-session supervised exercise training program and sustained self-reported PA among cancer survivors enrolled in a community survivorship program. As part of this analysis, we examined the impact of both utilization (i.e., session attendance) and psychosocial factors (e.g., quality of life) on longitudinal (up through 12 months post-enrollment) PA outcomes. A secondary aim focused on identifying predictors of session attendance.

Results of this study provide important insight into longitudinal PA patterns of cancer survivors referred for supervised exercise training as part of a

clinical, community-based program. It also helps us understand factors that may be important in facilitating exercise session attendance for cancer survivors.

CHAPTER TWO

Review of the Literature

CANCER SURVIVORSHIP AND PHYSICAL ACTIVITY

Overview of Cancer Survivorship

Advances in early detection, diagnosis and treatment have increased the number of cancer survivors living in the United States to over 14 million individuals. Estimates suggest the trajectory of survivorship will continue to grow rapidly, with the number of cancer survivors increasing by 31%, to almost 19 million, by 2024 (DeSantis et al., 2014). This large growth in the number of cancer survivors underscores the urgency to better understand and address their unique needs, which historically have been poorly understood and often unmet (Forsythe et al., 2013). Most national oncology organizations (e.g., National Cancer Institute; National Comprehensive Cancer Network; National Coalition for Cancer Survivorship) define the "survivorship" period from the time of initial diagnosis through the end of life. While this definition highlights the need for providers to proactively consider the impact of cancer and its treatment, it encompasses a diverse range of treatment and post-treatment experiences and trajectories. In response, many have suggested to address cancer survivorship within three distinct phases: 1) diagnosis/active treatment; 2) post-treatment

transition; 3) long-term survivorship (Mullan, 1985). Within this study, we discuss survivorship issues primarily within the second and third phases, with our study population also encompassing these post-treatment periods.

Late- and long-term effects during survivorship

In 2005, an influential report from the Institute of Medicine (IOM) highlighted the prevalence and impact of both late- (problems occurring months or years after completion of initial cancer treatment) and long-term (health problems identified during active treatment that sustain into the post-treatment survivorship period) effects for cancer survivors (Hewitt, Greenfield, & Stovall, 2005). In addition to increased risk of recurrence and secondary cancers, survivors often face a wide range of physical and psychological problems, including fatigue, decreased muscle mass, weight gain/loss (depending on cancer type and its treatment), sexual dysfunction, impaired sleep, and increased risk of cardiac symptoms secondary to chemotherapy induced cardiotoxicity. Psychosocial late- and long-term effects are also common, with significant reports of adjustment problems, post-traumatic stress, anxiety, fear of recurrence, depression, negative body image and low self-esteem, chronic pain, as well as cognitive dysfunction. Such late- and long-term effects may result in significant impairment of functional health and quality of life (QOL) for survivors (Beckjord

et al., 2014). Indeed, according to data from the National Health Interview Survey (NHIS), approximately one in four cancer survivors has decreased QOL due to physical problems and one in 10 due to emotional problems (American Cancer Society, 2014; Weaver et al., 2012).

Given the far-reaching effects of these physical and psychological challenges, there has been an increasing focus on interventions to alleviate or prevent these late- and long-term effects. This shift from disease-focused to comprehensive care for the *whole patient* has afforded health care providers a unique opportunity to improve the trajectory of cancer survivorship by promoting health behavior change (Adler & Page, 2008). Of note are non-pharmacological interventions to modify lifestyle and behavioral factors among survivors in an effort to improve quality of life and reduce the burden associated with physical and psychological late- and long-term effects. Many of the most researched interventions aim to promote *physical activity* (PA; broadly defined as increasing frequency of non-sedentary movement, although specific interventions may also focus on increasing movement intensity, strength, and/or flexibility). Buoyed by the vast evidence of PA benefits within the general population and other disease domains, the focus on documenting PA's benefits and increasing PA for cancer survivors has gained traction in recent years (Courneya, 2014). The sections below describe PA needs of cancer survivors, along with the observational and

interventional evidence to support greater PA in this population.

Overview of Physical Activity

Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. In contrast, the term "exercise" refers to a subcategory of physical activity that is planned, structured, repetitive and aims to improve or maintain physical fitness, performance or health (Caspersen, Powell, & Christenson, 1985). Current guidelines from the Centers for Disease Control and Prevention (CDC, 2010) focus on aerobic and muscle-strengthening activities to improve health outcomes. Specifically, adults (18-64) need to engage in at least 150 minutes of moderate- intensity or 75 minutes of vigorous-intensity or an equivalent mix of moderate- and vigorous-intensity aerobic activity each week and muscle-strengthening activities on 2 or more days a week. Older adults (age 65 or older) who are generally fit and have no limiting health conditions are also advised to follow these guidelines. Regular and adequate levels of PA are associated with numerous health benefits, including lower rates of cardiovascular disease, Type II diabetes, depression, and certain cancers (Warburton, Nicol, & Bredin, 2006; Rock et al., 2012). Adequate PA is also associated with less functional impairment, including better range of flexibility, reduced joint pain, and better performance of activities of daily living

(Loprinzi & Lee, 2014). Although some mechanistic aspects of PA are still unknown, it is understood that health benefits are partly mediated through maintenance of energy balance and weight control, with other direct effects related to associated immune system enhancement, lipid regulation, and additional biochemical changes (Ballard-Barbash et al., 2012; Eickmeyer, Gamble, Shahpar, & Do, 2012; Jones & Alfano, 2013; McTieran, 2008).

Physical Activity and Cancer Survivorship

Although the benefits of PA have been clearly documented in the general population, it is only within the last two decades that the role of PA in cancer survivorship has been understood. Historically, clinicians advised cancer patients and survivors to rest and avoid physical activity, based on the assumption that too much activity would be detrimental to treatment and survivorship outcomes (Jones & Alfano, 2013). This stance started to change with the publication of large-sale epidemiological studies that documented better health outcomes in cancer survivors who maintained adequate levels (i.e., 150 minutes moderate-intensity or 75 minutes vigorous-intensity activity per week) of PA. For example, the Health, Eating, Activity and Lifestyle (HEAL) study was a prospective, observational study investigating the association between pre- and post-diagnosis PA and mortality among breast cancer survivors. The study included 933 women

who were followed 5-8 years from breast cancer diagnosis. Results indicated that compared to women who were inactive pre- and post-diagnosis, those who increased physical activity post-diagnosis had a 45% lower risk of death (95% CI = 0.22 – 1.38). Furthermore, women who decreased physical activity post-diagnosis were at a four times greater risk of death (95% CI = 1.45-10.50; Irwin et al., 2008). Other evidence began to emerge that despite conventional wisdom, PA is generally safe and well tolerated for a diverse group of cancer survivors, even those with significant post-treatment side effects (e.g., lymphedema; Schmitz et al., 2010; Wolin, Schwartz, Matthews, Courneya, & Schmitz, 2012; Speck et al., 2010). For example, the Physical Activity and Lymphedema Trial (PAL) showed that strength training was safe for breast cancer survivors at risk of developing lymphedema as well as those with a diagnosis of lymphedema (Schmitz et al., 2009). These findings have been instrumental in advancing the promotion of exercise and PA in cancer survivors, as it challenged previous advice that women should avoid exercising the arm based on fears of causing or exacerbating lymphedema.

Based on this increasing evidence of the importance of PA in survivorship, the American College of Sports Medicine (ACSM) organized a 2009 roundtable on exercise in cancer survivors. This roundtable concluded that PA was generally safe for cancer survivors, with some indication of survivor-specific considerations based on cancer type and late- and long-term effects (Schmitz et al., 2010). Also

produced from the roundtable were evidence-based guidelines for PA in cancer survivors: at least 150 min/week of moderate-intensity activity or 75-min/ week of vigorous-intensity activity (or an equivalent combination) to gain substantial health benefits. Guidelines also recommend that cancer survivors aim for two to three sessions per week of strength training that include major muscle groups, in addition to stretching major muscle groups on days exercises are performed. Recent endorsements by the American Cancer Society (ACS) and the National Comprehensive Cancer Network (NCCN) have solidified these PA recommendations for cancer survivors.

Based on this emerging epidemiological and safety data, a number of well-controlled interventional trials have focused on increasing PA among cancer survivors. Such trials are needed, as recent evidence suggests that the majority (70%) of cancer survivors do not meet recommended guidelines for weekly activity levels (Bellizzi, et al., 2005; Coups & Ostroff, 2005). Indeed, it is estimated that only 10% of cancer patients will engage in physical activity during treatment and only 20-30% will be active after treatment (Courneya, Karvinen, & Vallance, 2007; Pinto & Ciccolo, 2011). Research suggests that for many cancer survivors, PA levels decline substantially after cancer treatment completion and fail to return to pre-diagnosis levels (Daley et al., 2007). For example, the Health, Eating, Activity and Lifestyle (HEAL) study indicated that on average, breast cancer survivors decreased their total activity by approximately 2 hours per week

from pre-diagnosis to post-diagnosis (Irwin et al., 2008). Moreover, a recent analysis from the Women's Health Initiative (WHI) demonstrated that post-diagnosis physical activity levels decreased among 25% of women with breast cancer, were unchanged in 35%, and increased in 40% over a maximum of 6 years of follow-up (Irwin et al., 2011). Even long-term survivorship has been associated with PA decreases; Mason et al. (2013) followed a multi-ethnic cohort of breast cancer survivors and noted a substantial drop in mean aerobic recreational physical activity levels between 5 and 10 years post-diagnosis.

Physical Activity Interventions for Cancer Survivors

To address these significant needs of cancer survivors, a number of randomized controlled trials (RCTs) have aimed to increase PA and improve physical and psychosocial outcomes for cancer survivors. For example, in a RCT with early stage breast cancer survivors, Mutrie et al. (2012) reported both short (6-month) and long-term (18-60 month) psychosocial and functional benefits for women participating in a supervised 12-week exercise program. Specifically, women in the intervention group reported more leisure time PA in addition to more positive mood compared to the control group. A recent review and meta-analysis of such studies by Garcia and Thomson (2014) concluded that for cancer survivors physical activity is positively associated with improvements in

physiological outcomes (e.g., weight management, cardiorespiratory fitness, muscular strength and endurance) and psychosocial factors such as quality of life and fatigue. Moreover, Craft, Vaniterson, Helenowski, Rademaker, and Courneya (2012) conducted a meta-analysis and review of the effects of exercise on depressive symptoms in cancer survivors, which indicated exercise is positively associated with reduced pain and fatigue with modest effects on depression across cancer types.

In summary, PA is a crucial component of cancer survivorship care, and multiple well-designed trials have demonstrated that PA interventions are efficacious (i.e., shown to be beneficial) in improving physical and psychosocial outcomes. However, there is a critical a need for dissemination and implementation of PA interventions within community oncology settings and research on intervention effectiveness (i.e., performance of an intervention in real life settings) in these non-controlled domains. Indeed, randomized controlled trials are by design, time and resource intensive and often hold constant individual and contextual factors that influence real-world intervention uptake and sustainability (White, McAuley, Estabrooks, & Courneya, 2009). Understanding the delivery, uptake, and outcomes of PA interventions in community settings allows for more generalizable and disseminable information to implement PA interventions.

Data on effectiveness of PA interventions for cancer survivors are generally sparse with only a handful of reports addressing community-based programs. Cheifetz et al. (2014) reported results of a 12-week supervised, community-based exercise and education program within a multisite setting, developed in collaboration with a university, acute care hospital, and not-for-profit YMCA facility. The study included 115 adult cancer survivors residing in the community and considered to be 'well' (i.e., cancer survivors living at home, ambulating independently with no acute medical conditions, and able to pass pre-exercise safety screening). Results indicated significant improvements in aerobic fitness after both 6 and 12 weeks of exercise training. Reports such as this point to the potential effectiveness of exercise programs, but many questions remain about the optimal implementation, impact of demographic and psychosocial factors, and long-term outcomes of such programs.

CHAPTER THREE

RATIONALE, AIMS, AND HYPOTHESES

Rationale

Although data from well-controlled clinical trials is promising in determining the efficacy of exercise training for cancer survivors, little is known about the effects (especially longer-term outcomes) and their correlates of supervised exercise training for cancer survivors in the community setting. There is a strong need to address this gap in pragmatic research to determine effectiveness (i.e., understanding how empirically supported interventions work in uncontrolled, often clinical settings; Phillips et al., 2014).

The current analysis fills this gap by examining the relationship between brief supervised exercise training and long-term, sustained PA among cancer survivors enrolled in a community survivorship program and focusing on utilization and psychosocial moderators of the relationship. A secondary aim focuses on exploring participant demographic and clinical characteristics associated with adherence (defined by session attendance) to the exercise intervention. Results provide important insight into the longitudinal PA patterns of cancer survivors referred for supervised exercise training as part of a clinical program. It also helps us understand factors that may be important in maximizing

exercise session attendance for cancer survivors**.**

Aims and Hypotheses

Aim 1: Evaluate longitudinal patterns (Baseline, 3, 6, and 12 months post-enrollment) in self-reported physical activity among participants who were referred for exercise training as part of a community cancer survivorship program.

Hypothesis I: There will be a statistically significant increase in level of physical activity across timepoints among the sample.

