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Understanding In-Person and Online Exercise Oncology Program Delivery: Participant Perspectives

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Understanding In-Person and Online Exercise Oncology Program Delivery: Participant Perspectives

by

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Abstract

Background: Alberta Cancer Exercise (ACE) is an exercise oncology program delivered in community-based settings until the onset of the COVID-19 pandemic, when ACE was forced to transition to an online platform for remote delivery.

Purpose: To evaluate the perspectives of cancer survivors who have transitioned from an in-person to an online exercise oncology program. Specifically, survivors' exercise facilitators and barriers in both delivery modes, delivery mode preference, and experience with program elements targeting behaviour change were gathered.

Methods: A retrospective cohort design using explanatory sequential mixed methods was used to assess participants' experiences with participation in both settings. Participants who have completed both in-person and online ACE classes were asked to complete a survey, with the option to complete a subsequent interview.

Results: A total of 57 participants (response rate 46%) completed the survey and 19 interviews were conducted. Most participants indicated preferring in-person programs (58%), followed by online (32%), and no preference (10%). There were significantly fewer barriers ($p<0.01$), but also fewer facilitators/benefits ($p<0.01$), to exercising online. Qualitative data analysis supported survey findings, with participants frequently noting the convenience of attending online, but a lack of equivalent social connection gained. Content analysis (survey comments) and thematic analysis (interview analysis) demonstrated that the online exercise setting was less conducive to providing behaviour change support, largely attributed to limitations inherent to the online platform.

Conclusion: ACE participants experienced facilitators and barriers to both the online and in-person delivery methods. The transition to online was supported by participants' in-person experiences, and for future work that includes solely online (i.e., for rural and remote cancer

survivor exercise program delivery), focusing on building social support and a sense of community will be critical to optimizing program benefits. Addressing the need for promoting and maintaining exercise in people with cancer using an online platform when standard exercise formats are restricted due to COVID-19 is timely and necessary. Beyond the COVID-19 pandemic, results of this research will remain relevant as we aim to increase the reach of online exercise oncology programming to more underserved populations of individuals living with cancer (i.e., rural/remote, immunocompromised, young adult populations).

Keywords: exercise oncology, telehealth, synchronous, supervised, group-based

Preface

This thesis is original, unpublished, independent work by the authour, Delaney Duchek. The research reported in Chapters 3-5 were covered by Ethics ID: HREBA.CC-20-0379, issued by the Health Research Ethics Board of Alberta (HREBA) – Cancer Committee (CC) for the project "Understanding in-person and online exercise oncology program experiences: Participant perspectives" on November 5, 2020.

This mixed-methods thesis was informed by the work of the following content experts:

- Dr. S. Nicole Culos-Reed, *PhD, Professor, Associate Dean Graduate,* Faculty of Kinesiology, University of Calgary.
- Dr. William Bridel, *PhD, Associate Professor,* Faculty of Kinesiology, University of Calgary.
- Dr. Meghan McDonough, *PhD, Professor,* Faculty of Kinesiology, University of Calgary.

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Dedication

This work is dedicated to Moira and Ed Duchek. My Nanny, who I hope would have benefitted from research like this; and to my Grandpa, who always loved me for who I am – and gave the best hugs.

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List of Symbols, Abbreviations, and Nomenclature

Abbreviation	Definition
ACE	Alberta Cancer Exercise
AE	Adverse Event
BCT	Behaviour Change Technique
COM-B	Capability, Opportunity, Motivation – Behaviour
COVID-19	Coronavirus 2019
CR	Completion Rate
EBBS	Exercise Barriers and Benefits Scale
EQ5D	EuroQOL Five Dimension Scale
ESAS	Edmonton Symptom Assessment System
EXCEL	Exercise for Cancer to Enhance Living Well
GLTEQ	Godin Leisure Time Exercise Questionnaire
MVPA	Moderate-to-Vigorous Activity
PA	Physical Activity
PAR-Q+	Physical Activity Readiness Questionnaire+
PROs	Patient-Reported Outcomes
QOL	Quality of Life
RR	Response Rate
RT	Resistance Training
SD	Standard Deviation
SF-36	Short Form 36 Health Survey Questionnaire
SMS	Short Message Service
WHO	World Health Organization

Statement of Contributions

I, Delaney Duchek (DD), was the primary Research Coordinator for this thesis work. Under the leadership of Dr. S. Nicole Culos-Reed and my committee members, Dr. William Bridel and Dr. Meghan McDonough, I led study recruitment, data collection, data analysis, and writing. Throughout this thesis, I was guided in my writing and analysis by Dr. Culos-Reed and my committee members.

