EXAMINING QUALITY OF LIFE OUTCOMES IN EXERCISE PROGRAM FOR CANCER SURVIVIORS

by

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Dalhousie University is located in Mi'kma'ki,
the ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

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ABSTRACT

The purpose of this study was to examine the effects of a pragmatic, community-and hospital-based exercise program on quality of life (QoL) outcomes in CS. This study looked at participant data collected by the Activating Cancer Communities through an Exercise Strategy for Survivors (ACCESS). The program featured twice-weekly exercise sessions for 24 sessions. Outcomes were measured at baseline and post-intervention. Data from 89 ACCESS participants were included in the current study. From pre- to post-program, significant improvements in QoL outcomes, including total QoL, physical well-being, emotional well-being, and functional well-being were found. Three predictor variables (i.e., age, time to program completion, and functional capacity) were found to have no significant impact on any QoL outcomes. These findings and the pragmatic approach of ACCESS strongly support the integration of PA programming into cancer care, which will further support the health and well-being of CS.

LIST OF ABBREVIATIONS USED

CS	Cancer Survivor
PA	Physical Activity
QoL	Quality of Life
6MWT	Six-Minute Walk Test
PWB	Physical Well-Being
SWB	Social Well-Being
EWB	Emotional Well-Being
FWB	Functional Well-Being
FACT-G	Functional Assessment of Cancer Therapy-General
RCT	Randomized Control Trial

GLOSSARY

Cancer	A disease associated with abnormal cell growth in the body, resulting in a tumor.
Cancer Survivor	A person is considered a survivor from the time of cancer diagnosis until the end of their life.
Cancer Continuum	The various points of a cancer survivor`s journey, from cancer prevention, detection, diagnosis, treatment, and survivorship.
Physical Activity	Any bodily movement produced by an individual requires an expenditure of energy.
Pragmatic Study	A study designed to assess the effectiveness of an intervention in generalizable real-life practice conditions is also referred to as a “real-world” study in the following document.
Quality of Life	An individual can enjoy and perform daily life activities relating to physical, social, emotional, and functional well-being.
Randomized control trial	A study randomly assigned participants into an experimental group or a control group, often to test whether an intervention works under optimal conditions.

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Chapter 1 Introduction

Cancer continues to be the leading cause of death in Canada, responsible for approximately 25% of deaths (Canadian Cancer Society, 2020). Further, nearly 1 in 2 Canadians will be diagnosed with cancer at some point during their lifetime (Canadian Cancer Society, 2020). However, due to the increased availability and improvements in screening and treatments, the number of Canadians surviving at least five years past their cancer diagnosis has increased (Canadian Cancer Society, 2020). These advancements in treatment have led to an increase in cancer survivors (CS). In turn, this increased survivability has revealed the adverse long-term effects of cancer and its treatment on the overall health and well-being of CS. Many CS experience short and long-term adverse physiological, psychological, and social side effects associated with their cancer diagnosis and treatments, ranging from mild to disabling and life-threatening (Courneya, 2003). Therefore, interventions are required to lessen the harmful effects of cancer and its treatment.

Implementing interventions for CS has become essential for overall health promotion for this population (Courneya & Friedenreich, 2007). A potential intervention method for individuals in the cancer continuum is physical activity (PA) (Garcia & Thomson, 2014). Decades of research suggest that PA is a safe and effective method for reducing many of the adverse side effects of treatment, preventing chronic disease, and improving treatment outcomes among CS, thus promoting better overall health (Garcia & Thomson, 2014; Phillips et al., 2014). PA is also positively associated with improved cardiorespiratory fitness, muscular strength and endurance, quality of life (QoL), and other positive psychosocial factors in CS (Garcia & Thomson, 2014;

Gerritsen et al., 2016). Due to the clear indication that PA plays a vital role in the overall health and well-being of CS, organizations, including the American College of Sports Medicine, have developed PA recommendations for cancer survivors (Campbell et al., 2019). However, despite the recommendations and the known benefits regarding PA, only a small percentage of Canadian CS are physically active (Neil, Gotay, & Campbell, 2013; (Courneya, Katzmarzyk, & Bacon, 2008; Rock et al., 2012). The literature suggests this may be due to a lack of available resources and exercise expertise, in addition to a lack of knowledge of benefits by clinicians (Keogh et al., 2017; Santa Mina et al., 2012; Shea, Urquhart, & Keats, 2019). Further, the implementation of PA is not currently a widely accepted standard of care in oncology and medical settings, despite the development of evidence-based guidelines (Schmitz et al., 2010). Further knowledge and research are needed to better integrate PA programming effectively into standard care for CS.

An expanding amount of evidence has shown the benefits and efficacy of PA for CS by implementing experimentally based PA programs (Juvet et al., 2017; Vulpen et al., 2017; Winkels et al., 2017). These studies often utilized randomized controlled trials (RCT) and a rigid “one size fits all approach,” with a focus on producing results determining whether an intervention works under optimal conditions (Patsopoulos, 2011). This research has provided various in-depth guidelines for applying disease-management PA strategies for CS (Segal et al., 2017; Denlinger et al., 2017; Cormie et al., 2018). However, due to this structured approach, the benefits and strategies of PA programming for CS are less well studied in "real-world" applications (Santa Mina et al., 2019; Kilari et al., 2016; Phillips et al., 2014). Specifically, researchers have expressed that restrictive intervention protocols may not fit a given CS's needs, preferences, and abilities (Santa Mina et al., 2019; Kilari et al., 2016). Therefore, research is needed to assess PA's effectiveness as a clinical tool in oncology through sustainable and pragmatic approaches in "real-world" settings (Santa Mina et al., 2019). The results observed from these pragmatic or “real-world” trials will produce generalizable results that can be applied in routine practice (Patsopoulos, 2011).

The literature has revealed that QoL is a significant benefit of PA for CS (Cormie et al., 2017 & Santa Mina et al., 2017). QoL is directly related to an individual`s overall well-being, enjoyment of life, and perceived ability to carry out their daily activities (NCI, 2017 & CDC, 2018). Unfortunately, CS are very likely to experience a decreased QoL due to their cancer diagnosis and associated treatments (Colombo et al., 2018). Therefore, QoL in CS has become an essential focus in rehabilitation and survivorship research (Gilchrist et al., 2009). The positive QoL outcomes for CS through PA participation have been thoroughly demonstrated through various experimental RCT-based studies (Dhawan et al., 2020; Hu & Zhao, 2021; Spencer & Staffileno, 2021). The emergence of pragmatic, evidence-based PA programs have also revealed promising QoL results in CS (Santa Mina et al., 2017; Cheifetz et al., 2013). These findings support the continued evaluation of the QoL benefits of “real-world” applications of PA programs. This research will further facilitate the implementation of PA as an effective and sustainable support for CS.

Various factors have been shown to be correlated with QoL (Heydarnejad, Hassanpour, & Solati, 2011). Some of these factors may have an influence on the QoL outcomes of CS participating in a PA program. Specifically, age, functional capacity, and program adherence have been shown to be associated with QoL. As individuals with chronic disease age, they may be more likely to experience decreased QoL (Hewitt et al., 2003). This may have a negative impact on the QoL outcomes a CS may receive from a PA program. Research has also demonstrated a significant correlation between functional capacity and QoL in CS participating in PA programming, as both have been shown to increase during PA participation (Duarte et al., 2020; Irwin et al., 2016; Nadler et al., 2019). Additionally, program adherence may also affect QoL outcomes as attending a PA program more regularly may lead to more significant improvements (Irwin et al., 2016).

Activating Cancer Communities through an Exercise Strategy for Survivors (ACCESS) is a pragmatic, evidence-based PA program designed to lessen the impact of a cancer diagnosis and its treatment(s) on the physical, psychological, and social well-being of CS. ACCESS provides Nova Scotian CS with the opportunity to engage in an individualized 24-session PA program tailored to their tumor type, cancer stage, treatment type, and other individual factors (e.g., activity preferences, fitness level, physical abilities, and personal needs). ACCESS features a pragmatic approach that differs from many of the existing RCT-based studies in the literature. Specifically, ACCESS is inclusive for all CS on the cancer trajectory (i.e., cancer type, treatment status, stage, time since diagnosis, etc.). Many RCT-based studies in the literature feature one cancer type and one treatment type, making ACCESS much more generalizable to "real-world" patients and settings. ACCESS also tailors the PA programming for each participant based on various factors, including medical history, treatment status, tumor type, fitness level, participant goals, participant preferences, and more. This contrasts with many of the RCT-based studies, which feature specific modes and intensities of exercise, which may prevent the participation of some CS due to pre-existing comorbidities and may inhibit adherence to PA beyond the study. As ACCESS includes a more flexible and individualized approach, this may increase exercise adherence and outcomes and overall participant enjoyment. The ACCESS study aims to examine whether a novel clinic to community cancer PA model improves the physical, mental, and social well-being of CS in Nova Scotia.

There is no current information about the implementation and effectiveness of a pragmatic, evidence-based PA program for CS in Nova Scotia, Canada. Therefore, the primary purpose of the present study was to assess the impact of a pragmatic intervention trial (i.e., ACCESS) on the QoL of CS. The specific objectives were to determine if:

1) If the ACCESS exercise program improves QoL in CS; 2) If the potential changes in QoL differ by participant age; 3) If the potential changes in QoL vary by length of program completion and 4) If the potential changes in QoL differ by changes in functional ability (i.e., 6MWT outcomes) of participants.