Aim II: Examine the role of utilization (e.g., session attendance) and psychosocial (e.g., quality of life) variables in predicting longitudinal reports of physical activity among cancer survivors.

Hypothesis IIa: Session attendance will be positively associated with physical activity outcomes among the sample, in that a greater number of sessions will be associated with greater physical activity across time periods.

Hypothesis IIb: The pattern of change in physical activity will be associated with quality of life, in that participants with higher baseline quality of life will report more physical activity during the study timepoints.

Aim III: (Exploratory) Identify demographic and clinical correlates of session attendance in this cohort of cancer survivors.

CHAPTER FOUR

METHODOLOGY

ProComS

The current analysis utilizes longitudinal data from 158 participants of the Fort Worth Program for Community Survivorship (ProComS), a community-based cancer survivorship program (primarily funded through a prevention services award from the Cancer Prevention Research Institute of Texas [CPRIT]) operating at the University of Texas Southwestern (UTSW) Moncrief Cancer Institute (MCI) in Fort Worth, Texas. Participants in the current analysis were recruited during the time of CPRIT funding, from March 2011 to August 2013. While MCI is an affiliate of UTSW, ProComS was limited to survivors who lived in the Fort Worth area and had primarily been treated at community oncology clinics throughout the city. Therefore, the program can best be described as an evidence-based, community-led survivorship program that addressed the psychosocial and behavioral needs of Fort Worth cancer survivors (Argenbright, Anderson, Berry, Inman, & Hamann, 2014; Oeffinger et al., 2013).

The goals of ProComS included the delivery and assessment of evidence-based services to address the psychosocial and behavioral needs of cancer survivors. Argenbright et al. (2014) provides detailed information about program

design, participant recruitment, and approach to interventions. To summarize, adults (at least 18 years or older) with a cancer diagnosis who had completed active cancer treatment were recruited for the program from various hospitals, cancer events, and advocacy groups in the Fort Worth area, beginning in March 2011. Initially, only individuals who were between 30 days and one-year post primary cancer treatment were eligible for ProComS; however, the eligibility criteria were later extended to accommodate a notable demand from longer-term survivors. Specifically, criteria were expanded in July 2011 to permit enrollment to anyone who had been diagnosed with cancer in the 5 years following the last active treatment date and later expanded again in May 2012 to include all adult cancer survivors regardless of time since the end of active treatment.

All program participants completed an initial visit with a registered research nurse at intake. During this initial visit, participants were oriented to ProComS and the various services available. The research nurse then conducted a basic history and physical assessment (i.e., blood pressure, height, weight, and medical history review) and discussed the participants' current needs. At this session participants could also decide whether they wanted to participate in the research component that evaluated psychosocial and behavioral self-reports at baseline (intake visit), followed by 3-, 6- and 12-months post-baseline (described in more detail below). Decisions about this research component did not affect referrals or inclusion in any program services. A total of 291 cancer survivors

were initially eligible and approached for the study, and of these, 205 (70.4%) agreed to participate. Those who agreed to participate in the study signed a consent form and an Authorization for Use and Disclosure of Protected Health Information, and were then asked to complete the baseline measures focused on quality of life, psychological distress, physical activity, and dietary habits. There were no statistical differences between approached patients who declined research (non-research patients; $n = 86$) and research participants ($n = 205$) with regard to age, gender, race/ethnicity, education level, preferred language, marital status, primary cancer diagnosis, or time since diagnosis. There were significant differences in comorbidity counts, such that research participants reported higher comorbidities compared to non-research participants ($\chi^2(2) = 60.5$, $p < .001$). There were also significant differences in cancer treatment history, such that research participants were more likely to report a history of chemotherapy ($\chi^2(1) = 65.0$, $p < .001$), surgery ($\chi^2(1) = 65.2$, $p < .001$), and radiation ($\chi^2(1) = 23.1$, $p < .001$) compared to non-research participants (Table 1).

Once participants completed the intake, they were referred to program services based on mutually determined need and initial intake information. For survivors recruited during the period of CPRIT funding (the time period included in the current analysis; March 2011-August 2013), all services were free of cost with session limits on certain specialties. These program services (all delivered by specialty-trained professionals) included supervised physical activity training (the

focus of the current analysis), psychotherapy, social work, nutritional interventions, genetic counseling, financial counseling, as well as interventions for cancer pain, lymphedema, and fatigue. Specialty referral services for smoking cessation and alternative exercise modalities (e.g., tai chi, yoga) were also available.

Among the 205 consented participants, 181 (88.3%) individuals were referred to the PA intervention during the funding period (March 2011-August 2013). Reasons for non-referral (*n*=24) included staffing or time limitations. Additional reasons for non-referral may have been related to lack of interest in the exercise program, feeling already active enough, having adequate resources to engage in PA (e.g., gym membership or personal trainer), or other higher priorities (e.g., financial concerns, psychological distress, poorly controlled pain). There were no statistical differences between those who were referred (*n* = 181) v. not referred (*n* = 24) to exercise training with regard to age, marital status, comorbidity counts, primary cancer diagnosis, time since diagnosis, or cancer treatment history (chemotherapy, radiation, surgery). Cell sizes (n<5) did not allow statistical testing of other demographic and clinical factors (Table 2). Among the 181 referred to exercise training, 21 individuals did not meet age-based inclusion criteria for the PA measurement (i.e., 18-69 years old) and were, therefore, excluded from the present report. One participant withdrew before completing baseline questionnaires, and one additional participant did not complete PA

measure at any timepoint. Thus, a total of 158 participants were included in the final analyzed sample. See Figure 1 for a detailed visual of analysis subset for the entire sample.

Content of the Physical Activity Intervention

The supervised physical activity intervention of ProComS used evidence-based practice in the current National Comprehensive Cancer Network (NCCN) Guidelines for Exercise as well as recommendations from the American College of Sports Medicine (ACSM). These assess a survivor's risk (low, medium, high) for exercise-induced adverse events. Using these guidelines enabled the trainer to design a program to improve a survivor's physical condition while minimizing the risk for injury. The intervention focused primarily on cardiovascular activity, strength, and flexibility. Prior to February 2012 participants received unlimited free sessions with physical activity trainers; however, due to high demand a 12 session limit with 3 subsequent follow-up visits was applied beginning in February 2012. The majority of study participants (n = 125, 79.1%) were limited to 12 exercise sessions. Sessions were led by one of two ACSM-certified exercise specialists and took place onsite at the Moncrief Cancer Institute.

Sessions progressed as follows:

- Participants who had been referred were first scheduled for a consultation, at which point the exercise trainer reviewed the completed intake packet (when available) with the patient and determined both short- and long-term fitness goals.
- After the initial consultation, the exercise trainer sent a medical release to the participant's physician of record to clear the cancer survivor for exercise. Participants had written goals and received tailored educational materials to assist them in optimizing program results and were scheduled for one-on-one exercise sessions (preferably twice weekly for the first few weeks of the program and then once weekly for the remaining sessions) with one of the two certified exercise trainers.
- Each session consisted of approximately 30 minutes one-on-one time with a trainer. Sessions typically began with warm up followed by floor exercises addressing individual concerns such as flexibility, core and balance issues, as well as range of motion. Participants were then instructed to use the cardio machines located in MCI's gym where they remained under supervision by the exercise trainer. Finally, participants were often given "homework" to complete before their next session. Participants were given a weekly exercise log, homework, brochures, educational materials, etc. to increase the likelihood of engaging in PA between sessions and post intervention. Spanish materials were available for Spanish speaking participants.

- At completion of the customized exercise program, participants received an informal graduation summary (e.g., reviewed progress, goals met, etc.) and a certificate of graduation. Furthermore, those participants who had completed the 12-session program were allotted 3 follow-up sessions. Preferably, the first follow-up appointment was scheduled for approximately 30 days after completion of the program. Participants were also provided referrals to other programs, including the MCI group exercise classes and the YMCA LIVESTRONG Program.

Measures

Outcome Variables

Physical Activity

The primary dependent variable (self-reported physical activity) for Aims I and II was measured at baseline, 3-, 6- and 12-months post-referral by the International Physical Activity Questionnaire – Short Form (IPAQ-SF; Appendix C), a well-validated self-report measure of physical activity within the last 7 days (available in both English and Spanish; Craig et al., 2003). The IPAQ-SF consists of 7 questions that ask participants about the frequency and duration of various activities assessing multiple domains including vigorous activities, moderate activities, walking, and sitting (minutes per day) and is designed for use with

young and middle age adults between the ages of 15 and 69. The version of the IPAQ used in the current study is a shortened version of the original 27-item IPAQ; both versions have previously been used in research with cancer patients and survivors (Johnson-Kozlow, Sallis, Gilpin, Rock, & Pierce, 2006; Oechsle et al., 2011). Test- retest reliability for this short, self-report version is acceptable (α= .74) and categorical estimates of sufficient physical activity (defined as 150 minutes or more) are repeatable with percent agreement ranging from 93 to 100 (Craig et al., 2003). The IPAQ has displayed fair criterion validity (α= .26 - .27) when compared to accelerometers among United States samples (Craig et al., 2003), although correlations between the Spanish-language IPAQ and accelerometer data are less robust ($r < 0.13$ when compared to accelerometer; Medina, Barquera, & Janssen, 2013). Although this is a limitation of this measure, it should be noted that the majority of our sample listed English as their primary language (i.e., 7% Spanish speaking)

The IPAQ-SF Scoring Protocol allows for both categorical and continuous indicators of physical activity. For a categorical measure, both the total volume and the number of day/sessions are included in the scoring algorithm. Three levels of physical activity have been suggested for classifying populations including: 1) Low (insufficiently active) 2) Moderate (sufficiently active or meeting minimum guideline requirements) 3) High (exceeding public health guidelines). More specifically, reports of PA over the past 7 days are used to

assign categorical scores as follows: 1) moderate scores are assigned to individuals who report any of the following criteria: (a) 5 or more days of moderate activity and/or walking for total of at least 30 minutes per day, (b) 3 or more days of vigorous-intensity activity for at least 20 minutes per day, (c) 5 or more days per week of any combination of walking, moderate, or vigorous-intensity activity equivalent to at least 600 MET-minutes/week; 2) high scores are assigned to individuals who report PA consistent with any of the following criteria: (a) at least 3 days of vigorous-intensity activity equivalent to 1500 MET-minutes/week or (b) 7 or more days of any combination of walking, moderate, or vigorous-intensity activity equivalent to at least 3000 MET-minutes/week; 3) low scores are assigned to individuals who do not meet criteria for moderate or high categorical scores. For continuous measurement of IPAQ data, PA is expressed in metabolic equivalent minutes per week (MET-minutes/week). A MET is the ratio of the rate of energy expended during an activity to the rate of energy expended at rest, such that 1 MET is the rate of energy expenditure while at rest (Ainsworth et al., 2011). In accordance with the IPAQ-SF scoring protocol, a MET score is derived for walking, moderate, and vigorous-intensity activities (3.3, 4.0, and 8.0 METs, respectively). Although guidelines often report recommendations for PA in minutes per week (i.e., 150 minutes per week of moderate or 75 minutes per week of vigorous activity), according to the Physical Activity Guidelines Advisory Committee Report (2008) the health benefits of PA depend mainly on

total weekly energy expenditure due to PA. Therefore, a MET is a unit useful for describing the energy expenditure of a specific activity. In scientific terms, PA guidelines equate to 500-1000 MET-minutes per week. A combined total PA MET-minute/week is computed as the sum of walking, moderate, and vigorous MET-min/week scores. The IPAQ-SF includes a sitting question as an additional indicator not included as part of the summary score of physical activity. This question intends to measure sedentary behavior, which has been identified as an independent risk factor for poor health outcomes.

Service Utilization (Session Attendance)

The primary dependent variable for Aim III was utilization of the ProComS exercise service. Service utilization is defined as participant attendance (0-12+ sessions) in the ProComS exercise program. Exercise service utilization information was collected from ProComS staff and service providers. Of note, group exercise classes were not included in the overall count of exercise sessions.

Independent and Control Variables

Demographic Characteristics

All demographic information was self-reported and included gender, age at initial visit, primary language (English or Spanish), race, ethnicity (Hispanic or

Non-Hispanic), educational attainment (highest level completed), marital status, 5-digit ZIP code (recoded as distance from clinic). Height and weight at initial visit were measured and used to calculate body mass index (BMI) using the standard kg/m^2 equation (Keys, Fidanza, Karvonen, Kimura, & Taylor, 1972). The majority of these demographic variables were self-reported on the Confidential Health Questionnaire (CHQ), a standard self-report form used by the Division of Hematology Oncology at the University of Texas Southwestern Medical Center (Appendix C).

Illness Characteristics

Illness characteristics were assessed by reviewing participants' Confidential Health Questionnaire (CHQ), review of medical records, and when available review of survivorship care plan. Variables included in this study include primary cancer diagnosis, history of recurrence or multiple cancers, cancer stage (early [0, I, II] v. late [III, IV]), time since diagnosis, and treatment history (i.e., chemotherapy, radiation, surgery).