Epigraph

“I think it's important to frame that digital health wasn't a stopgap fix for COVID-19, where once the vaccine and return to normal is established, we'll go back. I actually think it's past that. I think we've established that providers are able to provide world-class care through these new means. I think patients and loved ones demand it. They want it, it's convenient, it's affordable, and it's accessible. COVID-19 has hoisted health disparities and necessary efforts into the public light to ensure all patients — regardless of their socioeconomic status and where they live — have access to the best care for their well-being."

Dr. William Morris, MD, Cleveland Clinic, on the future of digital health

Chapter One: Introduction

1.1 Thesis Format

This thesis contains five chapters, including an introduction, literature review, methods, results, and discussion. Chapter one introduces the thesis and contains the purpose, research question and specific objectives, and rationale, along with a summary of the thesis format. Chapter two is a literature review of exercise oncology and online programs, including behaviour change technique use and barriers and facilitators to these programs. This review includes the background, limitations of the current body of literature, and highlights the significance and need for more research in this new area. Chapter three describes the methods used for this research study, including the study design, study population, procedures, and methods of data analysis. Chapter four reports the study population and the main quantitative and qualitative results of the study. This includes the key differences experienced by participants between in-person and online exercise oncology programs. Chapter five includes a discussion of the results, study limitations, strengths, and ultimately concludes the thesis by highlighting directions for future research in this area. Finally, there are appendices with supplementary information.

1.2 Problem Statement: COVID-19

On March 12, 2020, the World Health Organization (WHO) declared a global pandemic with the arrival of the novel coronavirus (COVID-19) (1). With this declaration, the WHO mandated several actions be taken in order to prevent rapid spread of the disease. Measures such as restricting local travel and business usage were implemented, requiring Canadians to stay home as much as possible to limit disease transmission. Whether due to decreased employment, increased anxiety, or physical distancing measures, many changes since COVID-19 have significantly impacted peoples' lives (1). It is perhaps unsurprising then that large declines have

been noted in both exercise habits and quality of life (QOL) (1). In an online survey of Canadian adults (n=1098), Lesser and Nienhuis (1) found significant changes in exercise levels. Their data demonstrated that 40% of inactive individuals demonstrated less activity, while 22% of previously active individuals became less active. Those individuals who reported decreased activity since the implementation of COVID-19 restrictions also reported a state of overall decreased well-being and more challenges to being physically active. The closure of or decreased access to community recreation centres, fitness facilities, parks, and other communal exercise locations may be a contributor to the decreased exercise levels in Canadians (1).

1.3 Impact of COVID-19 on Cancer Survivors

COVID-19 had, and will continue to have, a greater impact on vulnerable populations, including those managing a chronic disease who may be susceptible to infection (2,3). This includes cancer survivors, who are often part of an aging population at increased risk to contagion and mortality, in addition to being immunocompromised when undergoing various forms of cancer treatment (4–6). Cancer survivors have been shown to have a two-fold risk for contraction of COVID-19 (7,8). Therefore, in the midst of the pandemic, cancer populations are extremely vulnerable and at risk for hospitalization or severe outcomes from COVID-19 (9). Current physical restrictions may also limit family support and access to oncology supportive care services for many survivors, negatively affecting their sense of well-being (3,6,7). This includes limited access to exercise venues or expertise that is safe and/or affordable, despite compelling evidence about the necessity of exercise across the cancer journey (8,10). A current hybrid effectiveness and implementation study that is delivering safe and beneficial exercise to cancer survivors is the Alberta Cancer Exercise (ACE) program (11).