This study will further the existing knowledge around the QoL benefits for CS from a novel, pragmatic research-based PA program. This research will help future decisions and interventions to be made by health practitioners and researchers regarding integrating PA programming into cancer care. This research will also target and support CS as the results will better understand PA's benefits across the cancer continuum.

Chapter 2 LITERATURE REVIEW

Cancer and Physical Activity

In 2020 alone, it was estimated that 225 800 new cancer cases were diagnosed in Canada (Canadian Cancer Society, 2020). Evidence predicts that the number of cancers diagnosed in 2030 will be almost 80% greater than in 2005 (Canadian Cancer Statistics, 2015). These statistics are a significant concern as cancer is the leading cause of death in Canada, with 1 in 4 Canadians dying from cancer (Canadian Cancer Society, 2020). However, immense progress has been made in cancer control in Canada due to advances in prevention, screening, early detection, and treatment (Siegal et al., 2010). This progress has led to over 63% of Canadians surviving at least five years past their cancer diagnosis (Canadian Cancer Society, 2020). This increased survivorship has resulted in a new set of challenges that need to be addressed in cancer survivors (CS). These challenges include adverse physiological, psychological, and social side effects of cancer and its resulting treatments that negatively influence CS`s QoL and increase morbidity and non-cancer-related mortality (Hewitt et al., 2005). Therefore, implementing strategies to help support CS throughout their cancer journey is imperative to their overall health and wellbeing (Campbell et al., 2019). One potential method is incorporating physical activity (PA) into the long-term care plan for CS. Evidence supports vital health benefits of regular PA for CS. This evidence includes mitigating many of the various side effects experienced by CS due to their cancer and treatments (Garcia & Thomson, 2014; Sabiston & Brunet, 2012). The benefits experienced by CS make the use of PA to improve health outcomes, quality of life (QoL), and overall well-being a key area of study in cancer survivorship.

Physiological Effects of Cancer and Cancer Treatments

CS experience various adverse physiological effects due to their cancer and cancer treatments. Research has shown that CS has a heightened risk of comorbidity and all-cause mortality than those without a cancer diagnosis (Ng et al., 2017; Roy et al., 2018). Specifically, CS experience an increased incidence of cardiovascular and pulmonary dysfunction, including hypertension, myocardial infarction, stroke, and chronic obstructive pulmonary disease (Ameri et al., 2018; Carver et al., 2007; Keats et al., 2020). CS are also more likely to experience other chronic conditions such as diabetes, obesity, arthritis, liver cirrhosis, and osteoporosis (Keats et al., 2020; Mao et al., 2007). Various studies have also revealed that CS face high fatigue, pain, and functional decline (Garcia & Thomson, 2014; Blaney et al., 2010; van den Beuken-van Everdingen et al., 2007). Further, cancer and its treatments have been shown to affect physical fitness measures; including, muscular atrophy, weight changes, lowered aerobic capacity, and decreased strength and flexibility (Sabiston & Brunet, 2012; Garcia & Thomson, 2014).

Psychological Effects of Cancer and Cancer Treatments

CS are also at risk of experiencing adverse psychological effects due to their cancer and cancer treatments. These include emotional distress and mental health problems, including depression and other emotional issues (Adler, 2008; Linden et al., 2012; Frick et al., 2007). Clinical depression is a frequent yet often unrecognized source of CS suffering (Chochinov, 2001; Massie, 2004; Holland & Rowland, 1989). CS also display higher anxiety levels than non-cancer populations (Inherstern et al., 2017; Hinz et al., 2010). Further, cancer and cancer treatments may also involve losing body parts, scarring, adjustments to a prosthesis, decreased physical activities, tumors, hair loss, chemotherapy, and radiotherapy (Bahrami et al., 2017). These factors can often lead to body image disturbances (Bahrami et al., 2017). Psychological body image disturbances directly correlate with low self-confidence and sexual functioning, weak social relationships, and depression (Gehrman et al., 2006; Fobair et al., 2006). CS tend to decrease their PA levels after their cancer diagnosis due to poor body image and self-esteem (Courneya & Friedenreich, 1997; Canadian Cancer Society, 2019).

Social Effects of Cancer and Cancer Treatments

Social support plays a leading role in adapting to and overcoming life crises, such as cancer (Velikova-Tzonkova, 2013). Attention to psychosocial needs and QoL is essential for modern cancer care (National Cancer Plan 2000; National Institute of Clinical Excellence, 2004). Faller and colleagues (2016) state that CS typically report a higher level of physical and psychological stress due to their illness and require an increased need for social support than those without a cancer diagnosis. CS often face problems in various aspects of their social lives; including family life, relationships, work, income, leisure activities, and relationships with health care providers (Wright et al., 2002; Muzzatti & Annunziata, 2002; Duijts et al., 2014; Yabroff et al., 2016; Catt et al., 2017). Several studies have also indicated that CS's social problems significantly impact their mental health, QoL, and lead to a reduction in PA levels (Cull et al., 1995; Kobayashi et al., 2008; Dapueto et al., 2005; Wright et al., 2015; Coleman et al., 2014). CS also commonly experienced feelings of isolation, highlighting the need for social support among CS and a need for supportive resources and programming to provide a comforting environment for this population (McDonough et al., 2020; Shea, 2018).

Benefits of Physical Activity

Extensive research has been conducted regarding PA's safety, feasibility, and efficacy across the cancer continuum (Hayes et al., 2019). PA has been shown to be a safe, effective, and low-cost means of preventing and improving numerous physical and psychological treatments and disease-related side-effects across the cancer trajectory (i.e., on and off treatment) (Hewitt, Greenfield, & Stovall, 2005). Specifically, research has shown that CS involved in PA have a reduced risk of disease recurrence and cancer mortality, in addition to a reduced risk of side effects due to their cancer and its treatments such as anxiety, depression, and cancer-related pain (Hewitt, Greenfield, & Stovall, 2005; Buffart et al., 2014).

Physiological Benefits of Physical Activity

PA has been shown to benefit CS during and after treatment by mitigating treatment-related side effects and improved health outcomes (Chyu et al., 2016; Thompson et al., 2003; Kushi et al., 2012; Lenihan & Cardinale 2012). Several studies have shown that PA decreases the risk of various chronic diseases in CS, including coronary heart disease and type 2 diabetes (Jacobs et al., 2009; Rock et al., 2012). PA has also led to a significant reduction in body max index (BMI) and weight in this population (Fong et al., 2012), in addition to considerable improvements in body fat and lean body mass (McNeely et., 2006). Another benefit of PA in CS is improved physical function (Schmitz et al., 2005). Research has shown improvements in CS`s peak oxygen consumption, peak power output, aerobic capacity, and muscular strength and endurance through PA (Gjerset et al., 2011; McNeely et al., 2006; Kim et al., 2009; Schmitz et al., 2005). PA has also been shown to significantly reduce the fatigue levels experienced by CS and improve immune function (Speck et al., 2010; Brown et al., 2011). PA may also reduce the risk of cancer recurrence and lead to prolonged survival in CS (Fong et al., 2012; Schmitz et al., 2005).

Psychological Benefits of Physical Activity

Evidence shows that PA decreases depression, anxiety, and emotional distress in CS (Mahmic-Kaknjo, 2017; Garcia & Thomson, 2014; Sabiston & Brunet, 2012). PA has also been found to play an essential role in improving body image and self-esteem (Mishra et al., 2012; Garcia & Thomson, 2014). The literature suggests that PA is an effective method in reducing emotional distress and improving mental health components while leading to an improved QoL (Garcia & Thomson, 2014; Shea, 2018; Carayol et al., 2013).

Social Benefits of Physical Activity

Research has shown that more significant social and friend support increases PA levels and improves health and QoL in CS (Coleman et al., 2014). Various studies have shown that community-based PA programs lead to increased social support and feelings of belonging and connectedness among CS (Culos-Reed et al., 2005; McDonough et al., 2008). Research has demonstrated that CS experienced an increased sense of being understood by others through PA program participation, unlike traditional support groups (Missel et al., 2015; Cormie et al., 2015; Fischer et al., 2015; Luoma et al., 2014). The literature has also shown that PA leads to the fostering of social connections between CS, in addition to reduced social isolation and increased feelings of relatedness, belongingness, and camaraderie (Burke & Sabiston, 2010; McGrath et al., 2010; Donnelly et al., 2013; Missel et al., 2015; Ray & Verhoef, 2013; Luoma et al., 2014). Resnick and colleagues (2002) stated that the relationship between social support and PA is reciprocal, as social support increases PA levels, and PA increases social support. Social support in CS also has tremendous importance in dealing with mental health and psychological problems such as anxiety and depression, common in CS (Hauken et al., 2015; Usta, 2012).

Quality of Life

QoL has become a familiar and vital study outcome for exercise oncology research (Cormie et al., 2017). QoL is dependent on an individual's physiological, psychological, and social well-being (Nayak et al., 2017). CS experience many side effects due to their disease and related treatments that may lead to a reduction in their QoL (Nayak et al., 2017). This impact on QoL may involve poor emotional, physical, and societal functioning (Heidrich et al., 2006).