Comorbid Conditions

The Comorbidity Index provides a general estimate of self-reported symptoms and comorbid medical conditions reported in the Review of Systems section of the CHQ. Comorbid medical conditions and symptom burden may

negatively impact health related quality of life and overall functioning, especially for cancer survivors given the burden of cancer and its treatment. For this study, comorbidity index was defined as the sum of organ systems (0-13) in which each participant endorsed symptoms. Based on the number of endorsed symptoms, participants were classified as either "low," "moderate," or "high" on the Comorbidity Index. More specifically, participants who endorsed problems within 0-3 organ systems were considered "low"; within 4-7 organ systems were considered "moderate"; and within 8 or more organ systems were considered "high." Index scores could range from 0-13, as the Review of Symptoms section of the CHQ is comprised of 13 separate symptom clusters (excluding an open-ended "other" category) labeled by their overarching organ systems, such as respiratory, cardiac, and genitourinary.

Performance Status

The Karnofsky Performance Status (KPS) was used to measure participants' performance status at the time of enrollment. The research nurse determined each participant's KPS during their intake visit based on subjective assessment of their ability to perform ordinary tasks. Karnofsky and Burchenal (1949) created this scoring system as a means for physicians to evaluate a patient's suitability for chemotherapy. Today the KPS provides a standard way of measuring functional capacity of cancer patients. More specifically, the KPS

provides a standard way of measuring the ability of cancer patients to perform ordinary tasks. Scores range from 0 to 100 with lower scores indicating decreased functional capacity and poorer prognosis. Physicians often use this scoring index to compare effectiveness of different therapies and to assess the prognosis in individual patients, monitor changes in functional capacity, as well as identify individuals suitable for clinical trials.

KPS has demonstrated good construct validity and interrater reliability in use with a diagnosis of cancer (Schag, Heinrich, & Ganz, 1984). Indeed, higher functional status (KPS) at baseline has been shown to be a significant predictor of physical activity in a 5-year longitudinal study examining determinants of PA in women with breast cancer (Emery, Yang, Frierson, Peterson, & Suh, 2009).

Quality of Life

Participants completed the Functional Assessment of Cancer Therapy-General (FACT-G; Appendix C), which provides a useful summary of quality of life for a diverse group of cancer survivors. It is a 27-item questionnaire designed to retrospectively measure items that tap into overall quality of life across various domains. Each item is specifically tailored to symptoms most frequently reported by individuals with cancer for a period of seven days (Cella et al., 1993). Specifically, this 27-item questionnaire covers four domains including physical, functional, social/family, and emotional well-being, all of which are rated on a 5-

point Likert scale. The FACT-G yields four separate subscales (scores ranging from 0-28 for physical, functional and social/family and 0-24 for emotional well-being), in addition to providing an overall quality of life score representing all four domains with scores ranging from 0 to 108. Higher scores on each subscale, as well as a higher overall score, indicates better functioning in each domain as well as better global quality of life.

The FACT-G has been widely used with various samples of cancer survivors (e.g., Holzner et al., 2001; Levine & Balk, 2012) and has demonstrated appropriate reliability and validity. Specifically, the FACT-G has demonstrated high test-retest reliability for all of its subscales and its overall score (α = .82 - .92), excellent internal consistency for its total score (α = .89 - .92), and acceptable internal consistency for its subscales (α = .65 - .90) (Cella et al., 1993; Winstead- Fry & Schultz, 1997). The Spanish-language version of the FACT-G has shown comparable psychometrics to the original English-speaking patient data with internal consistency coefficients ranging from .66 to .89 and good concurrent validity when compared to several similar measures (Cella et al., 1998).

CHAPTER FIVE

STATISTICAL ANALYSES

Data were stored in a SQL-server linked to a Microsoft Access 2010 database (Microsoft Corp., Redmond, WA). Data relevant to this study were imported into the Statistical Package for Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, NY) and descriptive statistics were analyzed in SPSS. Prior to conducting the planned analyses, data were screened for outliers that may impact analysis. Additionally, distribution characteristics were examined and data not normally distributed were appropriately transformed when indicated. For example, a square root transformation was performed to reduce positive skewness in the IPAQ-SF scores. Descriptive results were produced for all variables, including frequencies and percentages for categorical variables, and means and standard deviations for continuous variables.

Study aims were analyzed using generalized estimating equations (GEE). Introduced by Liang and Zeger in 1986, this method of analysis is an extension of generalized linear models (GLM), and provides a method of inference for a wide variety of models when responses are correlated. GEE provides a method of analyzing repeated measures and correlated responses resulting in longitudinal data (Hanley, Negassa, & Forrester, 2003). The GEE method has been widely used to fit time trends in repeated measurements due to its robustness (Hu &

Lachin, 2001). In the current analysis, GEE with robust variance estimates were conducted to model associations with our outcome of interest. GEE can accommodate missing data, assuming that they are missing at random, thus in the current study no missing data were deliberately imputed. To address this assumption for Aims 1 and 2, we conducted analyses comparing participants with and without 12-month data on relevant baseline demographic and clinical characteristics. Inclusion of covariates for each Aim was determined with univariate analyses, including chi-square (where sample size allowed), *t*-tests or its non-parametric equivalent *(Mann-Whitney U test),* analysis of variance (ANOVA), and when appropriate Spearman correlation coefficients. In comparisons of dichotomous variables with cell sizes <5 no statistical comparisons were performed. Demographic and clinical variables were included in the final analysis models if they had statistically significant or borderline significant univariate associations ($p < .10$) with the dependent variable of interest (Baseline physical activity for Aims 1 and 2; session attendance for Aim 3).

CHAPTER SIX

RESULTS

Characteristics of the Sample

The sample for this analysis included 158 individuals from ProComS who were referred for exercise training (May 2011-August 2013), were under 70 years old, and completed a baseline measure (IPAQ-SF) of physical activity (see Figure 1 for diagram). Figure 1 also displays participant sample size at each timepoint for the primary outcome measure (IPAQ-SF).

Demographic and Illness Characteristics

Baseline demographic and illness characteristics were available for all 158 analyzed participants and are summarized in Table 3. The majority of the sample was female (n = 146, 92.4%) and Non-Hispanic white (n = 104, 65.8%) with an average age of 54.5 years (SD = 7.9). The sample was highly educated with 78.5% having attended at least some college; approximately half of the study sample was married (n = 83, 52.5%). Almost the entire study sample spoke English as a primary language (n = 147, 93.0%). Seventy-five percent of the

participants lived with 13.4 miles of the clinic, and the median distance for all participants was 9.8 miles (*M* = 11.7, *SD* = 14.7).

Regarding illness characteristics, the majority of patients reported a primary diagnosis of breast cancer (*n* = 122, 77.2%). Cancer stage was widely distributed; the majority of participants reported an early stage diagnosis (i.e., stage 0, I, or II; *n* = 104, 65.8%). The median time since diagnosis was 1.6 years (*M* = 3.3, *SD* = 4.1, range = 0.08 - 19.3 years). Seventeen participants (10.8%) reported a history of recurrence or secondary cancer. A history of chemotherapy, surgery, and radiation was documented for 118 (74.7%), 138 (87.3%), and 74 (46.8%) participants, respectively. At baseline mean BMI was 32.4 (*SD* = 7.7), with 58.2% of the participants as obese, 21.5% overweight, and 19.0% within the normal weight range. BMI was not reported for two (1.3%) participants.

Comorbidity counts were relatively well distributed with 40 (25.3%) participants classified as low, 61 (38.6%) as moderate, and 57 (36.1%) as high. Most participants (*n* = 108, 68.4%) demonstrated high functional capacity at intake (i.e., KPS score of 100%).

Baseline Physical Activity

At baseline, participants' median total physical activity (sum of walking, moderate, and vigorous) was 792 MET-minutes per week (*IQR:* 213, 1857).

Specific elements of the total physical activity score included median walking, at 297 MET-minutes per week (*IQR*: 92.4, 693), moderate activities (*Mdn* = 0 MET-minutes per week; *IQR:* 0, 480), and vigorous activities (*Mdn* = 0 MET-minutes per week; *IQR*: 0, 480). Refer to Figure 2 for median total physical activity scores for all timepoints. Based on categorizations of low, moderate, or high physical activity levels, the majority of participants at baseline were classified as low (*n* = 59, 37.3%) or moderate (*n* = 67, 42.4%) with approximately one fifth of the participants being classified as high (*n* = 32, 20.3%). Sedentary minutes per week were also calculated. At baseline, participants' median sitting time was 300 minutes/day (*IQR:* 180, 480). At 3-months post enrollment, participants' median sitting time was 300 minutes/day (*IQR:* 180, 480).

Exercise Service Utilization

As detailed in Figure 4, nearly half of the 158 participants who were referred to supervised exercise training attended 12 or more exercise sessions (*n* = 68, 43%). Only 5 participants (3%) attended zero sessions, such that they were referred but never met with an exercise trainer for a consultation and tailored exercise regimen. Based on the distribution of data, session utilization was dichotomized into a two-level variable (0-11 sessions v. 12+ sessions). This

decision was made after attempts to transform the highly skewed distribution of continuous data were not effective in normalizing the distribution.

The majority of participants initiated their physical activity sessions within the first three weeks after baseline measurement (*n* = 125, 81.7%). Specifically, 55 (35.9%) initiated exercise session the same day as study enrollment, 29 (19.0%) within the first week, 41 (26.8%) within 2-3 weeks, and 28 (18.3%) after the first 3 weeks of study enrollment. Session attendance spanned the entirety of the 12-month measurement period, however, the majority completed their exercise sessions within the first 3 months post-baseline (*n* = 98, 64.1%). Among the remainder, 20.9% (*n* = 32) of participants completed their sessions 3- 6-months post-baseline, and 15.0% (*n* = 23) completed their sessions 6-12-months post-baseline. Participants with at least two sessions averaged 12.5 days between each exercise session (2-3 sessions per month) with a standard deviation of 15 days between sessions (*Mdn* = 8.4 days; *IQR*: 5.9, 15.1).

Analyses of Study Aims

Aim 1: Evaluate longitudinal patterns (Baseline, 3, 6, and 12 months post-enrollment) in self-reported physical activity among participants who were referred for exercise training as part of a community survivorship program.

For Aim 1 we evaluated longitudinal patterns (Baseline, 3, 6, and 12 months post-enrollment) of self-reported physical activity (defined as MET-minutes/week of overall activity) among the 158 participants who were referred for exercise training and met analysis inclusion criteria. Table 4 presents mean values and standard deviations of physical activity at each specific timepoint. To address Aim I, generalized estimating equations (GEE) evaluated the time trend (change over time) for the probability of the event of interest, physical activity (defined as a square root transformation of the continuous variable of total MET-minutes/week). To address the assumption of GEE that missing data are missing at random, chi- square and *t*-tests or the non-parametric equivalent (*Mann-Whitney U test*) analyses compared participants who did v. did not complete outcome variables at each timepoint on available demographic and clinical characteristics (i.e., gender, age, BMI, time since diagnosis, cancer type, race/ethnicity, treatment history, comorbidity count, education level, baseline quality of life, and marital status) with results indicating no significant differences between the groups. There was also no significant difference in baseline PA between participants who did v. did not complete outcome variables at all four timepoints ($U = 2653$, $Z = 1.59$, $p = .112$). Results, suggest that data were not missing based on specific patterns and supporting the assumptions of the GEE analyses.

Based on their univariate associations ($p < .10$) with baseline physical activity scores, the following demographic and clinical covariates were included in the GEE analysis: a) Body Mass Index (normal, overweight, obese) ($F(2, 153) = 3.014$, $p = .052$); b) education (some college or more v. less than college) ($t(154) = 1.811$, $p = 0.072$); c) marital status (married, divorced/separated, widowed, never married/unmarried group) ($F(3, 154) = 4.408$, $p = .005$). Overall, results from the Aim 1 model indicate a significant main effect of time (Wald $\chi2$ (3) = 17.79, $p < .0001$), indicating consistently greater overall physical activity across the 12-month analysis period. All time points showed significant changes compared to baseline (Wald $\chi2$ (1) = 9.48, $p = .002$ (12 month); Wald $\chi2$ (1) = 11.14, $p = .001$ (6 month); Wald $\chi2$ (1) = 10.32, $p = .001$ (3 month), suggesting a sustained pattern of greater PA over time (Table 5). Results from the model also indicate that higher education was associated with consistently greater PA across timepoints, such that participants with at least some college reported more PA across time (Wald $\chi2$ (1) = 8.47, $p = .004$). In addition, results from the model indicated that BMI is associated with consistently greater PA across timepoints (Wald $\chi2$ (2) = 8.24, $p = .016$); participants with obese BMI levels reported less PA compared to participants with normal BMI levels (Wald $\chi2$ (1) = 4.16, $p = .041$). Marital status also contributed to the model and was associated with consistently greater PA (Wald $\chi2$ (3) = 9.20, $p = .027$), with

widowed participants reporting less PA compared to married participants (Wald $\chi2$ (1) = 7.07, p = .008; Table 5).

Aim II: Examine the role of utilization (e.g., session attendance) and psychosocial (e.g., quality of life) variables in predicting longitudinal reports of physical activity among cancer survivors.

For Aim II, an expanded GEE model (adapted from the model in Aim I) focused on the relationship between session attendance (0-11 v. 12+ sessions) and quality of life (non-transformed scores on the FACT-G) on changes in physical activity over time. All covariates from Aim 1 were included in the Aim 2 model.