1.4 Alberta Cancer Exercise (ACE)

ACE is a hybrid implementation-effectiveness study (11). ACE offers a free, supervised, group-based exercise oncology program to cancer survivors diagnosed with any form of cancer, up to 3 years post-treatment completion. Exercise classes (Calgary and Southern Alberta programs) follow a circuit-style design, focusing on strength, aerobic, balance, and flexibility training. ACE programs are led by qualified exercise professionals specifically trained in exercise oncology. Classes are 60 minutes in length and are offered twice weekly for a period of 12 weeks (with an 8-week option available[1]). ACE classes are offered at two levels: baseline and maintenance classes. Baseline classes are the study intervention, are free, and encompass the first ACE program that participants partake in. ACE maintenance classes are a pay-for-service program and are available for anyone who has completed the initial baseline program. The ACE maintenance program is not part of the ACE study but is delivered as a means to enhance exercise maintenance and promote continued well-being. Participants may continue to take ACE maintenance programs for as long as they wish.

ACE baseline evaluation includes participant-reported outcomes (PROs) including the Edmonton System Assessment System (ESAS), Short Form 36 Health Survey Questionnaire (SF-36), EuroQOL Five Dimension Scale (EQ5D), Godin Leisure Time Exercise Questionnaire (GLTEQ), and the Physical Activity Readiness Questionnaire+ (PAR-Q+)[2]. These PROs encompass QOL (physical, social, emotional, and functional well-being), cancer diagnosis and treatment, mental health measures (distress, anxiety, depression), fatigue, current exercise levels and intention, physical functioning with fitness assessments (lower body endurance, balance,

[1] 8-week ACE programs are offered to accommodate late registrants, to build new programs at certain times of the year (i.e., summer), or to fit into community fitness facilities calendars.
[2] ACE evaluations are not included in this thesis as ACE as a clinical trial is ongoing.

aerobic endurance, lower body flexibility, and shoulder range of motion), and satisfaction with the ACE program. PROs are collected at baseline, 12 weeks, 24 weeks, and 1 year, and with ongoing reporting of PROs on a yearly basis until 5 years post-program completion. Physical functioning assessments are conducted at baseline, 12 weeks, 24 weeks, and 1 year. Nearing its 5-year completion in 2021, the ACE program has demonstrated immense success across Alberta, with over 2300 participants completing the baseline program to date. Effectiveness will be evaluated after data set completion in Summer 2021, but implementation success includes an established clinic-to-community based model with implementation in more than 18 sites across Alberta. However, the final year of the ACE study coincided with a major roadblock: COVID-19.

1.4.1 Transition of ACE to an Online Platform

A lack of available healthcare and complementary healthcare resources for cancer populations during this pandemic has necessitated a shift of resources to a more accessible, online platform (10). COVID-19 has substantial effects on the delivery of the ACE program, as physical distancing measures eliminated the opportunity to run in-person exercise classes across Alberta. These changes necessitated the rapid transition of the ACE program to an online platform in April 2020. There was relatively little direction or guidance, due to the lack of previously offered exercise oncology programs that were synchronously delivered, group-based, and supervised via an online format. Synchronous interventions are defined as real-time, face-to-face interactions between participant and intervention leader (i.e., healthcare provider, exercise oncology instructor) using any technology that permits such interactions, including Zoom (12). ACE online delivery was built on Zoom, a videoconferencing platform accessible from any mobile or desktop device with an internet or cellular connection. The University of Calgary Zoom version offers end-to-end encryption, thereby heightening the security of offerings. For

ACE, all security precautions were taken to prevent the misinformed sharing of personal information of ACE participants, including utilizing a password, a secure Zoom link, and the waiting room function to screen participants who were allowed to enter the Zoom room. Participants were sent an instruction guide for Zoom use prior to beginning any online classes or physical functioning assessments (Appendix D).

Many aspects of the in-person ACE program were transitioned to the online Zoom platform, including the group-based nature of the program, circuit-style training focusing on strength, aerobic, balance, and flexibility training, and the length and frequency of the program (2x/week for the 8- or 12-week duration). Other aspects inherent to the previously established ACE program had to be adjusted to the new online environment, including how the physical functioning assessments were conducted, no/limited fitness equipment, and class size. Additionally, a lack of informal interaction between participants inherent to an online platform has ultimately affected the delivery of social support and development of a sense of community that participants had previously experienced in-person.