Fortunately, as demonstrated above, evidence has revealed that PA plays a significant role in improving all aspects of well-being and, therefore, QoL. Numerous studies focused on QoL in CS showed that PA could improve physical, psychological, and social functioning and overall life satisfaction (Sabiston & Brunet, 2012; Gerristen & Vincent, 2015; McKneely, 2006; Albrecht & Taylor, 2012). Specifically, Santa Mina and colleagues (2017) examined the effects of a supervised community-based aerobic and resistance training program for CS. The results revealed that the pragmatic, 30-week PA program led to significant improvements in various QoL outcomes, including total QoL, physical well-being, emotional well-being, and functional well-being as measured by the FACT-G questionnaire. Similarly, a study by Musanti and colleagues (2019) found that a 12-week supervised community-based PA program for CS led to significant improvements in QoL among participants. This program implemented aerobic and resistance training, in addition to flexibility and balance exercises (Irwin et al., 2017). QoL was measured through a patient-reported outcomes measurement information system (Musanti et al., 2019). An RCT-based study by Courneya and colleagues (2009) for lymphoma patients revealed that 12-weeks of supervised aerobic training three times per week led to significant improvements in overall QoL for the intervention group. QoL was measured using the Functional Assessment of Cancer Therapy-Anemia, which features the FACT-G questionnaire, with additional items focused on anemia and fatigue for CS. Another RCT-based study by Milne and colleagues (2008) examined the effects of a three-times-weekly combined aerobic and resistance training program on breast CS`s QoL. The results showed that the 12-week program led to significant positive changes in QoL for the participants as measured by the Functional Assessment of Cancer Therapy-Breast scale (Milne et al., 2009). Henke and colleagues (2014) implemented an RCT-based study for lung CS undergoing palliative chemotherapy, to examine the effects of a strength and endurance training program on QoL. The strength and endurance training sessions were administered to participants, while they underwent three cycles of chemotherapy, with the endurance training occurring five days per week and the strength training every second day (Henke et al., 2014). Participants in the intervention group experienced significant improvements in their QoL as measured by the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30 questionnaire.

Research has revealed various factors that may be correlated with QoL (Heydarnejad, Hassanpour, & Solati, 2011). Specifically, increased age may be associated with decreased QoL in individuals with chronic diseases, such as cancer (Hewitt et al., 2003). However, according to Netuveli et al. (2006), individuals may experience an improved QoL as they age. However, this study also found that fundamental factors can harm QoL, such as longstanding illness (Netuveli et al., 2006). Various studies have also revealed a significant relationship between functional capacity and quality of life in CS (Galiano-Castillo et al., 2016; Ramachandran et al., 2018). Specifically, studies have observed improvements in functional capacity and QoL in CS participating in PA programming (Duarte et al., 2020; Irwin et al., 2016; Nadler et al., 2019), indicating a potential correlation between the two variables.

Program adherence may also affect the QoL outcomes of CS in participating in PA programming. Specifically, how long participants take to complete a PA program may impact the change in QoL outcomes. For example, a study by Irwin and colleagues (2016) found that participants who had a greater program adherence were more likely to experience more significant improvements in QoL (Irwin et al., 2016).

Current Guidelines and PA Patterns for CS

Experts recommend that Canadian CS avoid inactivity and achieve the current PA guidelines for health (30 minutes 3x/week of moderate-intensity PA, including resistance training 2x per week) to receive the associated health benefits (Campbell et al., 2019). Participating in regular PA has been shown to reduce the risk of various chronic conditions and reduce all-cause mortality for CS (Wharburton et al., 2017). PA participation is also associated with improving fatigue, anxiety, depression, and QoL (CSEP, 2019).

Unfortunately, a large percentage (>80%) of adults in Canada, both with and without a cancer diagnosis, do not meet these PA guidelines (Keats et al., 2016; Health Agency of Canada, 2020; Neil, Gotay, & Campbell, 2013). Factors that may affect PA levels in CS are sex, education level, presence of comorbidities, BMI, and age (Trost et al., 2002; Forbes et al., 2014; Speed-

Andrews et al., 2014; Nayak et al., 2014). Further, exercise is not currently implemented as a widely accepted standard of care in oncology and medical settings, despite the development of evidence-based guidelines and well-recognized PA benefits in those with chronic diseases such as cancer and the general population (Schmitz et al., 2010).

Wharton and colleagues (2017) revealed promising findings showing a dose-response relationship between PA and health status (Wharburton et al., 2017). Therefore, although most CS are not sufficiently active enough, health benefits can still be achieved at PA volumes less than the current PA recommendations (Wharburton et al., 2017). Therefore, encouraging CS to start or continue adding small amounts of PA into their lifestyles will provide these individuals with evident health benefits (Foulds et al., 2014; Wharton et al., 2017).

PA Programming for CS

The current PA programming for CS involves various community, clinic, and home-based initiatives (Hardcastle & Cohen, 2017). Research has shown a variety of pros and cons regarding the different PA program locations for CS. A survey conducted by Jones and Courneya (2002) showed that CS might prefer clinic/hospital-based PA programming compared to an at-home program or community location. This may be due to the familiarity and high expectations for safety in a clinical environment (Hardcastle & Cohen, 2017). Conversely, additional research has shown that CS may prefer participating in group exercise programs in a non-clinical setting focused on health promotion rather than illness (Rogers et al., 2009; Blaney et al., 2013). Community-based programs can increase the benefits of PA for CS through increased accessibility and safety, social interaction, and supervision by trained exercise specialists (Santa

Mina et al., 2017). However, potential limitations of this approach include lack of motivation, access, time, and possible financial cost for participants (Hardcastle & Hagger, 2015). These barriers may lead to poor uptake and adherence to community-based PA programs. Home-based PA programming may also be advantageous for this population as it would decrease access, time, and transport issues associated with the community or hospital-based programs (Hardcastle & Hagger, 2015). However, home-based programming includes limitations that may negatively affect adherence, such as safety concerns, reduced motivation, and lack of supervision and social interaction (Segal et al., 2017). A literature review revealed that supervised programming appears to be more effective for CS than unsupervised programs (Campbell et al., 2019). However, this may be due to factors associated with a supervised setting, including an increased PA dose or factors such as increased attention, motivation, reinforcement, etc. (Campbell et al., 20190. Research has also shown that implementing individualized PA programming based on participant preferences, goals, and characteristics may optimize uptake and adherence of CS in the program (Hardcastle & Hagger, 2015). Providing PA programming with both aerobic and resistance training has led to more significant improvements in CS outcomes. Specifically, the combination of aerobic and resistance training reduces anxiety and depression, lowers fatigue, improves QoL, and improves physical function (Campbell et al., 2019). Program length should be at least 8 to 12 weeks long and should offer training for participants two to three times per week (Campbell et al., 2019). Information and referrals for PA programming from patients` oncologists may also increase uptake and adherence (O'Leary et al., 2007).

Key guidelines for PA programming include: 1) aim to have participants reach the recommended PA guidelines (30 minutes 3x/week of moderate-intensity PA, including resistance training 2x per week); 2) conducting a pre-exercise assessment before intervention; 3) providing a group and supervised setting for participants for optimal benefit (i.e., QoL and muscular fitness); 3) encouraging CS to continue performing PA as part of their lifestyle to maintain program benefits (Segal et al., 2017; Campbell et al., 2019).

Gaps in the Literature

Decades of research have revealed the benefits of exercise for CS (Santa Mina et al., 2019). This literature mainly features RCT-designs which have provided a strong foundation regarding the efficacy of PA in improving QoL in this population. However, a limitation of the experimental designs used in many of these studies is the lack of generalizability to a clinical setting and population. These restrictive intervention studies often do not align with "real-world settings" and the abilities and preferences of the target population (Santa Mina et al., 2019). Further, these studies often feature small sample sizes, highly selected participants, and highly controlled settings and protocols, resulting in overestimating benefits and underestimating harm (Ford et al., 2016). Therefore, there should be an increased focus on pragmatic trials, which allow real-world data to be obtained based on the effectiveness of an intervention in broad patient groups (Ford et al., 2016; Zuidgeest et al., 2017). A pragmatic approach generates real-world evidence before the launch of the intervention in clinical and community settings. This allows for appropriate changes and adjustments to the intervention, ensuring increased effectiveness and feasibility of PA programming for CS as implemented into routine cancer care.

Hayes and colleagues (2019) explored PA and CS's current literature and created guidelines regarding specific PA prescriptions. These recommendations highlighted the importance of targeted and individualized PA prescriptions to ensure the most significant benefit and lowest CS risk. The guidelines recommended considering individual characteristics of each CS; including, cancer diagnosis, health/PA history, treatment side effects, patient capacity, and goals. The article also suggests constant monitoring and modification as the program and participant progresses (Hayes et al., 2019). Additionally, Schmitz and colleagues (2010) presented cancer-specific PA guidelines, explicitly focusing on breast, prostate, colon, hematologic, and gynecologic cancer populations. These guidelines were based on the current American College of Sports Medicine (ACSM) recommendations for PA (i.e., 150 minutes per week of moderate to vigorous PA per week and 2-3 days of strength). They were then tailored to fit each specific cancer population (Schmitz et al., 2010). However, despite these guidelines by governing sport and health organizations, little research has been done examining the outcomes of a pragmatic, individualized PA program for CS. Hayes and colleagues (2019) state that implementing personalized and flexible programming for participants can lead to increased program adherence, enjoyment, and benefits, in addition to reduced participant risks. Therefore, further research must be conducted to assess individualized and tailored PA programs for CS to explore these potential outcomes.