In the Aim 2 model, the main effect of time remained significant at Wald $\chi2$ (3) = 15.17, p = .002, indicating consistently greater PA across timepoints. All time points remained statistically significant compared to baseline (Wald $\chi2$ (1) = 10.94, p = .001 (12 month); Wald $\chi2$ (1) = 7.33, p = .007 (6 month); Wald $\chi2$ (1) = 7.87, p = .005 (3 month), suggesting a sustained pattern of greater PA over time (Table 6). Results from the model also indicated that baseline global quality of life scores were positively associated with consistently greater PA across timepoints (Wald $\chi2$ (1) = 6.04, p = .014) and with exercise session attendance; participants who attended 12+ sessions reported greater PA compared to those with lower session attendance (0-11) (Wald $\chi2$ (1) = 3.84, p = .05). Main effects

for BMI (p = .013), marital status (p = .007), and education (p = .008) also remained significant in the model, consistent with directions indicated in Aim 1 (Table 6).

Aim III: (Exploratory) Identify demographic and clinical correlates of session attendance in this cohort of cancer survivors.

The goal of Aim III was to identify significant predictors of exercise session attendance (defined by 0-11 v. 12+ sessions) for participants. Results from univariate logistic regression analyses are presented in Table 7. Participants who attended 12+ sessions had significantly higher baseline emotional well-being scores, as measured by the FACT-G Emotional Well-Being (EWB) subscale (OR = 1.14, p = .007). Marital status was noted to be a trending predictor of session attendance (p = .056), such that widowed participants were less likely to attend 12+ sessions compared to married participants (OR = 4.80, p = .059). History of secondary cancer or recurrence was also noted to be a trending predictor of session attendance (p = .057), such that participants with a history of secondary cancer or recurrence were more likely to attend 12+ sessions compared to those without a history of secondary cancer or recurrence (OR = 2.70, p = .064).

A multivariate logistic regression analysis included the variables that showed a significant or marginally significant (p<.10) association to the outcome of interest (session attendance) in the univariate analyses. A test of the full model

against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between participants who attended 0-11 sessions versus 12+ sessions ($\chi 2$ (5)= 18.28, p = 003). The model explained 14.8% (Nagelkerke R^2) of the variance in session attendance and correctly classified 66.9% of cases. The Wald criterion demonstrated that baseline emotional well-being score was a significant predictor of session attendance (p = .009). History of secondary cancer or recurrence was also significant in the final multivariate model (p = .033). However, marital status was not significant in the multivariate model (p = .122) (Table 8).

CHAPTER SEVEN

Conclusions and Recommendations

DISCUSSION

The primary aims of this study were to examine the relationship between brief supervised exercise training and long-term (12-month) self-reported PA among cancer survivors enrolled in a community survivorship program, understand significant correlates of physical activity, and identify correlates of participants' exercise program completion (12+ sessions). Results from the first analysis demonstrated significant increases in self-reported physical activity over the 12- month period following program enrollment, with consistent gains over time. These results indicate that, in general, the cancer survivorship program was effective in promoting physical activity. The pattern of consistently greater PA across timepoints suggests that even though most participants completed their exercise sessions early in the study period, benefits of the training remained for months afterward. Of note is that the exercise session instruction included discussions of sustainable activity (i.e., using everyday household items in place of gym equipment; assigning at-home activity "homework"). Additionally, participants had the option of maintaining training at their local YMCA LIVESTRONG Program and/or continuing with the program's group exercise classes, both free of charge. Reducing barriers

(e.g., lack of home exercise equipment) to PA potentially improved perceived behavioral control and increased self-efficacy, maintaining improvements in PA outside of the sessions.

With regard to clinical and demographic characteristics, results from this study indicated that participants who had normal/healthy BMI at baseline, were married, and had more education tended to report consistently greater PA across study timepoints. In general, these findings are consistent with previous research; healthy weight, more education, and being married are all well-established buffers of both general health and disease-specific outcomes (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2008; Centers for Disease Control and Prevention, 2010; Dupre, Beck, & Meadows, 2009). Participants who had these "beneficial" baseline characteristics may have been better equipped to have higher levels of physical activity. For example, participants with normal/healthy BMIs were likely less impacted by comorbidities, joint problems, and range of motion issues that may have affected the obese participants. Similarly, participants with more education may have had more resources and control over their time to exercise. Finally, married participants likely had increased social support (both emotional and functional) from spouses, which likely enabled successful conduct of physical activity.

Our second aim focused on the specific impact of baseline global QOL and session attendance on PA outcomes. Results indicated that both better

baseline global QOL scores and higher session attendance (12+ sessions) were associated with consistently greater PA across timepoints. The quality of life finding is consistent with the literature indicating the beneficial impact of quality of life/psychosocial functioning on physical activity (Blanchard, Courneya, & Stein, 2008). Indeed, the physical and functional well-being subscales of QOL have demonstrated strong associations with meeting exercise guidelines among cancer survivors (Peddle, Au, & Courneya, 2008). For example, participants who reported higher quality of life were likely less impacted by the physical symptoms and functional impairment that may act as barriers to engaging in physical activity. In regard to session attendance, those who attended more exercise sessions had greater exposure to the exercise intervention and likely applied this training to their daily lives in a more comprehensive way. For example, those who attended more exercise sessions had more time with the exercise trainers who spent time addressing the individual needs or concerns of each participant. Participants with greater session attendance may have been more likely to achieve short- or long-term goals identified in collaboration with their trainer during the initial exercise session. It may be that those who attended more sessions also met their goals, which increased confidence moving forward leading to maintenance of PA after completion of intervention. Moreover, those attending a greater number of sessions spent more time in a safe and supportive environment, which may have increased their perceived level of social support. For example, social

support may have been increased via working one-on-one with the trainer, group exercise classes, support groups located at MCI, or feeling connected or understood by other cancer survivors in the program.

Our final goal was to identify predictors of session attendance, defined as 0-11 versus 12+ exercise sessions. Results from the multivariate analysis showed that baseline emotional well-being and secondary cancer or cancer recurrence were significant predictors of session attendance (12+ sessions). The first finding is consistent with studies suggesting that lower emotional well-being can act as a barrier to non-adherence, both specific to exercise and broadly to other behavioral outcomes engaging in physical activity and exercise intervention non-adherence (Mazzeschi et al., 2012; DiMatteo, Lepper, & Croghan, 2000; Humpel & Iverson, 2007; Emery, Yang, Frierson, Peterson, & Suh, 2009). In this study, individuals with lower emotional well-being may have experienced negative affect coupled with mental fatigue and poor coping skills, which may have made it difficult to sustain a physical activity program. Despite the emotional well-being results, global QOL and the remaining three subscales did not significantly predict session attendance, which was surprising given the associations of physical and functional well-being with physical activity in the larger literature and as noted in results from the second aim. These results highlight the importance of screening for psychological distress, poor coping, or depressive symptoms at baseline as these can contribute to poor emotional well-being and may act as an independent

risk factor for non-adherence to exercise interventions in this vulnerable population. In addition, it should be noted that more traditional predictors of reduced service utilization, including distance from clinic, younger age, higher education, marital status, gender, were not associated with exercise session utilization in the current analysis.

Related to the second predictor, results suggest that those with a history of secondary cancer or recurrence may have been more motivated to participate in the program to reduce further risk of recurrence, alleviate late-and long-term side effects, and/or regain a sense of control over their health. Those with a history of secondary cancer or recurrence may find it easier to cope and adjust to cancer and its treatment given their previous experience. Indeed, Andersen and colleagues found that women diagnosed with recurrent breast cancer demonstrated resilience in response to the diagnosis. The authors found that those with a recurrent breast cancer coped relatively well compared to their initial diagnosis with no significant worsening in overall distress or quality of life (Andersen, Shapiro, Farrar, Crespin, & Wells-DiGregorio, 2005). Yang and colleagues found that among patients with a newly diagnosed recurrent breast cancer had significantly lower anxiety and confusion compared to patients who were coping with their first diagnosis (Yang, Thornton, Shapiro, & Andersen, 2008). Interestingly, this may be associated with our findings that those who were referred for exercise training had a high level of comorbidity. Although exercise training was offered to the

majority of ProComS participants, it appears that those with more comorbid conditions actually participated, at least in regard to the exercise component. Although this was not tested statistically, it may be that those who have a more significant medical history (e.g., history of previous cancer and/or multiple comorbid conditions) want to receive assistance in reducing the burden of disease. Future studies should evaluate this further, and look at variables beyond typical cancer staging, as stage and its prognosis varies based on cancer type.

Overall, our results are promising in the implementation and dissemination of an exercise program within a community cancer survivorship clinic. Of note is the very high uptake of referral (97%) among participants and continued session attendance, demonstrating acceptability of the intervention. These results suggest that cancer survivors are able to maintain adequate PA over time. It appears that interventions targeting specific types of PA, such as walking, may hold promise in community settings. Walking scores accounted for much of the increase in PA across timepoints. This study demonstrates the translations of evidence-based PA interventions into practice and suggests that this is an area that holds promise in improving both short- and long-term outcomes of cancer survivors.

Limitations

The pragmatic design associated with the current analyses provides a practical reflection of patient involvement and response at the community level. Although this dissemination and implementation focus has definite strengths, the lack of a randomized comparison group may have restricted interpretation of results. An equivalent control group ('non-referred' or 'non-intervention') may have strengthened the causal inference of our findings and helped determine whether in this community setting the improvements in physical activity would be noted even in the absence of an exercise intervention. A similar issue relates to the self-determination of session attendance for exercise participation; a study in which exercise session number was randomized may be able to provide more information about "optimal" attendance. In addition, PA was based on self-report subject to recall bias and over-reporting. The correlation between self-reported (e.g., questionnaires) and objective (e.g., accelerometers) measures of PA varies between studies ($r = 0.71 – 0.96$) (Lee et al., 2011; Prince et al., 2008; Craig et al., 2003). Across studies, however, the Spearman correlation (r) is on average low to moderate ($r = 0.37$) (Prince et al., 2008). Despite this relatively low correlation with objective measurement, self-report questionnaires (e.g., IPAQ-SF) are commonly used to assess PA behaviors, especially for larger studies where self-report is often more feasible and cost effective. Finally, although effort was made to recruit from multiple settings, it should be noted that the majority of participants were female, breast

cancer survivors, non-Hispanic White, and well educated. Therefore, results from this study may not generalize well to more diverse population of cancer survivors.

Clinical Relevance and Practical Recommendations

Evidence-based exercise interventions implemented at the community level offer meaningful and measurable benefits to cancer survivors. The majority (97%) of those referred for supervised exercise training attended at least one session, suggesting cancer survivors are highly motivated to participate in these programs. Additionally, we observed sustained increases in PA among cancer survivors referred for exercise training in this community program, suggesting promise for dissemination into other community settings. Furthermore, a pattern of consistently greater reports of PA across timepoints suggests that even though most participants completed their exercise sessions early in the study period, benefits of the training remained for months afterward. Future studies should consider implementation of brief, evidence-based exercise programs (12 sessions) that result in impactful results. Despite the community setting, the current analysis was situated in a comprehensive, multidisciplinary program well-staffed to meet to the needs of this population. This will be useful in designing future interventions that improve PA while optimizing resources

and reducing costs. Results indicate that in general, the cancer survivorship program was effective in promoting physical activity. Future interventions should include both subjective and objective measurements of PA, in addition to evaluating the impact of theory-based intervention components (e.g., specific goal-setting behaviors, increasing social support, and providing education). Understanding how programs demonstrating longer-term effects can be sustained in the community setting beyond grant funding or time limited research is critical to support the growing number of cancer survivors.

APPENDIX A

TABLES

Table 1

Baseline Characteristics of Eligible Consented v. Eligible Declined

Variable	**Group**				
	Eligible Consented	Eligible Declined			
	M (SD)	*M (SD)*	*U*	*Z*	*p*
Age (years)	56.6 (9.8)	56.8 (13.1)	8412	-.307	.76
Time since diagnosis (years)	3.3 (4.4)	2.6 (3.5)	5784	-.835	.40
	N (%)	*N (%)*	*χ2*	*df*	*p*
Gender			.14	1	.71
Female	179 (87.3)	73 (84.9)			
Male	26 (12.7)	13 (15.1)			
Preferred Language			3.1	1	.078
English	193 (94.1)	75 (87.2)			
Spanish	12 (5.9)	11 (12.8)			
Race/Ethnicity			.56	2	.46
Non-Hispanic White	139 (67.8)	54 (62.8)			
Hispanic/Minority	65 (31.7)	32 (37.2)			
Unknown/Missing	1 (0.5)	–			
Marital Status			.11	2	.75
Married	111 (54.1)	34 (39.5)			
Unmarried	94 (45.9)	25 (29.1)			
Unknown/Missing	–	27 (31.4)			
Education Level			5.2	3	.073
High School or less	42 (20.5)	16 (18.6)			

Some College/Tech School	78 (38.0)	12 (14.0)			
College Graduate or more	83 (40.5)	26 (30.2)			
Unknown/Missing	2 (1.0)	32 (37.2)			
Comorbidity Index			60.5	2	<.001*
Low	47 (22.9)	61 (71.0)			
Moderate	82 (40.0)	10 (11.6)			
High	76 (37.1)	15 (17.4)			
Primary Cancer Diagnosis			3.7	1	.055
Breast	149 (72.7)	52 (60.5)			
Other	56 (27.3)	34 (39.5)			
Chemotherapy			65.0	1	<.001*
No	64 (31.2)	72 (83.7)			
Yes	141 (68.8)	14 (16.3)			
Surgery			65.2	1	<.001*
No	42 (20.5)	61 (70.9)			
Yes	163 (79.5)	25 (29.1)			
Radiation			23.1	1	<.001*
No	103 (50.2)	70 (81.4)			
Yes	102 (49.8)	16 (18.6)			

Note. Significant at the $p < .05$ level.