1.4.1.1 Online ACE Classes

While the exercise programming in online classes has thus remained similar, other aspects of online class delivery changed. First, one instructor and one moderator are present for each class. The instructor's responsibilities and roles are to lead the class through the warm-up, circuit-based exercises, and a cooldown while offering exercise modifications throughout class if necessary. The role of the moderator is to take attendance, monitor for safety, and offer technique adjustments or encouragement to participants throughout class. Both the instructor and moderator arrive 15 minutes early and stay up to 15 minutes after the end of class to facilitate interactions that build the sense of community and social support between participants. This

additional time pre- and post-class time also allows participants to come early or stay late after class to ask any questions regarding exercise modifications.

1.4.1.2 Addressing Online Safety in Exercise Delivery

Ensuring the safety of ACE participants taking part in remotely delivered classes has been a main focus of ACE during this transition. The maximum number of participants permitted in each class is capped at 23 to ensure that all participants remain on the same Zoom screen, ensuring continuous monitoring of participants. Participants are not permitted to enter the Zoom room if they arrive after warm-up is completed, to decrease the risk of injuries from improper warm-up. Additionally, during class, all participants are required to keep their cameras on and to adjust camera angle (i.e., when transitioning to floor exercises) to ensure adequate supervision by the instructor and moderator to ensure safety. If an adverse event (AE) occurs, the moderator is responsible to move the affected participant into a separate breakout room to monitor the participant's condition and seek help as necessary. The moderator is also responsible for having emergency contact information for each participant during class time in case of an adverse event (See Appendix D for AE protocol).

Understanding the impact of these significant changes imposed by COVID-19 on the ACE experience for its participants is critical to safe and beneficial online delivery. Specifically, understanding participants' perceived facilitators, barriers, and experiences of the key elements of the ACE program, including the behaviour change support, will further our understanding of how to optimize online exercise oncology program delivery.

Chapter Two: Literature Review

2.1 Exercise and Cancer

2.1.1 Cancer Prevalence

In 2020, cancer rates are expected to reach 225,800 new cases and 83,300 cancer-related deaths in Canada (13). In Alberta alone, the number of newly diagnosed cancer cases is projected to reach 27,000 annually by 2030 (14). This rise in cancer diagnoses in Canada is in part due to Canada's aging population, as well as decreasing mortality rates and an increase in treatment-related technologies and early detection for a wide range of cancers (15,16). A 'cancer survivor' is defined as anyone who has been diagnosed with cancer, is currently living with cancer, or has transitioned into extended survival (17). Due to steadily improving treatments and survival rates, there is a growing population of cancer survivors living with or beyond a cancer diagnosis. Thus, there are a growing number of individuals who must learn how to live with the potentially enduring negative side effects of the disease and its treatment (11,18). This population of survivors living with long-term side effects has sparked the emergence of supportive cancer care services or complementary approaches to therapy that focus on increasing survivors' QOL. One such complementary therapy is exercise, which is safe and beneficial for cancer survivors (11).

2.1.2 Exercise Benefits and Levels in Cancer Populations

The benefits of exercise in cancer populations are well-documented. Exercise improves aerobic capacity, strength, body composition, mental and emotional health, and QOL (18–23). Exercise can also mitigate treatment-related side effects such as pain and cancer-related fatigue, improve chemotherapy completion rates, and aid in preventing secondary cancer recurrence or mortality in certain cancers (22,24–32). Despite these well-established findings reinforcing the health benefits of exercise, only approximately one-third of survivors meet the current exercise

recommendations for cancer populations (22,32). Previous surveys have estimated the percentage of active cancer survivors to be lower than the percentage of the general population who are active (33). These numbers demonstrate the necessity of creating and offering accessible exercise programs that build healthy exercise habits in cancer populations (34). To do so, consideration of both barriers and facilitators to exercise is essential.