Summary

The current literature states that CS will experience many benefits from PA participation (Garcia & Thomson, 2014; Phillips et al., 2014). Some of these benefits include reduced risk of comorbidity of other chronic diseases (Jacobs et al., 2009; Rock et al., 2012), improved mental health (Mahmic-Kaknjo, 2017; Garcia & Thomson, 2014), and increased social support and feelings of connectedness (Culos-Reed et al., 2005; Emslie et al., 2007; McDonough et al., 2008). However, only a small percentage of CS are physically active (Keats et al., 2016; Health

Agency of Canada, 2020; Neil, Gotay, & Campbell, 2013). Most of the existing research surrounding PA and CS is based on RCTs and cancer-specific studies (Velthuis et al., 2010; Hayes et al., 2019). These studies may not apply to a given CS's needs, preferences, and abilities as they often utilize a very structured “one-size fits all” approach, in terms of the frequency, intensity, and mode of activity, which does not consider the individual characteristics of each participant (Santa Mina et al., 2019; Kilari et al., 2016).

Therefore, future research should focus on pragmatic approaches and explore implementing sustainable and evidence-based practices in "real-world" settings (Santa Mina et al., 2019). Further, a specific focus on QoL outcomes in pragmatic PA programs would be beneficial as QoL is a critical focus in cancer research (Cormie et al., 2017). Additionally, limited research exists investigating how these QoL outcomes may be impacted by specific factors among participants, leading to a further avenue of research. This focus has the potential to lead to a better understanding of the implementation and effectiveness of PA programming for CS in Nova Scotia.

The secondary data analysis of components of the ACCESS study will analyze the effectiveness of ACCESS through analyzing pre-and post-program QoL measures and various predictor variables. The primary purpose of the current study was to assess the efficacy of the ACCESS exercise program by; 1) examining whether a 12-week exercise program improves QoL in CS; 2) examining whether outcomes differ by participant age; 3) examining whether the QoL outcomes differ by length of completion of the program; 4) examining whether the QoL outcomes differ by a change in functional capacity among participants.

Chapter 3 METHODOLOGY

Study Design

For the current study, a secondary data analysis was conducted using the ACCESS study collected between September 2018 and March 2020. The data was used to determine the following study objectives: 1) If the ACCESS exercise program improved QoL in CS; 2) If the changes in QoL differed by participant age; 3) If the changes in QoL differed by length of program competition; and 4) If the changes in QoL differed by changes in the functional capacity of participants.

The ACCESS Study

ACCESS is a hybrid type II implementation-effectiveness (Curran et al., 2012) study designed to bridge the gap between research and practice and, therefore, lessening the impact of a cancer diagnosis and its treatment(s) on the overall well-being of CS. ACCESS provides CS with the opportunity to participate in an individualized PA program. The ACCESS study assessed whether a clinic-to-community cancer PA model improves the physical, mental, and social well-being of CS in Nova Scotia. The goal of ACCESS is to develop a better understanding of the processes involved with the implementation and sustainability of cancer and exercise programming in Nova Scotia and beyond.

Participants

Inclusion & exclusion criteria

To be eligible for the ACCESS study, participants had to: 1) Have received a diagnosis of cancer; 2) Be 18 years or older; 3) Be able to participate in mild levels of physical activity (PA) (at a minimum); 4) Be pre-treatment, receiving active treatment, or have received a cancer diagnosis within the past five years or have late occurring/ongoing side-effects as a result of the cancer diagnosis (e.g., fatigue); 5) Be able and willing to attend a twice-weekly exercise program; 6) Be able to provide informed written consent in English, and 7) Have medical approval to participate. In addition, for the current secondary data analysis, all participants must have: 1) completed the 12-week ACCESS program; 2) all relevant pre- and post-program measures collected and recorded (e.g., QoL, 6MWT, age, length of program).

Participant Recruitment

For ACCESS, participants were recruited throughout the Halifax Region Municipality in Nova Scotia. Participants were referred to the program through either “self” or “clinician” referrals. All participants required a Clinician Screening Form to be completed to be eligible for program participation by a clinician to participate.

Sample Size

The ACCESS program is an ongoing research initiative, and to date, the program has received over 330 clinician and self-referrals since September 2018. The current study included 89 CS across the cancer trajectory. Figure 1 highlights the selection process for participants in the present study.

PROCEDURE

Study Setting

The current study used data collected at Halifax ACCESS sites. This included the Dickson Building at the QEII health center and the Canada Games Centre. Participants deemed "high-risk" were required to attend the QEII location under the ACCESS Certified Exercise Physiologist (CEP) to ensure their safety. All participants deemed "low-risk" were eligible to participate in any program location.

Consent

The ACCESS study is approved under the Nova Scotia Health Authority Research Ethics Board ROMEO File #: 1023682. All participants consented to participate in the study.

Protocol

Individuals who consented to participate in the study underwent a baseline assessment, including a pre-intervention questionnaire and fitness assessment (e.g., FACT-G and 6MWT). Following baseline screening and evaluation, participants underwent 24-sessions of twice-weekly PA programming. Participants at the QEII location followed individualized programming directed by the ACCESS CEP. Participants that attended the Canada Games Centre location participated in group-based sessions led by trained exercise professionals. Programming for all participants featured a combination of aerobic, resistance, and flexibility training. Baseline measures were repeated at the end of the 24-sessions for each participant.

Master`s student, Caroline Straub, requested data for this thesis from the ACCESS study on September 1, 2020. The data requested included all ACCESS participants who had completed the program, specifically demographic measures (e.g., sex, age, cancer type, education, income), FACT-G data, fitness measures, program start and stop dates, and program location. The applicable data was released to Caroline by the primary investigators of ACCESS, Dr. Melanie Keats and Dr. Scott Grandy. After the requested data was received, data was cleaned and reviewed. In addition, communication was maintained with the data custodians regarding requests for missing data and oversight of the data management and analysis.

OUTCOME MEASURES

Materials and Instrumentation

For ACCESS, all participants underwent a comprehensive assessment of fitness (CSEP, 2013). This included the 6MWT, which was used to assess functional capacity. In addition, a 27-item questionnaire was used to evaluate various measures pre- and post-program. The Functional Assessment of Cancer Therapy– General (FACT-G) questionnaire was used to assess total QoL and four subdomains of QoL (e.g., physical, social, emotional, and functional well-being). The FACT-G has been used extensively and is highly recommended for assessing CS populations' QoL (Homoen et al., 2015). Participant demographic information was also collected through the baseline questionnaire. This included age, sex, cancer type, socioeconomic status, and health status.

Data Analysis

Participant demographics were summarized using descriptive statistics (mean, SD, frequency, and percentages). These variables included age, sex, cancer type, income, employment status, education, program adherence, and health status. Normality was assessed through Kurtosis and Skewness statistics. These statistics revealed that the data was not normally distributed. However, due to the central limit theorem, which states, "...the sum of a sufficiently large number of independent identically distributed variable approximately follows a normal distribution"

(Springer Link, 2008). Therefore, despite the lack of normally distributed data, parametric statistics were still used. All statistical analyses were be conducted using SPSS software (version 25). A *p*-value of less than 0.05 was used to indicate statistical significance.

For objective 1, repeated measures ANOVAs were conducted on the outcome variables (i.e., total QoL and QoL subdomains) to determine if these variables changed over the 12-week program. The effect size was measured for objective 1 using Cohen`s d. For objective 2, a multiple linear regression was used to assess whether age influenced QoL outcomes. For objective 3, a multiple linear regression was used to determine whether the length of program completion influenced QoL outcomes. Finally, for objective 4, a multiple linear regression was used to assess whether participant 6MWT results influenced QoL outcomes. For objectives 2, 3, and 4, difference scores were calculated for the QoL and 6MWT outcomes. This involved subtracting the pre-intervention values from the post-intervention values. These difference scores were then used for the multiple linear regressions stated above. The effect sizes for objectives 2, 3, and 4 were measured using Cohen`s $f^2$. A repeated-measures ANOVA was also used to determine whether a significant change occurred over the 12-week program for the 6MWT. The effect size was measured for this paired t-test using Cohen`s d.