Table 2

Characteristics of Exercise Referred v. Non-Referred

Variable	**Group**				
	Referred	Non-Referred			
	M (SD)	*M (SD)*	*U*	*Z*	*p*
Age (years)	56.6 (9.8)	56.6 (9.3)	2135	-.135	.89
Time since diagnosis (years)	3.3 (4.3)	3.3 (5.3)	2108	-.193	.85
	N (%)	*N (%)*	χ2	*df*	*p*
Gender					
Female	162 (89.5)	16 (66.7)			
Male	19 (10.5)	8 (33.3)			
Preferred Language					
English	170 (93.9)	23 (95.8)			
Spanish	11 (6.1)	1 (4.2)			
Race/Ethnicity					
Non-Hispanic White	148 (81.8)	16 (66.7)			
Hispanic/Minority	31 (17.1)	8 (33.3)			
Unknown/Missing	2 (1.1)	–			
Marital Status			.047	1	.83
Married	99 (54.7)	12 (50.0)			
Unmarried	82 (45.3)	12 (50.0)			
Education Level					
High School or less	35 (19.3)	7 (29.2)			
Some College/Tech School	71 (39.2)	7 (29.2)			
College Graduate or more	73 (40.3)	10 (41.7)			

Unknown/Missing	2 (1.1)	–			
Comorbidity Index			3.77	2	.15
Low	45 (24.9)	2 (8.3)			
Moderate	72 (39.8)	10 (41.7)			
High	64 (35.4)	12 (50.0)			
Primary Cancer Diagnosis			.50	1	.65
Breast	133 (73.5)	16 (66.7)			
Other	48 (26.5)	8 (33.3)			
Chemotherapy			.033	1	.86
No	57 (31.5)	8 (33.3)			
Yes	124 (68.5)	16 (66.7)			
Surgery					
No	37 (20.4)	5 (20.8)			
Yes	144 (79.6)	19 (79.2)			
Radiation			.006	1	.94
No	92 (50.8)	12 (50.0)			
Yes	89 (49.2)	12 (50.0)			

Note. Significant at the $p < .05$ level.

Table 3

*Demographic and Clinical Characteristics of Participants (*N = *158)*

Variable	*n (%)*	Variable	*n (%)*
Gender		Cancer Location	
Female	146 (92.4)	Breast	122 (77.2)
Male	12 (7.6)	Prostate	4 (2.5)
Race/Ethnicity		Head and Neck	3 (1.9)
Non-Hispanic White	104 (65.8)	Colorectal	7 (4.4)
Non-Hispanic Black	24 (15.2)	Lung	3 (1.9)
Hispanic	25 (15.8)	Gynecologic	5 (3.2)
Other	5 (3.2)	Hematologic	8 (5.1)
Preferred Language		Other	6 (3.8)
English	147 (93.0)	Cancer Stage	
Spanish	11 (7.0)	0	9 (5.7)
Marital Status		I	46 (29.1)
Married	83 (52.5)	II	49 (31.0)
Divorced or separated	35 (22.2)	III	27 (17.1)
Widowed	9 (5.7)	IV	12 (7.6)
Never married/unmarried couple	31 (19.6)	Unknown/Missing	15 (9.5)
Highest education level		Recurrence/secondary cancer	
High school or less	32 (20.2)	No	141 (89.2)
Some college (1-3 years)	66 (41.8)	Yes	17 (10.8)
College graduate or higher	58 (36.7)	Chemotherapy	
Unknown/Missing	2 (1.3)	No	40 (25.3)
Body Mass Index (BMI)		Yes	118

			(74.7)
Underweight (<18.5 kg/m²)	0	Surgery	
Normal (18.5-24.9 kg/m²)	30 (19.0)	No	20 (12.7)
Overweight (25.0-29.9 kg/m²)	34 (21.5)	Yes	138 (87.3)
Obese (30 kg/m² or higher)	92 (58.2)	Radiation	
Unknown	2 (1.3)	No	84 (53.2)
Comorbidity Index		Yes	74 (46.8)
Low (0-3)	40 (25.3)		
Moderate (4-7)	61 (38.6)		
High (8 or above)	57 (36.1)		

Variable	*M*	*SD*	*n*
Age (years)	54.5	7.9	158
Time since diagnosis (years)	3.3	4.1	158
KPS at time of enrollment	95.9	7	156
Distance from clinic (miles)	11.7	14.7	158

Table 4

Mean IPAQ-SF Scores by Timepoint

	Baseline (N=158)	3 Months (N=116)	6 Months (N=101)	12 Months (N=93)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Walking MET-minutes/week	663 (1005.2)	717 (951.2)	858 (1192.0)	1071 (1357.7)
Moderate MET-minutes/week	221 (293.3)	320 (306.8)	296 (312.2)	272 (301.4)
Vigorous MET-minutes/week	330 (535.6)	570 (621.1)	575 (628.0)	483 (620.8)
Total MET-minutes/week	1210 (1290.5)	1601 (1343.3)	1728 (1609.5)	1820 (1591.1)

Note. Walking MET-minutes/week = 3.3 METs x walking minutes x walking days; Moderate MET-minutes/week = 4.0 METs x moderate minutes x moderate days; Vigorous MET-minutes/week = 8.0 METs x vigorous minutes x vigorous days; Total MET-minutes/week = Walking + Moderate + Vigorous MET-minutes/week scores.

Table 5

Parameter Estimates for Physical Activity (Aim 1)

Parameter	*B*	Std Error	95% Wald Confidence Interval Lower	Upper	Wald x^2	*df*	*p*
(Intercept)	26.8***	4.39	18.20	35.40	37.29	1	.000
12 months	6.83***	2.22	2.48	11.18	9.48	1	.002
6 months	6.79***	2.03	2.80	10.77	11.14	1	.001
3 months	5.71***	1.78	2.23	9.19	10.32	1	.001
Baseline	0[a]	.	.	.	.	.	.
Some college or more	8.80***	3.02	2.87	14.72	8.47	1	.004
Less than college	0[a]	.	.	.	.	.	.
Obese	-7.19**	3.53	-14.10	-.280	4.16	1	.041
Overweight	.402	3.98	-7.39	8.196	.010	1	.919
Normal	0[a]	.	.	.	.	.	.
Never married/ Unmarried Group	-1.93	3.08	-7.97	4.12	.391	1	.532
Widowed	-9.94***	3.74	-17.26	-2.61	7.07	1	.008
Divorced/ Separated	1.99	3.06	-4.02	7.99	.422	1	.516
Married	0[a]	.	.	.	.	.	.
(Scale)	373.14						

*p<.10. **p<.05. ***p<.01

Table 6

Parameter Estimates for Physical Activity (Aim II)

Parameter	*B*	Std Error	95% Wald Confidence Interval Lower	Upper	Wald x^2	*df*	*p*
(Intercept)	15.54***	5.58	4.61	26.47	7.77	1	.005
12 months	7.09***	2.14	2.89	11.29	10.94	1	.001
6 months	5.67***	2.09	1.56	9.78	7.33	1	.007
3 months	5.13***	1.83	1.54	8.71	7.87	1	.005
Baseline	0[a]	.	.	.	.	.	.
Some college or more	7.54***	2.84	1.97	13.11	7.04	1	.008
Less than college	0[a]	.	.	.	.	.	.
Obese	-7.68**	3.45	-14.44	-.912	4.95	1	.026
Overweight	-.889	3.82	-8.37	6.60	.054	1	.816
Normal	0[a]	.	.	.	.	.	.
Never married/ Unmarried Group	-1.09	3.02	-7.00	4.82	.131	1	.718
Widowed	-11.02***	3.62	-18.12	-3.93	9.27	1	.002
Divorced/ Separated	2.50	2.94	-3.27	8.26	.720	1	.396
Married	0[a]	.	.	.	.	.	.
≥12 Sessions	4.98**	2.54	-.003	9.97	3.84	1	.050
≤11 Sessions	0[a]	.	.	.	.	.	.
FACT-G Total	.137*	.056	.028	.247	6.04	1	.014

(Scale)	351.80

*p<.10. **p<.05. ***p<.01

Table 7

Univariate analysis of predicting session attendance (N = 158)

Variable	Completed 0-11 sessions (n)	Completed 12+ sessions (n)	Odds Ratio	95% CI	*p* Value
Age (continuous)	-	-	1.02	0.98-1.06	.262
Gender					
Male	7	5	1.06	0.32-3.51	.920
Female	83	63	1.00		
Cancer Type					.132
Breast	65	56	1.80	0.83-3.90	.139
Other	25	12	1.00		
Cancer Stage					.259
Early (0 thru II)	55	49	1.00		
Late (III thru IV)	23	13	1.58	0.72-3.44	.254
Unknown/Unlisted	12	6	-	-	-
BMI					.801
Obese	55	37	0.77	0.34-1.76	.535
Overweight	19	15	0.90	0.34-2.42	.838
Normal	16	14	1.00		
Unknown/Unlisted	-	2	-	-	-
Race/Ethnicity					.512
Non-Hispanic White	55	49	1.00		
Non-Hispanic Black	15	9	0.67	0.27-1.68	.395
Hispanic	17	8	0.53	0.21-1.33	.176
Other	3	2	0.75	0.12-4.67	.756
Marital Status					.056
Married	48	35	1.00		
Divorced/Separated	18	17	1.30	0.59-	.523

Widowed	2	7	4.80*	2.86 0.94-24.52	.059
Unmarried	22	9	0.56	0.23-1.37	.203
Education					.540
High school or less	21	11	1.00		
Some college or higher	67	57	1.62	0.72-3.65	.234
Unknown/Unlisted	2	-	-	-	-
Comorbid Class					.799
Low	21	19	1.00		
Medium	36	25	0.77	0.34-1.71	.519
High	33	24	0.80	0.36-1.81	.599
Number of treatment types received					.686
1	25	15	1.00		
2	36	28	1.30	0.58-2.91	.529
3	29	25	1.44	0.62-3.31	.395
History of Previous Cancer and/or Recurrence					.057
Yes	6	11	2.70*	0.95-7.21	.064
No	84	57	1.00		
Time since diagnosis					
>1.5 years	52	32	0.65	0.35-1.22	.181
<=1.5 years	38	36	1.00		
Distance from clinic					
>10 miles	38	28	0.96	0.50-1.85	.907
<10 miles	47	36	1.00		
Unknown/Unlisted	5	4	-	-	-
Baseline Quality of Life (QOL) FACT-G Total	-	-	1.01	0.99-1.03	.181
Baseline QOL					.081

Subscales					
PWB-subscale	-	-	0.96	0.88-1.05	.350
EWB-subscale	-	-	1.14***	1.04-1.25	.007
FWB-subscale	-	-	0.96	0.88-1.04	.297
SWB-subscale	-	-	1.02	0.94-1.10	.653
Baseline Total MET-minutes/week (transformed)	-	-	1.01	0.99-1.03	.296

Note. Unknown/Unlisted not included in analysis.*p<.10. **p<.05. ***p<.01

Table 8

*Multivariate analysis of predicting session attendance (*N *= 158)*

Variable	Completed 0-11 sessions (n)	Completed 12+ sessions (n)	Odds Ratio	95% CI	*p* Value
Marital Status					.112
Married	48	35			
Divorced/Separated	18	17	1.20	0.52-2.76	.667
Widowed	2	7	6.17*	1.13-33.62	.036
Unmarried	22	9	0.70	0.28-1.75	.441
History of Secondary Cancer and/or Recurrence					
Yes	6	11	3.52*	1.11-11.17	.033
No	84	57			
Baseline QOL Subscales					
EWB-subscale	-	-	1.10**	1.02-1.18	.009