2.1.3 Barriers and Facilitators to Exercise in Cancer Populations

Barriers are factors that hinder an individual from exercising, while facilitators are factors that help an individual to engage in exercise. Barriers and facilitators to in-person exercise in cancer populations are well-documented. A systematic review conducted by Clifford et al. (35) showed the most common exercise barriers in cancer survivors tend to be persistent treatment-related side effects, lack of time, and fatigue. Other barriers included not receiving enough information and not knowing what to do during exercise (35). This same systematic review found the most common facilitators to exercise to be gaining a feeling of control over health, managing emotions and well-being, improving physical health, and the social benefits of exercising. Similarly, Blaney et al. (36) found common barriers to be pain, lack of motivation, weather extremes, travel and time commitments, and cost. Facilitators included managing fatigue, improving QOL, and gaining a sense of achievement from exercising (36). To further understand barriers and build support for facilitators for exercise, a behaviour change framework can be valuable. One such framework is the COM-B, a component of a larger behaviour change model referred to as the behaviour change wheel (37). The behaviour change wheel situates behaviour change techniques (BCTs) as mechanisms to target the components of the COM-B: capability (C), opportunity (O), and motivation (M). One way of enhancing these COM-B components is by overcoming exercise barriers and enhancing facilitators to ultimately increase the behaviour (B), which in this case, is exercise (37).

2.2 Theoretical Framework: COM-B

The COM-B framework for behaviour change identifies three necessary components for a behaviour to occur (37). First, capability is defined as the aptitude of an individual to participate in an activity or task and can be subdivided into psychological and physical capacity for behaviour change (i.e., knowledge, necessary skills). Second, opportunity refers to all factors and situations external to an individual that facilitate or prompt the behaviour in question and can be either environmental or social (i.e., incentives, social norms). Last, motivation is defined as any thought process that guides behaviour. This component encompasses a wide range of cognitive processes, including habitual practices, decision-making, and emotional responding (38). Motivation is divided into reflective and automatic motivation, referring to conscious and subconscious levels of motivation (i.e., plans, emotions) (39). All three behavioural components and the interactions between them contribute to a behaviour (B). Within this study, the COM-B framework is being used to outline the mechanisms through which exercise behaviour change can occur, including exercise barriers and facilitators. Specifically, in the case of understanding barriers and facilitators, the behaviour (exercise), can be understood by assessing an individual's capability to overcome barriers or enact facilitators, their opportunity to do so (reducing barriers, improving facilitators), and their motivation (enhanced with facilitators, diminished by barriers). The COM-B is situated at the center of the behaviour change wheel to indicate the influence that BCTs can have on these three important components to behaviour change. While the COM-B provides a framework to understand three key components through which behaviour change can occur, it may be limited in understanding each possible mechanism for such change (40).

2.3 Behaviour Change Techniques for Exercise

The COM-B provides a framework for the implementation of BCTs to increase exercise behaviour (via improving capability, opportunity, and motivation) (37). As exercise behaviours

tend to be multifaceted with many contributing factors, the behaviour change component of exercise interventions intended to support exercise behaviour are often complex (41,42). Thus, behaviour change interventions are generally comprised of several BCTs, aimed at increasing exercise habits via support for overcoming barriers or supporting facilitators to exercise. Within the COM-B framework, BCTs can be used to target each element – capability, opportunity, and motivation – via the impact on barriers and facilitators, and ultimately supporting exercise behaviour. BCTs are regarded as the smallest "active ingredient" of an intervention and have been shown to be related to successful increases in exercise levels in cancer survivors (22,43). In 2013, Michie et al. constructed a hierarchical BCT taxonomy consisting of 93 techniques in order to create a comprehensive operational system to apply and code BCTs. BCTs, and more specifically Michie et al.'s (44) BCT taxonomy, is an integral component of the larger behaviour change wheel framework. Various studies have been conducted evaluating a wide range of BCTs employed to target health-related behaviours in cancer survivors, generally demonstrating the ability to successfully impact exercise levels (34,45–48).