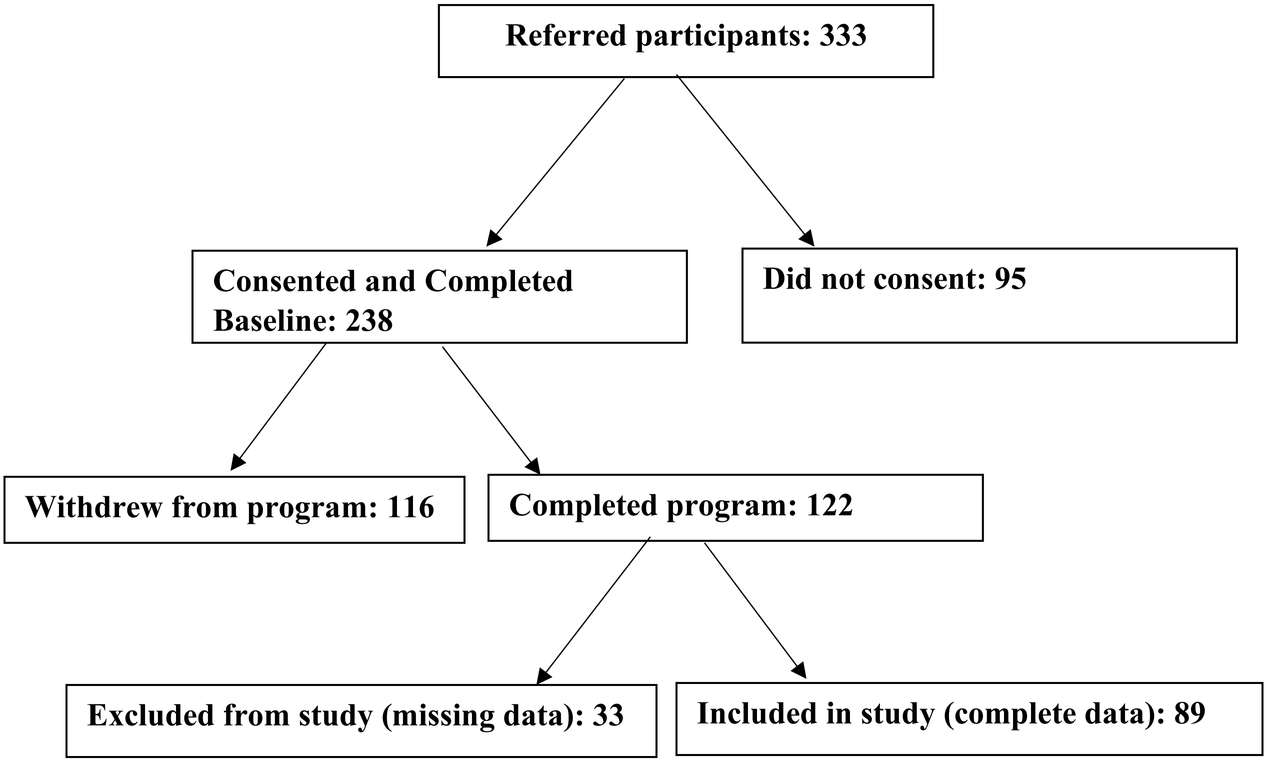

Figure 1. Inclusion process for participant selection.

Chapter 4 RESULTS

This study aimed to assess the effectiveness of the ACCESS program for CS in Halifax, Nova Scotia. Specifically, the present study analyzed secondary data from the ACCESS exercise program, which included quality of life (QoL) outcomes from the FACT-G questionnaire, six-minute walk test (6MWT) outcomes, participant age, and length of program. A total of 89 participants were included in the current study. A description of the participant sociodemographic characteristics, cancer type, and health status is presented in Table 1. The three most common cancer types among participants were breast cancer (n=31), gastrointestinal cancers (n=12), and blood cancers (n=11). The mean age for participants in the current study was 61 (+/-10.837) years of age. Regarding health status, 31.4% of participants reported having a good, very good, or excellent health status before starting the program, with the other 68.6% reporting fair to poor health before the program.

Table 1

ACCESS Participant Characteristics

Characteristics	*n*	*% of total sample (n=89)*
Sex		
Female	59	66.3
Male	30	33.7
Age		
28-45	8	9.0
40-59	28	31.4
60-69	30	33.7
70-87	23	25.8
Cancer type		
Breast	31	34.8
Prostate	6	6.7
GI	12	13.5
Lung	5	5.6
Blood	11	12.4
Other	24	27.0
Household Income		
Less than $24,999	6	6.9
$25,000-$74,999	29	32.5
$75,000-$149,999	36	40.4
$150,000 or more	11	12.3
Prefer not to answer/missing	7	7.8
Education		
Highschool (or less)	15	16.9
Trade school/Diploma	20	22.5
University certificate	10	11.2
Bachelor`s degree	22	24.7
Graduate degree	20	22.5
**missing*	2	2.2
Employment		
Full-time	17	19.1
Unemployed	2	2.2
Retired	36	40.4
Part-time	3	3.4
Homemaker	3	3.4
On disability leave	27	30.3
**missing*	1	1.1
Self-rated health status		
Excellent	2	2.2
Very Good	24	2.2

Characteristics	n	% of total sample (n=89)
Good	43	27
Fair	15	48.3
Poor	4	16.9
**missing*	1	4.5
# Weeks to completion		
12 weeks	11	12.4
13-16 weeks	36	40.4
17-19 weeks	20	22.5
20-24 weeks	13	14.6
24+ weeks	9	10.1
Body Mass Index (BMI)		
18.5-24.9	35	39.3
25-29.9	28	31.5
≤30	26	29.2
Program Location		
QEII	73	82.0
Canada Games Centre	16	18.0

Due to the clinical population and to maintain program adherence, participants were given flexibility regarding attendance. This allowed participants to attend 24 sessions to complete the program while potentially taking longer than the designated 12-weeks. This flexibility permitted participants to miss sessions due to treatment or disease-related symptoms. Any missed sessions were added to the end of the program, which allowed participants to complete the full 24-sessions of the program. Table 1 highlights the number of weeks it took for participants to complete the program.

Regarding the length of program completion for ACCESS, 12.4% of participants completed the program within 12 weeks, 40.4% of participants completed the program within 13-16 weeks (i.e., up to 4 months), and 47.2% of participants completed the program in 17 or more weeks. Participants' mean number of days for program completion was 125.2 (SD=40.54) or 17.8 weeks

(SD=5.73). The maximum number of days for program completion was 268 days or 38 weeks. The minimum number of days for program completion was 78 days, slightly less than 12-weeks. This shortened time for program completion was likely due to some participants attending more than two sessions per week to complete the program by a specific date to accommodate scheduled procedures, vacations, etc.

Impact of PA on functional ability and QoL

Figure 1 displays the mean number of laps pre- and post-program for the 6MWT. After 24-sessions of the ACCESS program, the study found that participants experienced a significant improvement in the number of laps completed in 6 minutes ($p<0.001$), with an effect size of $d=0.413$, indicating a medium effect.

Figure 2 and Figure 3 present the means and standard deviations for the pre- and post-QoL outcomes. Figure 2 displays the total QoL of participants pre- and post-intervention. Figure 3 depicts the subdomain QoL outcomes. The pre- and post-total QoL means were 77.99 (SD=13.85) and 82.73 (SD=13.95), respectively, with an effect size of $d=0.341$. This indicates a small effect. The pre- and post-PWB (physical well-being) means were 20.58 (SD=5.41) and 22.12 (SD=4.88), respectively, with an effect size of $d=0.299$. This indicates a small effect. The pre- and post-SWB (social well-being) means were 21.85 (SD=4.53) and 22.04 (SD=4.03), respectively, with an effect size of $d=0.044$. This indicates a small effect. The pre- and post-EWB (emotional well-being) means were 17.48 (SD=3.58) and 18.69 (SD=3.79), respectively, with an effect size of $d=0.328$. This indicates a small effect. The pre- and post-FWB (functional well-being) means were 18.09 (SD=6.00) and 19.88 (SD=6.28), respectively, with an effect size of $d=0.291$. This indicates a small effect. From baseline to post-assessment, statistically significant changes in outcome measures were observed for total QoL, PWB, EWB, and FWB (p≤0.001). Overall, these findings indicate that a 12-week PA program led to significant improvements in PWB, EWB, FWB, and total QoL for CS. An increase in SWB was also observed; however, this was not statistically significant (p=0.700). This reveals that a 12-week PA program did not lead to significant improvements in SWB for CS. All participants had complete QoL data except for one missing baseline data for EWB, FWB, and total QoL. Therefore, these measures were not included in the analysis.

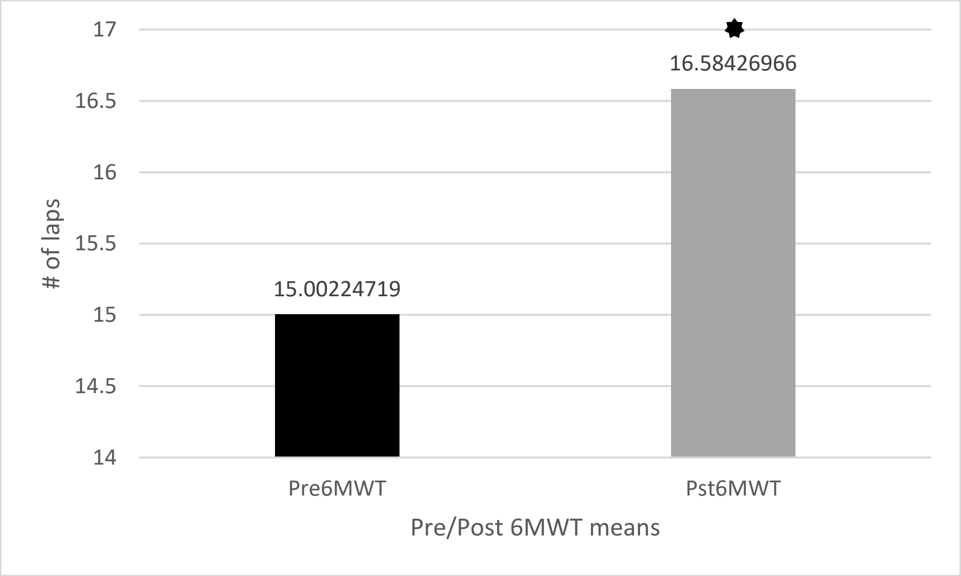

Figure 2. Impact of 12-week physical activity intervention on 6MWT (six-minute walk test)

✸ Indicates significant difference (p<0.001).