Note. Unknown/Unlisted not included in analysis.
*p<.10. **p<.05. ***p<.01

APPENDIX B
Figures

Figure 1

Flow of Exercise Participants

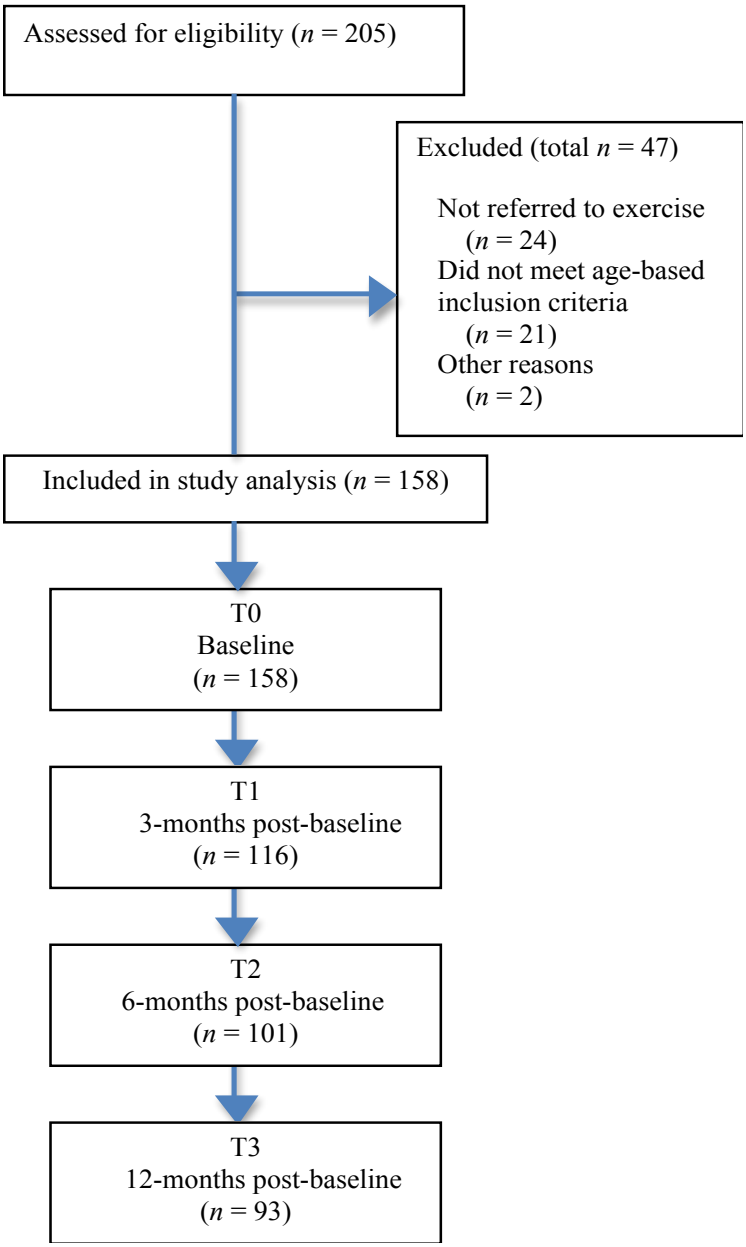


Figure 2

Total Physical Activity Across Timepoints

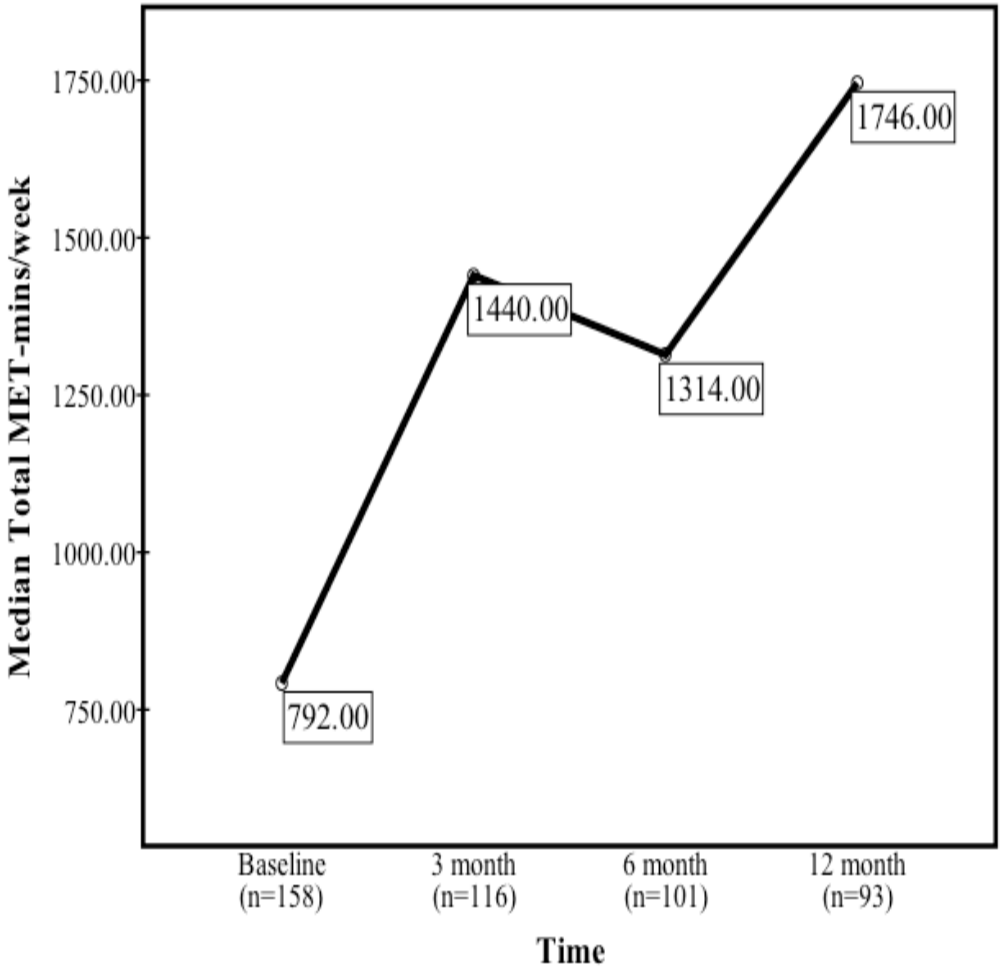


Figure 3

Total Physical Activity Across Timepoints by Session Attendance

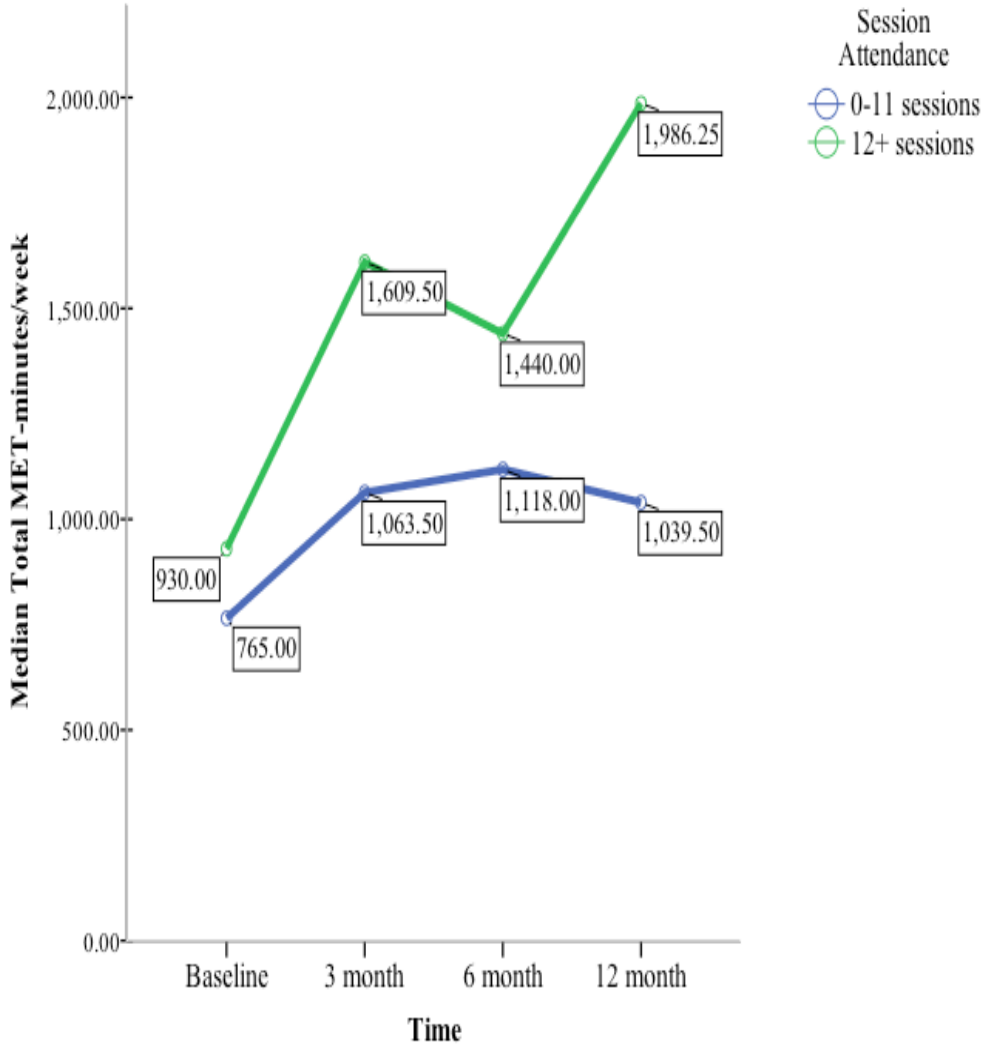
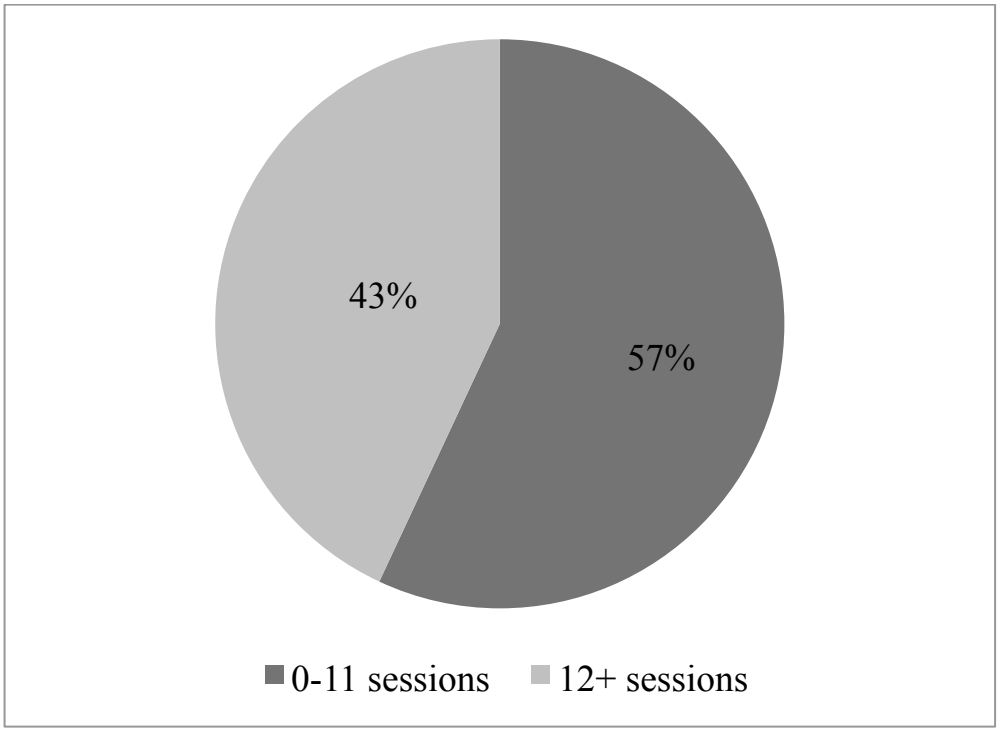


Figure 4

*Exercise Session Attendance (*N = *158)*



APPENDIX C
Self-Report Measures

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***

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

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 might do 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

This is the end of the questionnaire, thank you for participating.

UT SOUTHWESTERN
MEDICAL CENTER
UNIVERSITY HOSPITALS & CLINICS
HAROLD C. SIMMONS COMPREHENSIVE CANCER CENTER

Division of Hematology Oncology

Confidential Health Questionnaire

Pt. Name: _____
Address: _____
City State Zip
MRN: _____
DOB: _____
SSN: XXX-XX-___ ___ ___ ___ SEX: _____
DOS: _____
Phone Number:

_____
Date / Time

Instructions: Please complete all applicable sections.