Specifically, systematic reviews have been conducted evaluating the effectiveness of BCTs within exercise behaviour change interventions in cancer populations (34,47,49–51). Interventions vary widely in the BCTs used and how they are implemented, including counselling via telephone, email, in-person, or a combination of these; group discussions about exercise barriers and goals; supervised exercise sessions using behaviour therapy; and various other digital-based behaviour change interventions (i.e., SMS text messaging, mobile applications, and tele-counselling). Common BCTs in successful interventions have included self-monitoring, goal setting, positive reinforcement, encouraging social support, group-based settings (exercise or support group), and home-based environments (34,47). Results

demonstrated that most interventions were successful in creating exercise behaviour change in participants with cancer. Given the knowledge that exercise is safe and effective in cancer populations, paired with the understanding that many cancer survivors do not reach guideline levels of exercise, providing survivors with exercise interventions that include the delivery of BCTs may help improve the adoption of sustainable exercise behaviours in alternative delivery modes (33,34).

2.3.1 ACE Exercise and Educate Model

ACE uses an 'Exercise and Educate' model, based in the COM-B behaviour change framework, to address exercise barriers and facilitators to support sustainable exercise behaviour change in participants (11). Specifically, ACE delivers key education topics targeting BCTs, such as action planning, coping with barriers, and educating on exercise, in its baseline class structure to encourage increased exercise levels in its participants. These skills are developed through five specific education topics delivered during ACE baseline classes. These education topics include exercising with cancer, coping with cancer-related side effects, goal setting, motivation, and building social support. In addition, ACE instructors are trained in how to integrate the overall model within each class, providing informal BCTs during class time, including boosting self-efficacy through instructor encouragement, providing feedback on technique and form, and reviewing goals with participants. In the ACE maintenance model, instructors are encouraged to continue to converse with participants about their exercise goals, to build confidence surrounding exercise, to support the development of an 'exercise community', and to continue to educate on various aspects of exercising during class times.

2.4 Translating Exercise Evidence into Practice

While sufficient data illustrates the benefits of exercise and the efficacy of programs for building exercise habits in cancer survivors, a lack of successfully translating this evidence into

practical opportunities for survivors has occurred (11). From the community-based exercise oncology application trials that have been conducted, largely short-term benefits and a lack of adherence to exercise have been reported (43,52). With the added confounding factor of the COVID-19 pandemic, cancer survivors worldwide have been forced to reap the benefits of exercising on their own accord or to find alternative exercise oncology programs. Possible alternative programming may include a program delivered via an online, remote format to maintain safe levels of physical distancing and ultimately guard their health. Therefore, understanding the current literature on remotely delivered, online exercise programs is necessary to situate the current work.

2.4.1 The Transition of Exercise Oncology Programs to an Online Format

From the onset of the COVID-19 pandemic, a broad expansion of telehealth technology has been occurring in order to deliver remote healthcare to cancer populations. Telehealth broadly refers to providing distance-based exercise or other health-based interventions by utilizing communication technologies (4,53). Such telehealth exercise programs may overcome barriers such as travel, time, and parking costs burdening participants, while also increasing the ability to reach populations with diminished mobility or those living in rural or remote areas outside of urban, academic settings where most exercise oncology programs are delivered (18,53–57). Conversely, barriers faced with these home-based, remotely delivered programs also need to be considered. Barriers to adherence include accessing the necessary software and a strong internet connection, qualified exercise professionals, and exercise equipment that may affect the success of remotely delivered exercise oncology programs (8,55,58). Rapid improvements over the last ten years in telehealth technology, coupled with an impetus for online healthcare brought forward by COVID-19-related restrictions, has created an opportunity to optimize remotely-delivered supportive cancer care resources (10,59,60). With the increasing

awareness that home-based exercise interventions using assorted forms of telehealth technology (i.e., smartphones, mobile applications, SMS text-message support) can improve exercise habits and functional benefits, the development of more interventions to reach cancer survivors who prefer home-based exercise or those incapable of attending in-person programs should be a priority (4,61). This includes evaluating supervised telehealth interventions that include videoconferencing to reproduce traditional in-person, supervised, and group-based exercise interventions for cancer populations (4).