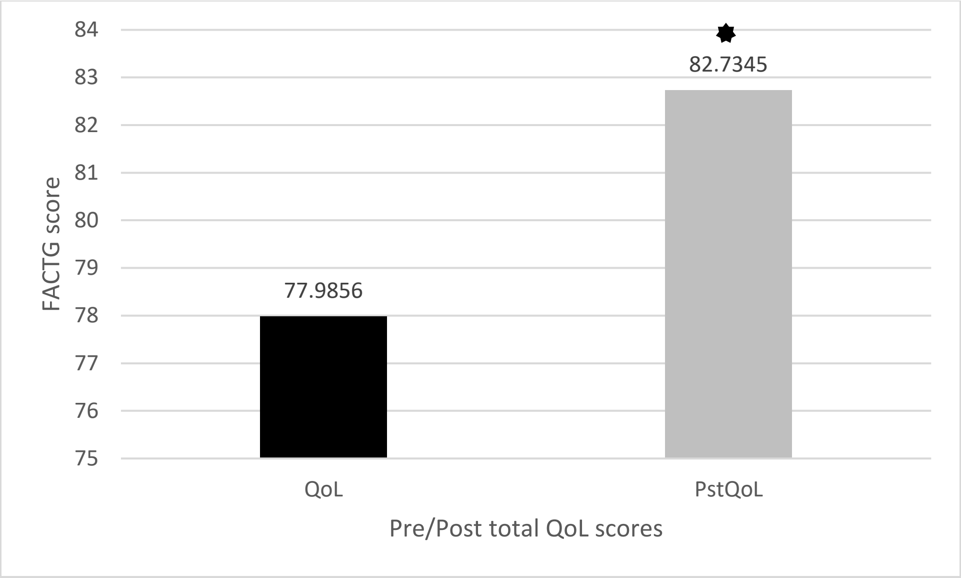

Figure 3. Impact of 12-week physical activity intervention on total QoL
✸ Indicates significant difference ($p<0.001$) between pairs.

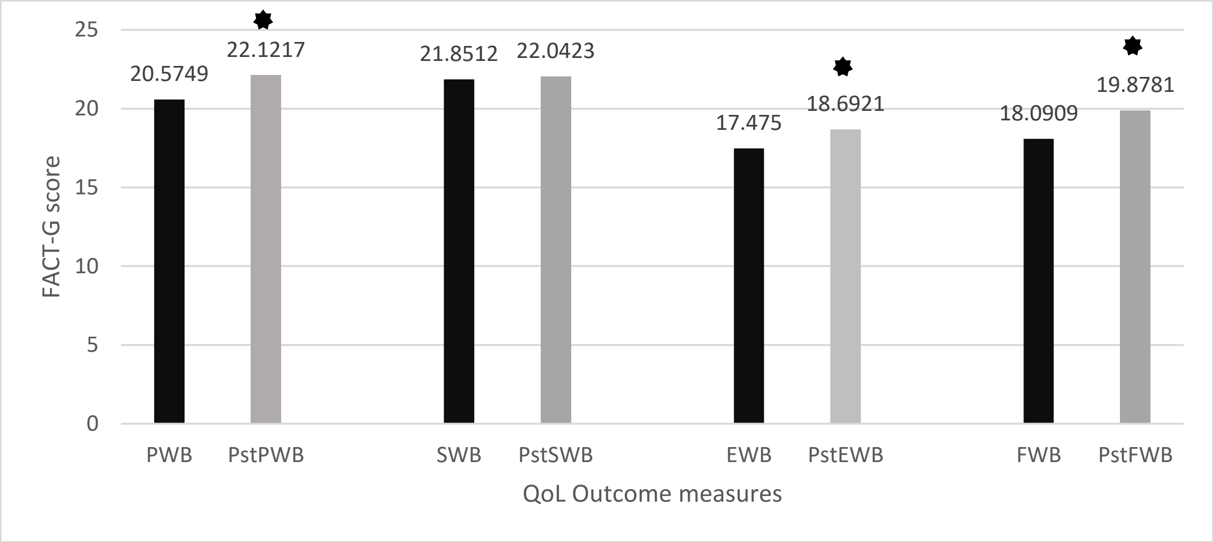

Figure 4. Impact of 12-week PA intervention on QoL
✸ Indicates significant difference ($p<0.001$) between pairs.

Factors affecting Quality of Life

Linear regression was used to determine any significant relationships between the three predictor variables (age, time to completion, and 6MWT outcomes) and the QoL outcomes. As displayed in table 3, no significant relationships were observed between age and total QoL, PWB, SWB, EWB, or FWB ($p \geq 0.05$). No significant relationships were observed between program adherence (i.e., days to completion) and total QoL, PWB, SWB, EWB, or FWB ($p \geq 0.05$). Similarly, no significant relationships were observed between 6MWT outcomes and total QoL, PWB, SWB, EWB, or FWB ($p \geq 0.05$). This reveals that age, time to program completion, and 6MWT outcomes did not significantly impact the QoL outcomes for a 12-week PA program for CS.

Table 2: Relationships between QoL and predictor variables (p=significance, f^2=effect size)

	PWB	**SWB**	**EWB**	**FWB**	**total**
Age					
p	0.578	0.509	0.579	0.537	0.120
f^2	0.007	0.008	0.010	0.007	0.013
# of weeks					
p	0.480	0.975	0.435	0.842	0.738
f^2	0.006	0.011	0.004	0.011	0.010
6MWT					
p	0.818	0.463	0.571	0.989	0.957
f^2	0.011	0.006	0.007	0.012	0.012

Note: An effect size, f^2, of ≥ 0.02 indicates a small effect.

Chapter 5 DISCUSSION

The primary purpose of the current study was to analyze data from the ACCESS program to determine whether the pragmatic program led to significant changes in participant QoL outcomes. In addition, this study also investigated whether age, time to completion, and functional capacity significantly influenced participants` QoL outcomes. The study revealed that total QoL for participants significantly improved throughout the PA intervention. Significant improvements were also observed in physical well-being (PWB), emotional well-being (EWB), and functional well-being (FWB). However, no significant improvement was observed for social well-being (SWB).

Interestingly, no significant relationships were found between any of the predictor variables and the QoL outcomes. These results indicate that a pragmatic PA program for CS may significantly improve multiple facets of QoL. This supports the hypothesis that "real-world" PA programs for CS improve QoL and overall well-being.

The significant improvements in the QoL measures in the current study parallel much of the existing literature surrounding PA programming and QoL (Cormie et al., 2017; Santa Mina et al., 2017). Research has shown that PA leads to significant improvements in QoL in patients with various cancer types (Cormie et al., 2017). Specifically, various RCT-based studies have found that PA participation is essential for maintaining and improving QoL in CS (Dhawan et al., 2020; Hu & Zhao, 2021; Spencer & Staffileno, 2021; Schmidt et al., 2015). For example, Dhawan and colleagues (2020) implemented an RCT-based PA program for CS undergoing chemotherapy. The participants in the intervention group were directed to perform strength and balance exercises daily for 10-weeks. The results revealed that 10-weeks of the home-based PA program led to significant improvements in QoL among participants (Dhawan et al., 2020). Similarly, Schmidt and colleagues (2015) implemented an RCT-based PA program for breast CS that featured supervised, twice-weekly sessions for 12-weeks. The programming featured resistance training with all participants following a set number of repetitions and intensity for each exercise. The results also showed important improvements in QoL outcomes (Schmidt et al., 2015). Experimental RCT studies have provided extensive literature on the benefits of PA for this population Dhawan et al., 2020; Hu & Zhao, 2021; Spencer & Staffileno, 2021; Schmidt et al., 2015).

More recently, studies focusing on PA programming for CS have taken a more pragmatic and generalizable approach. Specifically, Santa Mina and colleagues (2017) investigated the effects of a “real-world” community-based PA program for CS in Southern Ontario. The results showed that QoL measures in participants were improved throughout the 30-week PA program. Participants attended the supervised program twice weekly for an initial 10-week phase and weekly for a 20-week transition phase. Both phases of the program featured individualized aerobic and resistance training for each participant based on their medical history and fitness and functional measures (Santa Mina et al., 2017). Similarly, Cheifetz and colleagues (2013) observed positive improvements in CS`s QoL outcomes through the CanWell program, a pragmatic, community-based PA program in Hamilton, Ontario. Participants were required to attend the supervised PA program twice weekly for 12 weeks and followed individualized aerobic, resistance, and flexibility exercises (Cheifetz et al., 2013).