Section 1: Current Meds & Doses (including prescription, non-prescription(s), & herbals)

Section 2: Allergies (including drugs, foods, adhesives and IV contrast dyes)

Section 3: Please list any major illnesses and surgeries you have had

Section 4: Immunization

◯ Hep B ◯ Tetanus ◯ Flu ◯ Pneumonia Date _____
◯ Hep A ◯ TB ◯ Other _____

Section 5: Social History

Marital Status: ◯ Single ◯ Married ◯ Divorced ◯ Widow
Employment: ◯ Employed (occupation)_____ ◯ Retired ◯ Disabled
Occupational Toxin Exposure History: _____
Highest Level of Education: ◯ High School ◯ Some College ◯ Degree
Substance Usage: Tobacco: ◯ Cigarettes _____ Packs Per Day ◯ Cigars ◯ Pipe
◯ Snuff ◯ Previous Smoker/Stop Date _____
Alcohol: ◯ Beer _____ Cans Per Day ◯ Liquor _____ Glasses Per Day
◯ Wine _____ Glasses Per Day ◯ Previous Drinker/Stop Date _____
Caffeine: ◯ Tea ◯ Coffee ◯ Cola
Drugs: ◯ None ◯ Previous ◯ Occasional ◯ Frequent

Section 6: Family History

Relations	Medical Problem	Present Age / Age of Death
Mother		
Father		
Brother		
Sister		
Children		
Others: Cousins		
Uncles/Aunts		
Grandparents		

Form # IMJ/CHQ-001 / 09.04 (Rev. 09.05)

MEDICAL ONCOLOGY

UT SOUTHWESTERN MEDICAL CENTER
UNIVERSITY HOSPITALS & CLINICS
HAROLD C. SIMMONS COMPREHENSIVE CANCER CENTER

Division of Hematology Oncology

Confidential Health Questionnaire

Pt. Name: _____
Address: _____
City State Zip
MRN: _____
DOB: _____
SSN: XXX-XX-___ ___ ___ ___ SEX: _____
DOS: _____

Section 7: Review of Systems (Mark Appropriate Bubble)

1. Constitutional
- ◯ Weight Loss
- ◯ Weight Gain
- ◯ Loss of Appetite
- ◯ Fever
- ◯ Unusual Weakness
- ◯ Night Sweats
- ◯ No Problem Noted

2. Eyes/Ears/Nose
- ◯ Recent Visual Change
- ◯ Double Vision
- ◯ Hearing Loss
- ◯ Ringing in Ears
- ◯ Nose Bleeds
- ◯ No Problem Noted

3. Mouth/Throat
- ◯ Ulcers
- ◯ Thyroid Problems
- ◯ Gum Bleeding/Pain
- ◯ Hoarseness
- ◯ Difficulty Swallowing
- ◯ No Problem Noted

4. Respiratory
- ◯ Asthma
- ◯ Chest Pain
- ◯ Shortness of Breath
- ◯ Wheezing
- ◯ Cough
- ◯ Pleurisy
- ◯ History Pneumonia/Bronchitis
- ◯ No Problem Noted

5. Cardiac
- ◯ High Blood Pressure
- ◯ Palpitations
- ◯ Chest Pain (angina)
- ◯ Leg/Foot Edema
- ◯ Shortness of Breath
- ◯ Aneurysm
- ◯ History of Heart Attack
- ◯ Murmur
- ◯ Heart Failure
- ◯ No Problem Noted

6. GI
- ◯ Nausea
- ◯ Vomiting
- ◯ Pain
- ◯ Colitis
- ◯ Diarrhea
- ◯ Constipation
- ◯ Blood in Stool
- ◯ Ulcer
- ◯ Change Bowel Habits
- ◯ Vomiting Blood
- ◯ Hemorrhoids
- ◯ Hepatitis
- ◯ No Problem Noted

◯ There are no new changes from last visit on _____.

I have read and reviewed this form.

_____
Patient's Signature

_____
Date

7. Genitourinary
- ◯ Frequent Urination
- ◯ Incontinence of Urine/Stool
- ◯ Burning on Urination
- ◯ Blood in Urine
- ◯ Kidney Stones
- ◯ Hysterectomy
- ◯ Sexual Problems
- ◯ Hot Flashes
- ◯ Vaginal Discharge
- ◯ Last Pap _____
- ◯ Last Menstrual Period_____
- ◯ Last Mammogram_____
- ◯ No Problem Noted

8. Musculoskeletal
- ◯ Muscle Aches
- ◯ Arthritis/Joint Pains
- ◯ Weakness
- ◯ Paralysis
- ◯ No Problem Noted

9. Skin
- ◯ Rashes
- ◯ Hives
- ◯ Ulcers
- ◯ Sores
- ◯ Pigmented Moles
- ◯ Skin Cancer
- ◯ No Problem Noted

10. Neurological
- ◯ Seizures
- ◯ Fainting
- ◯ Headaches
- ◯ Stroke
- ◯ TIA
- ◯ Speech Problems
- ◯ Balance Problems
- ◯ Paralysis
- ◯ Weakness
- ◯ No Problem Noted

11. Psychiatric
- ◯ Depression
- ◯ Anxiety
- ◯ Sleep Problems
- ◯ Others
- ◯ No Problem Noted

12. Endocrine
- ◯ Intolerance to Heat/Cold
- ◯ Diabetes
- ◯ Thyroid Disease
- ◯ Other
- ◯ No Problem Noted

13. Heme/Lymphatic
- ◯ Enlarged Lymph Nodes
- ◯ Anemia
- ◯ Leukemia
- ◯ Platelet Problems
- ◯ Lymphoma
- ◯ Red Cell Problems
- ◯ Blood Clots - When/Where_____
- ◯ Anticoagulants - Dose_____
- ◯ No Problem Noted

14. ◯ Other _____

I have reviewed and discussed this information with the patient.

_____
Health Care Provider's Signature

_____
Date

Form # IMJ/CHQ-001 / 09.04 (Rev. 09.05)

FACT-G (Version 4)

Below is a list of statements that other people with your illness have said are important. **Please circle or mark one number per line to indicate your response as it applies to the past 7 days.**

	PHYSICAL WELL-BEING	Not at all	A little bit	Some-what	Quite a bit	Very much
GP1	I have a lack of energy	0	1	2	3	4
GP2	I have nausea	0	1	2	3	4
GP3	Because of my physical condition, I have trouble meeting the needs of my family	0	1	2	3	4
GP4	I have pain	0	1	2	3	4
GP5	I am bothered by side effects of treatment	0	1	2	3	4
GP6	I feel ill	0	1	2	3	4
GP7	I am forced to spend time in bed	0	1	2	3	4

	SOCIAL/FAMILY WELL-BEING	Not at all	A little bit	Some-what	Quite a bit	Very much
GS1	I feel close to my friends	0	1	2	3	4
GS2	I get emotional support from my family	0	1	2	3	4
GS3	I get support from my friends	0	1	2	3	4
GS4	My family has accepted my illness	0	1	2	3	4
GS5	I am satisfied with family communication about my illness	0	1	2	3	4
GS6	I feel close to my partner (or the person who is my main support)	0	1	2	3	4
Q1	*Regardless of your current level of sexual activity, please answer the following question. If you prefer not to answer it, please mark this box* ☐ *and go to the next section.*					
GS7	I am satisfied with my sex life	0	1	2	3	4

FACT-G (Version 4)

Please circle or mark one number per line to indicate your response as it applies to the past 7 days.

	EMOTIONAL WELL-BEING	Not at all	A little bit	Some-what	Quite a bit	Very much
GE1	I feel sad	0	1	2	3	4
GE2	I am satisfied with how I am coping with my illness	0	1	2	3	4
GE3	I am losing hope in the fight against my illness	0	1	2	3	4
GE4	I feel nervous	0	1	2	3	4
GE5	I worry about dying	0	1	2	3	4
GE6	I worry that my condition will get worse	0	1	2	3	4

	FUNCTIONAL WELL-BEING	Not at all	A little bit	Some-what	Quite a bit	Very much
GF1	I am able to work (include work at home)	0	1	2	3	4
GF2	My work (include work at home) is fulfilling	0	1	2	3	4
GF3	I am able to enjoy life	0	1	2	3	4
GF4	I have accepted my illness	0	1	2	3	4
GF5	I am sleeping well	0	1	2	3	4
GF6	I am enjoying the things I usually do for fun	0	1	2	3	4
GF7	I am content with the quality of my life right now	0	1	2	3	4

REFERENCES

Adler, N. E., & Page, A. E. K. (2008). *Cancer care for the whole patient: Meeting psychosocial health needs.* Institute of Medicine, Committee on Psychosocial Services to Cancer Patients/Families in a Community Setting & Board on Health Care Services. Washington, DC: The National Academies Press.

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett Jr, D. R., Tudor-Locke, C., ... & Leon, A. S. (2011). 2011 Compendium of physical activities: A second update of codes and MET values. *Medicine & Science in Sports & Exercise*, *43*(8), 1575-1581.

American Cancer Society. (2014). *Cancer Treatment and Survivorship Facts & Figures 2014-2015.* Atlanta: American Cancer Society.

Andersen, B. L., Shapiro, C. L., Farrar, W. B., Crespin, T., & Wells-DiGregorio, S. (2005). Psychological responses to cancer recurrence. *Cancer*, *104*(7), 1540-1547.

Argenbright, K. E., Anderson, P. R., Berry, E., Inman, E. C., & Hamann, H. A. (2014). Using community resources to build a survivorship program. *Oncology Issues, 29*(1), 41-47.

Ballard-Barbash, R., Friedenreich, C. M., Courneya, K. S., Siddiqi, S. M., McTiernan, A., & Alfano, C. M. (2012). Physical activity, biomarkers,

and disease outcomes in cancer survivors: A systematic review. *Journal of the National Cancer Institute, 104*(11), 815-840.

Beckjord, E. B., Reynolds, K. A., Van Londen, G. J., Burns, R., Singh, R., Arvey, S. R., ... & Rechis, R. (2014). Population-level trends in post-treatment cancer survivors' concerns and associated receipt of care: Results from the 2006 and 2010 LIVESTRONG surveys. *Journal of Psychosocial Oncology*, *32*(2), 125-151.

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 Oncology*, *23*(34), 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(13), 2198-2204.

Bourke, L., Homer, K. E., Thaha, M. A., Steed, L., Rosario, D. J., Robb, K. A., ... & Taylor, S. J. (2013). Interventions for promoting habitual exercise in people living with and beyond cancer. *Cochrane Database of Systematic Reviews, 9*, CD010192.

Broderick, J. M., Guinan, E., Kennedy, M. J., Hollywood, D., Courneya, K. S., Culos-Reed, S. N., … & Hussey, J. (2013). Feasibility and efficacy of a supervised exercise intervention in de-conditioned cancer survivors during

the early survivorship phase: The PEACH trial. *Journal of Cancer Survivorship, 7*(4), 551-562.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126–131.

Cella, D., Hernández, L., Bonomi, A. E., Corona, M., Vaquero, M., Shiomoto, G., & Baez, L. (1998). Spanish language translation and initial validation of the functional assessment of cancer therapy quality-of-life instrument. *Medical Care, 36*(9), 1407-1418.

Cella, D. F., Tulsky, D. S., Gray, G., Sarafian, B., Linn, E., Bonomi, A., ... & Brannon, J. (1993). The Functional Assessment of Cancer Therapy scale: Development and validation of the general measure. *Journal of Clinical Oncology, 11*(3), 570-579.

Centers for Disease Control and Prevention. (2010). *State indicator report on physical activity, 2010.* Atlanta, GA: U.S. Department of Health and Human Services.

Cheifetz, O., Park Dorsay, J., Hladysh, G., MacDermid, J., Serediuk, F., & Woodhouse, L. J. (2014). CanWell: Meeting the psychosocial and exercise needs of cancer survivors by translating evidence into practice. *Psycho-Oncology, 23*(2), 204-215.

Coups, E. J., & Ostroff, J. S. (2005). A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. *Preventive Medicine*, *40*(6), 702-711.

Courneya, K. S. (2010). Efficacy, effectiveness, and behavior change trials in exercise research. *International Journal of Behavioral Nutrition and Physical Activity*, *7*(1), 81.

Courneya, K. S. (2014). Physical activity and cancer survivorship: A simple framework for a complex field. *Exercise and Sport Sciences Reviews, 42*(3), 102-109.

Courneya, K. S., Karvinen, K. H., & Vallance, J. K. (2007). Exercise motivation and behavior change. In M. Feuerstein (Ed.), *Handbook of cancer survivorship* (pp. 113-132). New York, NY: Springer.

Courneya, K. S., Segal, R. J., Gelmon, K., Mackey, J. R., Friedenreich, C. M., Yasui, Y., ... & McKenzie, D. C. (2014). Predictors of adherence to different types and doses of supervised exercise during breast cancer chemotherapy. *International Journal of Behavioral Nutrition and Physical Activity, 11*(1), 1-9.

Craft, L. L., Vanlterson, E. H., Helenowski, I. B., Rademaker, A. W., & Courneya, K. S. (2012). Exercise effects on depressive symptoms in cancer survivors: A systematic review and meta-analysis. *Cancer Epidemiology Biomarkers & Prevention, 21*(1), 3-19.

Craig, C. L., Marshall, A. L., Sjöström, 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*(8), 1381-1395.

Daley, A. J., Crank, H., Mutrie, N., Saxton, J. M., & Coleman, R. (2007). Determinants of adherence to exercise in women treated for breast cancer. *European Journal of Oncology Nursing, 11*(5), 392-399.

DeSantis, C. E., Lin, C. C., Mariotto, A. B., Siegel, R. L., Stein, K. D., Kramer, J. L., …& Jemal, A. (2014). Cancer treatment and survivorship statistics, 2014. *CA: A Cancer Journal for Clinicians, 64*(4), 252-271.

DiMatteo, M. R., Lepper, H. S., & Croghan, T. W. (2000). Depression is a risk factor for noncompliance with medical treatment: Meta-analysis of the effects of anxiety and depression on patient adherence. *Archives of Internal Medicine*, *160*(14), 2101-2107.

Dupre, M. E., Beck, A. N., & Meadows, S. O. (2009). Marital trajectories and mortality among US adults. *American Journal of Epidemiology*, *170*(5), 546-555.

Eickmeyer, S. M., Gamble, G. L., Shahpar, S., & Do, K. D. (2012). The role and efficacy of exercise in persons with cancer. *PM&R, 4*(11), 874-881.