ACCESS, the program in the current study, also utilized a “real-world” approach in its PA programming. Specifically, ACCESS is a highly generalizable, evidence-based program implemented for “real-world” CS in community and hospital-based settings. Like ACCESS, Santa Mina et al. (2017) and Cheifetz et al. (2013) provided supervised and individualized, group-based training programs for participants. In addition, Santa Mina et al. (2017) and Cheifetz et al. (2013) both offered community-based locations, while ACCESS offered programming at a hospital location in addition to community-based sites. Participants in Cheifetz et al. (2013) and ACCESS both attended 12-weeks of twice-weekly PA programming, while Santa Mina et al. (2017) offered 10-weeks of two supervised sessions and then a subsequent 20-weeks of just one session per week. All three programs offered participants supervised, individualized programming featuring a combination of aerobic and resistance training (Santa Mina et al., 2017; Cheifetz et al., 2013).

In contrast to Santa Mina et al. (2017) and Cheifetz et al. (2013), ACCESS offered participants a more flexible approach that allowed participants to make up any missed sessions at the end of their 12-weeks. This ensured that all participants received all 24-sessions. Further, unlike Santa Mina et al. (2017) and Cheifetz et al. (2013), participants in the ACCESS program were asked to keep a record of their fatigue, energy levels, and readiness to exercise before each session, in addition to their fatigue, energy levels, and rate of perceived exertion after each session. This allowed participants to evaluate how they felt each day, which allowed their program to be tailored if needed. This further supported the individualized nature of the ACCESS program.

The implementation of pragmatic research provides evidence regarding “real-world” conditions. It therefore allows the effects of an intervention to be observed in a more unstructured setting with less rigid procedures (Zuidgeest et al., 2017). Pragmatic programs like ACCESS and others are important because they play a vital role in expanding the knowledge surrounding the effectiveness of PA programming for CS in real-world settings (Lahart, Weller, & Kirkham, 2020). RCT-based studies have shown the benefit of PA for CS (Dhawan et al., 2020; Hu &

Zhao, 2021); however, these studies often include a rigorous schedule and fixed exercise intensity, which may not translate effectively into the lives of CS outside of an experimental setting. The results showed that implementing a less structured and rigorous approach allowed participants to receive significant improvements in program outcomes regarding the current study. This suggests that having PA programming outside of a rigid experimental setting can provide CS with a flexible and highly beneficial means of improving their QoL.

As found in the current study, an improvement in QoL is a common finding in the literature regarding PA programming for CS. Patel and Rhise (2017) found that just 6-weeks of aerobic exercise led to significant improvements in total QoL among CS compared to a control group. Although this study was only 6-weeks, compared to the 12-week ACCESS program, Patel and Rhise's (2017) findings reveal the critical role that PA plays in improving the QoL of CS even over a short period. However, the literature states that for CS, 8-12 weeks of PA programming may be needed to consistently improve treatment-related side effects (Campbell et al., 2019). Therefore, administering the ACCESS program for 12-weeks is likely a key component in providing significant improvement in QoL outcomes for participants. Irwin and colleagues (2016) also observed positive changes in CS`s QoL after the 12-week LIVESTRONG PA program at the YMCA. The results also revealed a dose-response effect, with participants that had greater adherence to the PA program having more statistically significant improvements in QoL (Irwin et al., 2016). Therefore, it can be suggested that CS should be encouraged to attend PA programming more regularly to see more significant improvements in their QoL (Irwin et al., 2016).

In contrast to the current study's findings, a meta-analysis by Zeng and colleagues (2019) found that PA did not have a beneficial effect on QoL. However, differences exist between the current study and the findings by Zeng and colleagues (2019). Specifically, Zeng and colleagues included only studies that utilized RCTs, while the present study was not randomized and featured a less rigorous and more pragmatic approach (2019). Further, the current study featured participants with various treatment statuses (i.e., not on treatment, treatment, varying treatment types, etc.). At the same time, Zeng and colleagues specifically focused on participants receiving chemotherapy or post-chemotherapy (2019). The inclusion of participants receiving chemotherapy or post-chemotherapy may result in a decreased ability to see change among participants during the PA program as cancer treatments have been shown to have various adverse effects on the QoL and overall health of CS (Hewitt et al., 2005). These differences in participant characteristics and study procedures prevent a comparison from being made between these studies.

The present study results showed significant improvements in three QoL subdomains, including PWB, EWB, and FWB. Reviews of the literature revealed significant improvements in PWB, EWB, and FWB from PA participation have been consistently demonstrated in previous studies (Rajarajeswaran & Vishnupriya, 2009; Courneya & Friedenreich, 1999). Monga and colleagues (2007) implemented an 8-week RCT-based study for prostate CS receiving radiotherapy. Both the control and intervention groups received radiotherapy, with the intervention group also performing supervised aerobic exercise 3 times per week. The findings showed significant improvements in PWB among participants in the intervention group after the 8-week program (Monga et al., 2007). However, in contrast to the current study results, Monga et al. (2007) did not find significant changes in EWB or FWB. These differences in findings may exist due to the specific cancer type (i.e., prostate) and treatment status (radiotherapy) included in Monga et al. (2007) compared to the more inclusive nature of the ACCESS program. Mock and colleagues

(2001) observed the effects of a home-based walking PA program on QoL outcomes for breast CS treatment. The results showed that the women who walked at least 90-minutes per week on three or more days experienced significant improvements in their EWB. This study also found that participants experienced a decreased PWB from pre- to post- treatment while on the walking program (Mock et al., 2001).

Regarding the current study, the findings by Mock et al. (2001) may not be comparable to the conclusions of the ACCESS program due to various discrepancies in methodology. Firstly, ACCESS featured supervised aerobic and resistance training sessions in community/hospital settings, while Mock et al. (2001) implemented a home-based walking program. The lack of supervision and primary focus on aerobic activity in Mock et al. (2001) may have resulted in different outcomes for CS compared to the ACCESS program. Specifically, research has shown that a combined aerobic and resistance training program effectively creates positive changes in QoL outcomes than programs solely featuring one or the other (Sweegers et al., 2018). Further, the literature also reveals that supervised PA programming improvements in QoL outcomes are more likely to result in more significant effects than home-based programs (i.e., unsupervised) (Campbell et al., 2019). Lastly, Mock and colleagues (2001) only focused on breast CS undergoing treatment, while ACCESS includes all cancer types and treatment statuses. The inclusion of participants actively receiving treatment during the PA intervention may have decreased PWB as decreased physical fitness and lowered aerobic capacity have been common adverse effects of cancer and its treatments (Sabiston & Brunet, 2012; Garcia & Thomson, 2014).

Andersen and colleagues (2013) implemented a 6-week RCT-based study for CS, with the intervention group performing high-intensity aerobic and heavy resistance training for 9 hours per week. In contrast to the current study, Andersen et al. (2013) showed no significant improvements in any QoL subdomains, including PWB, EWB, FWB. The inconsistency in results between the current study and Andersen et al. (2013) may be due to the differences in methodology. Firstly, Andersen and colleagues (2013) only included actively receiving chemotherapy during the study, whereas ACCESS included participants of all treatment statuses. Specifically, 13 participants received treatment for the current study, 58 participants were not, and 18 participants had unknown treatment statuses. Therefore, because most of the ACCESS participants were not on therapy during the intervention, this may have improved QoL outcomes compared to Andersen et al. (2013), which only included participants receiving treatment. A potential avenue for future research for the ACCESS program would be to focus on time since treatment impacts QoL outcomes. Secondly, the two studies differ in length, with Andersen and colleagues (2013) only being 6-weeks long versus 12-weeks for ACCESS. This suggests that a more extended program may be necessary for significant improvements in these QoL outcomes. This is supported in the literature, which suggests a PA program length of 8-12 weeks to be most effective in addressing the health-related outcomes experienced by CS, including QoL (Campbell et al., 2019). Thirdly, Andersen and colleagues (2013) was an RCT-based study and featured high-intensity cardiovascular and heavy resistance training for all participants, compared to the ACCESS program, which provided individualized training programs. The structured approach in Andersen et al. (2013), with all participants performing the same intensity of exercises compared to the more individualized ACCESS program, may have contributed to the discrepancies in results between the two studies. Lastly, Andersen and colleagues (2013) stated that many of their participants had high QoL scores at baseline due to their inclusion criteria. Therefore, it may have been difficult for them to improve their scores over the 6-weeks of PA programming. This was not the case for ACCESS as it included participants from across the cancer trajectory and therefore provided a heterogenous sampling of QoL scores among participants. This may have allowed for a more significant change from baseline to post-intervention for many participants. A more substantial assortment of baseline QoL scores in the current study likely provided a greater likelihood for a significant difference than the ceiling-effect in Andersen et al. (2013).