Emery, C. F., Yang, H. C., Frierson, G. M., Peterson, L. J., & Suh, S. (2009). Determinants of physical activity among women treated for breast cancer

in a 5-year longitudinal follow-up investigation. *Psycho-Oncology, 18*(4), 377-386.

Forsythe, L. P., Kent, E. E., Weaver, K. E., Buchanan, N., Hawkins, N. A., Rodriguez, J. L., ... & Rowland, J. H. (2013). Receipt of psychosocial care among cancer survivors in the United States. *Journal of Clinical Oncology*, JCO-2012.

Garcia, D. O., & Thomson, C. A. (2014). Physical activity and cancer survivorship. *Nutrition in Clinical Practice, 29*(6), 768-779.

Giovannucci, E. L. (2012). Physical activity as a standard cancer treatment. *Journal of the National Cancer Institute*, *104*(11), 797-799.

Hanley, J. A., Negassa, A., & Forrester, J. E. (2003). Statistical analysis of correlated data using generalized estimating equations: An orientation. *American Journal of Epidemiology*, *157*(4), 364-375.

Helgeson, V. S., Snyder, P., & Seltman, H. (2004). Psychological and physical adjustment to breast cancer over 4 years: Identifying distinct trajectories of change. *Health Psychology, 23*(1), 3-15.

Hewitt, M., Greenfield, S., & Stovall, E. (2005). *From cancer patient to cancer survivor: Lost in transition.* Washington, DC: The National Academies Press.

Holmes, M. D., Chen, W. Y., Feskanich, D., Kroenke, C. H., & Colditz, G. A. (2005). Physical activity and survival after breast cancer diagnosis. *JAMA, 293*(20), 2479-2486.

Holzner, B., Kemmler, G., Sperner-Unterweger, B., Kopp, M., Dünser, M., Margreiter, R., ... & Greil, R. (2001). Quality of life measurement in oncology—A matter of the assessment instrument?. *European Journal of Cancer, 37*(18), 2349-2356.

Hu, M., & Lachin, J. M. (2001). Application of robust estimating equations to the analysis of quantitative longitudinal data. *Statistics in Medicine*, *20*(22), 3411-3428.

Humpel, N., & Iverson, D. C. (2007). Depression and quality of life in cancer survivors: Is there a relationship with physical activity?. *International Journal of Behavioral Nutrition and Physical Activity*, *4*(1), 65.

Irwin, M. L., Crumley, D., McTiernan, A., Bernstein, L., Baumgartner, R., Gilliland, F. D., ... & Ballard-Barbash, R. (2003). Physical activity levels before and after a diagnosis of breast carcinoma. *Cancer, 97*(7), 1746-1757.

Irwin, M. L., McTiernan, A., Manson, J. E., Thomson, C. A., Sternfeld, B., Stefanick, M. L., ... & Chlebowski, R. (2011). Physical activity and survival in postmenopausal women with breast cancer: Results from the women's health initiative. *Cancer Prevention Research, 4*(4), 522-529.

Irwin, M. L., Smith, A. W., McTiernan, A., Ballard-Barbash, R., Cronin, K., Gilliland, F. D., ... & Bernstein, L. (2008). Influence of pre-and postdiagnosis physical activity on mortality in breast cancer survivors: The health, eating, activity, and lifestyle study. *Journal of Clinical Oncology, 26*(24), 3958-3964.

Johnson-Kozlow, M., Sallis, J. F., Gilpin, E. A., Rock, C. L., & Pierce, J. P. (2006). Comparative validation of the IPAQ and the 7-Day PAR among women diagnosed with breast cancer. *International Journal of Behavioral Nutrition and Physical Activity, 3*(1), 7.

Jones, L. W., & Alfano, C. M. (2013). Exercise-oncology research: Past, present, and future. *Acta Oncologica, 52*(2), 195-215.

Kampshoff, C. S., Jansen, F., van Mechelen, W., May, A. M., Brug, J., Chinapaw, M. J., & Buffart, L. M. (2014). Determinants of exercise adherence and maintenance among cancer survivors: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 11*(1), 80-80.

Karnofsky, D. A., & Burchenal, J. H. (1949). The clinical evaluation of chemotherapeutic agents in cancer. In C. M. McLeod (Ed.), *Evaluation of chemotherapeutic agents in cancer* (p. 191). New York, NY: Columbia University Press.

Keys, A., Fidanza, F., Karvonen, M. J., Kimura, N., & Taylor, H. L. (1972). Indices of relative weight and obesity. *Journal of Chronic Diseases*, *25*(6), 329-343.

Levine, A. S., & Balk, J. L. (2012). Pilot study of yoga for breast cancer survivors with poor quality of life. *Complementary Therapies in Clinical Practice, 18*(4), 241-245.

Liang, K. Y., & Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika, 73*(1), 13-22.

Loprinzi, P. D., & Lee, H. (2014). Rationale for promoting physical activity among cancer survivors: Literature review and epidemiologic examination. *Oncology Nursing Forum, 41*(2), 117-125.

Mason, C., Alfano, C. M., Smith, A. W., Wang, C. Y., Neuhouser, M. L., Duggan, C., . . . McTiernan, A. (2013). Long-term physical activity trends in breast cancer survivors. *Cancer Epidemiology Biomarkers & Prevention, 22*(6), 1153-1161.

Mazzeschi, C., Pazzagli, C., Buratta, L., Reboldi, G. P., Battistini, D., Piana, N., … & De Feo, P. (2012). Mutual interactions between depression/quality of life and adherence to a multidisciplinary lifestyle intervention in obesity. *The Journal of Clinical Endocrinology & Metabolism, 97*(12), E2261-E2265.

McCabe, M. S., Faithfull, S., Makin, W., & Wengstrom, Y. (2013). Survivorship programs and care planning. *Cancer*, *119*(S11), 2179-2186.

McTieran, A. (2008). A mechanism linking physical activity with cancer. *Nature Reviews Cancer*, *8*(3), 205-211.

Medina, C., Barquera, S., & Janssen, I. (2013). Validity and reliability of the International Physical Activity Questionnaire among adults in Mexico. *Revista Panamericana de Salud Pública, 34*(1), 21-28.

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*(22), 3527-3534.

Mols, F., Vingerhoets, A. J., Coebergh, J. W., & van de Poll-Franse, L. V. (2005). Quality of life among long-term breast cancer survivors: A systematic review. *European Journal of Cancer, 41*(17), 2613-2619.

Mullan, F. (1985). Seasons of survival: Reflections of a physician with cancer. *New England Journal of Medicine, 313*(4), 270-3.

Mutrie, N., Campbell, A., Barry, S., Hefferon, K., McConnachie, A., Ritchie, D., & Tovey, S. (2012). Five-year follow-up of participants in a randomised controlled trial showing benefits from exercise for breast cancer survivors during adjuvant treatment. Are there lasting effects? *Journal of Cancer Survivorship, 6*(4), 420-430.

National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology: Survivorship (version 1.2015). Retrieved from www.nccn.org. Accessed May 10, 2015.

Nayak, P., Holmes H. M., Nguyen H. T., & Elting L. S. (2014). Self-reported physical activity among middle-aged cancer survivors in the United States: Behavioral risk factor surveillance system survey, 2009. *Preventing Chronic Disease, 11*, E156.

Oechsle, K., Jensen, W., Schmidt, T., Reer, R., Braumann, K. M., de Wit, M., & Bokemeyer, C. (2011). Physical activity, quality of life, and the interest in physical exercise programs in patients undergoing palliative chemotherapy. *Supportive Care in Cancer, 19*(5), 613-619.

Oeffinger, K. C., Argenbright, K. E., Levitt, G. A., McCabe, M. S., Anderson, P. R., Berry, E., ... & Wollins, D. S. (2013, December). Models of cancer survivorship health care: Moving forward. In American Society of Clinical Oncology educational book/ASCO. American Society of Clinical Oncology. Meeting (Vol. 34, pp. 205-213).

O'Neill, S. C., DeFrank, J. T., Vegella, P., Richman, A. R., Henry, L. R., Carey, L. A., & Brewer, N. T. (2013). Engaging in health behaviors to lower risk for breast cancer recurrence. *PLoS ONE, 8*(1), e53607.

Peddle, C. J., Plotnikoff, R. C., Wild, T. C., Au, H. J., & Courneya, K. S. (2008). Medical, demographic, and psychosocial correlates of exercise in

colorectal cancer survivors: An application of self-determination theory. *Supportive Care in Cancer*, *16*(1), 9-17.

Phillips, S. M., Alfano, C. M., Perna, F. M., & Glasgow, R. E. (2014). Accelerating translation of physical activity and cancer survivorship research into practice: Recommendations for a more integrated and collaborative approach. *Cancer Epidemiology Biomarkers & Prevention, 23*(5), 687-699.

Physical Activity Guidelines Advisory Committee. (2008). *Physical activity guidelines advisory committee report, 2008.* Washington, DC: U.S. Department of Health and Human Services.

Pinto, B. M., & Ciccolo, J. T. (2011). Physical activity motivation and cancer survivorship. *Recent Results in Cancer Research, 186,* 367-387.

Rock, C. L., Doyle, C., Demark-Wahnefried, W., Meyerhardt, J., Courneya, K. S., Schwartz, A. L., . . . & Gansler, T. (2012). Nutrition and physical activity guidelines for cancer survivors. *CA: A Cancer Journal for Clinicians, 62*(4), 243-274.

Rowland, J. H., Hewitt, M., & Ganz, P. A. (2006). Cancer survivorship: A new challenge in delivering quality cancer care. *Journal of Clinical Oncology, 24*(32), 5101-5104.

Sangha, O., Stucki, G., Liang, M. H., Fossel, A. H., & Katz, J. N. (2003). The self-administered comorbidity questionnaire: A new method to assess

comorbidity for clinical and health services research. *Arthritis Care & Research, 49*(2), 156-163.

Schag, C. C., Heinrich, R. L., & Ganz, P. A. (1984). Karnofsky performance status revisited: Reliability, validity, and guidelines. *Journal of Clinical Oncology, 2*(3), 187-193.

Schiller, J. S., Ward, B. W., Freeman, G., & Clarke, T. (2014). *Early release of selected estimates based on data from the January - June 2014 National Health Interview Survey*. National Center for Health Statistics. Retrieved from: http://www.cdc.gov/nchs/nhis.htm

Schmitz, K. H. (2011). Exercise for secondary prevention of breast cancer: Moving from evidence to changing clinical practice. *Cancer Prevention Research,, 4*(4), 476-480.

Schmitz, K. H., Courneya, K. S., Matthews, C., Demark-Wahnefried, W., Galvo, 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*(7), 1409-1426.

Schmitz, K. H., Troxel, A. B., Cheville, A., Grant, L. L., Bryan, C. J., Gross, C. R., ... & Ahmed, R. L. (2009). Physical activity and lymphedema (the PAL trial): Assessing the safety of progressive strength training in breast cancer survivors. *Contemporary Clinical Trials, 30*(3), 233-245.

Shi, Q., Smith, T. G., Michonski, J. D., Stein, K. D., Kaw, C., & Cleeland, C. S. (2011). Symptom burden in cancer survivors 1 year after diagnosis. *Cancer, 117*(12), 2779-2790.

Smith, S. K., Mayer, D. K., Zimmerman, S., Williams, C. S., Benecha, H., Ganz, P. A., ... & Abernethy, A. P. (2013). Quality of life among long-term survivors of non-Hodgkin lymphoma: A follow-up study. *Journal of Clinical Oncology, 31*(2), 272-279.

Speck, R. M., Courneya, K. S., Masse, L. C., Duval, S., & Schmitz, K. H. (2010). An update of controlled physical activity trials in cancer survivors: A systematic review and meta-analysis. *Journal of Cancer Survivorship, 4*(2), 87-100.

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2008). *Physical activity guidelines for Americans.* (ODPHP Publication No. U0036). Retrieved from: http://www.health.gov/paguidelines

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal*, *174*(6), 801-809.

Weaver, K. E., Forsythe, L. P., Reeve, B. B., Alfano, C. M., Rodriguez, J. L., Sabatino, S. A., ... & Rowland, J. H. (2012). Mental and physical health–related quality of life among US cancer survivors: Population estimates

from the 2010 National Health Interview Survey. *Cancer Epidemiology Biomarkers & Prevention*, *21*(11), 2108-2117.

White, S. M., McAuley, E., Estabrooks, P. A., & Courneya, K. S. (2009). Translating physical activity interventions for breast cancer survivors into practice: An evaluation of randomized controlled trials. *Annals of Behavioral Medicine, 37*(1), 10-19.

Winstead-Fry, P., & Schultz, A. (1997). Psychometric analysis of the functional assessment of cancer therapy-general (FACT-G) scale in a rural sample. *Cancer, 79*(12), 2446-2452.

Wolin, K. Y., Schwartz, A. L., Matthews, C. E., Courneya, K. S., & Schmitz, K. H. (2012). Implementing the exercise guidelines for cancer survivors. *Journal of Supportive Oncology*, *10*(5), 171.

Yang, H. C., Thornton, L. M., Shapiro, C. L., & Andersen, B. L. (2008). Surviving recurrence: Psychological and quality of life recovery. *Cancer*, *112*(5), 1178-1187.