Interestingly, completion of the ACCESS program did not lead to any improvement in SWB. This parallels the findings in Andersen et al. (2013), which also found no significant changes in SWB over a supervised, 6-week PA training program for CS. However, as stated above, differences in the methodologies between ACCESS and Andersen et al. (2013) may prevent accurate comparisons from being made between the two studies. In contrast, the lack of significant change in SWB as found in the current study opposes many literature findings that suggest that PA does significantly improve SWB (Knobf et al., 2007; Monga et al., 2007). Korstjens and colleagues (2006) implemented a supervised 12-week PA program for CS consisting of twice-weekly strength and endurance sessions. The program led to significant improvements in outcomes, including total QoL and SWB as measured by the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (Kortsjens et al., 2006). Similarly, Monga and colleagues (2007) investigated the effects of an RCT-based study focusing on aerobic PA programming for prostate CS undergoing radiotherapy. The results revealed that the intervention group experienced improved SWB as measured by the Functional Assessment of Cancer Therapy-Prostate (FACT-P) questionnaire (Monga et al., 2007).

Therefore, it may be beneficial to explore the reasons behind the lack of significant improvement in SWB for participants in ACCESS. The lack of substantial change may be due to the nature of the SWB subdomain of the FACT-G. For example, question GS4 asks, “My family has accepted my illness,” and question GS6 asks, “I feel close to my partner (or the person who is my main support).” These questions focus more on the social component of participants outside the program. Although the questions in the SWB domain of the FACT-G are essential and relevant for the QoL of CS in general, for the current study, the questions do not capture the social experiences of the CS in a PA program. Suppose the SWB questions focused more on the aspects of the social component of the program instead of questions focused on participants` personal lives. In that case, there may have been a more significant change in the SWB outcomes from pre- to post-intervention. This would be a beneficial focus for future research endeavors.

The current study also found that functional capacity significantly improved from baseline to post-intervention for the 12-week ACCESS PA program. This was demonstrated by a significant improvement in the number of laps for the 6MWT. The average increase among participants was approximately 1.5 laps from baseline to post-intervention, equating to 46 meters. According to Gremeaux and colleagues (2011), the minimally clinically significant difference for the 6MWT is 25 meters. Therefore, it can be stated that the improvement observed among ACCESS participants in the 6MWT is clinically meaningful. These results are consistent with the literature. Specifically, Santa Mina and colleagues (2017) found that a 10-week community-based PA program for CS led to clinically meaningful improvements in functional capacity as measured by the 6MWT. Similarly, Rajotte and colleagues (2012) found that a supervised, 12-week PA program led to significant improvements in 6MWT outcomes for CS.

The present study investigated the influence of three predictor variables on the QoL outcomes. Precisely, age, time to completion, and functional capacity were analyzed concerning total QoL and the four QoL subdomains. To the researcher`s knowledge, age has not been directly analyzed as a predictor variable for QoL outcomes within a pragmatic PA program for CS in the literature.

The current study found that age as a predictor variable did not significantly impact total QoL or any QoL subdomains. Similar results in the literature also revealed no significant relationship between age and QoL (Thatcher, Hopwood, & Anderson, 1997; Rustoen, 1995).

In contrast, Hewitt and colleagues (2003) found that age may be associated with a decreased QoL, especially in those with chronic disease. As the current study found no significant correlation between QoL and age, further research should investigate the relationship between age and QoL outcomes for CS in a pragmatic PA program. In addition, a beneficial avenue for future research would be to include a control group to see if there was a difference in individuals who did not participate in the program.

The present study also assessed whether the time to complete the program had a significant influence on the QoL outcomes of participants. ACCESS participants could make up any missed sessions, which allowed all participants to attend 24-exercise sessions. Therefore, in the current study, many participants took longer than the recommended 12-weeks to complete the program, with the most extended participant taking 268 days, which is 3-times the recommended length. This was due to a combination of factors, including personal and health-related concerns. Therefore, the current study focused on whether a longer program completion time would harm program outcomes. It could be suggested that the longer a participant takes to complete the PA program, they may be less likely to experience significant improvements in program outcomes. However, the current study revealed that time to completion did not significantly affect any QoL outcomes. This suggests that regardless of the length of the program for participants, they were still able to receive positive QoL benefits upon returning and continuing with the program. However, because so many participants took an extended length of time to complete the program (i.e., 240+ days), it is difficult to determine whether the QoL changes experienced by participants were due to the PA programming or external factors. Therefore, future research with the ACCESS program should focus on having participants finish the program within a more structured timeline (i.e., 12 weeks) to determine whether the changes in QoL from baseline to post-intervention were due to the PA program any confounding variables.

A study by Irwin and colleagues (2016). found that in a 12-week community-based PA program for CS, participants who regularly attended the program experienced a more remarkable and statistically significant improvement in their QoL. This would also be an exciting avenue for further research with the ACCESS program regarding program attendance and level of QoL improvements. To explore this, future research could involve having two groups of participants, with one group completing 24-sessions over 12 weeks (i.e., twice weekly) and the other group meeting 24-sessions over 24 weeks (i.e., once weekly). Comparing the QoL outcomes between groups would reveal whether greater program attendance has a significant impact on the QoL outcomes of participants.

The current study also assessed whether functional capacity had a significant impact on participants' QoL outcomes. Previous research has consistently demonstrated a correlation between QoL and functional capacity among CS participating in PA programs (Duarte et al., 2020; Irwin et al., 2016; Nadler et al., 2019). Specifically, Irwin et al. (2016) and Nadler et al. (2019) found clinically meaningful improvements in QoL and functional capacity as measured by the 6MWT in CS following PA programming. In addition, Duarte and colleagues (2020) also found significant correlations between QoL and functional capacity (i.e., 6MWT). This is important as CS has been shown to have a lower functional capacity and QOL than healthy individuals (Duarte et al., 2020).

Further, the adverse side effects experienced by CS due to treatment and disease (i.e., fatigue and pain) often lead to a decreased functional capacity and ability to perform daily activities. Levels of functionality play a vital role in levels of QoL for CS; therefore, this reduced functional capacity leads to a decreased perception of QoL (Duarte et al., 2020). In the current study, functional capacity (i.e., 6MWT outcomes) did not significantly affect any QoL outcomes. Therefore, regardless of a participant`s change in functional capacity throughout the program, they may still be able to experience significant changes in their QoL outcomes.

Strengths and Limitations

The current study has various important strengths. First, the data was collected from the ACCESS program, a pragmatic, evidence-based PA program delivered in multiple locations in Nova Scotia. The pragmatic nature of ACCESS included individualized programming, flexible program length, and an overall less structured approach often applied in RCT-based studies. The results showed that utilizing a less rigorous approach in a PA program still led to significant improvements in QoL and functional capacity. This increases the potential for real-world application of these findings and, therefore, the generalizability of the current study. Another strength of the study is using the predictor variables (i.e., age, time to completion, and functional capacity) on QoL. To the researcher's knowledge, these variables have not been used in conjunction with QoL outcomes for a pragmatic PA program for CS; therefore, this provided a novel research approach. Another strength of the current study is the inclusive nature of the sample population. In the literature, cancer-based PA studies often focus on one cancer type or treatment type. Therefore, because ACCESS includes participants from across the cancer trajectory, this helps its generalizability to all CS, regardless of their cancer type, stage, treatment status, etc.

The current study is not without limitations. ACCESS is a pragmatic implementation study and therefore has no control group. This prevented comparisons from being made between groups, and therefore only correlative inferences can be made. Specifically, the lack of a control group lowers the validity of the results. As a result, it is difficult to determine whether the change in outcomes resulted from the intervention or any potential confounding variables.

Further, only 89 participants were included in the current study. Santa Mina et al. (2017) and Rojette et al. (2012) investigated the effects of community-based PA programs for CS. Both studies assessed similar program outcomes to the current study, including functional capacity and QoL. Both studies had relatively large sample sizes of n=229 for Santa Mina et al. (2017) and n=229 for Rojette et al. (2012). In comparison, the current study had a relatively small sample size. This, in turn, may have reduced the statistical power of the results. Another limitation of the present study was the time to completion for participants. As participants could make up missed sessions, many participants took longer to complete the program (i.e., 200+ days) than the anticipated 3-months. However, the results suggest that the length of program completion did not harm the QoL outcomes; therefore, it is not a significant limitation for the current study.

Conclusions

Future research should investigate predictor variables that may significantly influence QoL outcomes for CS in PA programs. This analysis could include some of the other measures included in the ACCESS program, such as time since diagnosis and treatment, muscular strength (i.e., grip strength), Depression and Anxiety score (i.e., DAS questionnaire), body composition (i.e., BMI, waist circumference), treatment status, etc. Identifying these variables can allow further individualization of the PA program to account for specific characteristics that may influence QoL outcomes. Further, suppose specific participant characteristics or outcomes can act as a predictor for QoL. This could help reduce participant burden by reducing the amount of testing or surveys participants must complete. Future studies should also implement a revised QoL questionnaire regarding SWB specifically for group PA programming. These questions should focus more on the social benefits that participants received from the program than the current structure of the questionnaire. This would allow a better reflection for participants on the program's impact on their SWB compared to how external factors influenced their SWB.

ACCESS is a “real-world,” evidence-based PA program for CS in Halifax, Nova Scotia. The current study's findings are consistent with the existing literature surrounding pragmatic approaches to PA programming for this population. In addition, the present study supports the translation of study findings from RCT-based programs into “real-world” patient care settings. Specifically, this study reveals that a pragmatic community and hospital-based PA program will positively influence QoL outcomes for CS. These results are clinically relevant as they suggest that having a less structured approach for PA programming can lead to significant improvements in outcomes. This supports the transition of PA programming into an integral part of cancer care.

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