2.4.1.1 Overview of Telehealth Exercise Interventions in Cancer Populations

To our knowledge, little intervention research on an online, supervised, group-based exercise program delivered synchronously in cancer populations has occurred before or during COVID-19. Synchronous, supervised exercise interventions in other chronic disease populations have been conducted, including chronic obstructive pulmonary disorder and cystic fibrosis (62,63). These interventions have been found to be safe, feasible, and acceptable in these populations. However, these interventions have not been group-based, missing out on a potential key social support element that may positively impact adherence and other outcomes.

While research in the specific category of synchronous, group-based, and supervised telehealth research for cancer populations is thus minimal, other forms of telehealth interventions targeting cancer survivors' exercise levels have been conducted, using technology such as email or telephone support, web-based education modules or exercise programs, mobile applications, and wearable technology, among others (12,18,49,55,58,64–66).

Several reviews in the last five years have been conducted to evaluate the feasibility and effectiveness of telehealth exercise oncology interventions, both before and during COVID-19 (12,18,49,55,58,64–66). Appendix E includes 9 reviews conducted since 2017 evaluating the feasibility and efficacy of remotely delivered telehealth interventions in cancer survivors. It is

important to note that of a total of 92 unique articles included in these reviews, there are none that were delivered using synchronous, supervised, and group-based components in an online (remote delivery) format. The overall recency of this research demonstrates the rapidly growing nature of telehealth interventions for cancer populations. Reviews that have targeted participant acceptability or trial feasibility have shown positive results (32,55,58). These reviews also suggest mixed results on physical or psychosocial outcomes, with interventions showing no significant changes, moderate improvements, or significant improvements in various outcomes. Interventions have demonstrated effectiveness in improving moderate-to-vigorous physical activity (MVPA) levels, QOL, self-reported fatigue, and aerobic capacity, amongst other benefits, across a range of cancer diagnoses (10,12,68,49,55,56,58,64–67). Regarding physical and/or psychosocial outcomes, a recent review conducted by Furness et al. (12) evaluated the use of synchronous, asynchronous, or combined exercise oncology telehealth interventions in a home environment. Overall, this review concluded that there was insufficient evidence to determine whether asynchronous or synchronous delivery modes exhibit better results (i.e., on exercise behaviour change, QOL, mental health outcomes) due to a lack of available interventions to analyze (12). Overall, more favourable results for QOL, fatigue, and depression were seen in synchronous delivery modes; however, these findings should be interpreted cautiously given the study designs, small sample sizes, and small total number of studies included in analysis. Increases in exercise behaviours were not different between delivery modes. One review has examined the large variety of home-based exercise programs for cancer survivors (61). Of the 229 studies included, only one trial utilized video calling to supervise individuals while exercising, and qualified exercise professionals only supervised upon participant request (61,69). It is important to note that only one of the synchronously delivered interventions included in

these reviews was group-based, involving group-based telephone counselling for weight loss (no face-to-face contact or exercise included; 69).

Recommendations for online exercise oncology programs highlight a need for home-based exercise for cancer survivors, particularly during the time of COVID-19, as well as a need to provide the opportunity for peer social support through group-based programs, high quality instruction, and supervision (10). From these reviews, a gap remains in the delivery and evaluation of remotely delivered, supervised, synchronous, group-based exercise oncology programs. Due to the rapid and unprecedented nature of being forced to deliver exercise oncology programs in an online environment, there was a possibility to evaluate the experiences of cancer survivors during this transition in the ACE program. Given the potential for online exercise oncology programs to be delivered past the cessation of the COVID-19 pandemic, it is important to understand differences between online and in-person exercise oncology program to optimize facilitators and address barriers to this exercise environment.

2.5 Research Significance

The necessary transition of the ACE program to an online delivery format presented a unique opportunity to provide valuable, practice-based evidence that has the potential to direct future research and inform the safe and effective delivery of online exercise oncology programs. Addressing the need for promoting and maintaining exercise in people with cancer using an online platform is becoming increasingly pertinent given the unknown length of COVID-19 related restrictions for vulnerable populations. Beyond the COVID-19 pandemic, results of this research will remain relevant as we aim to increase the reach of exercise oncology programming to underserved populations of individuals living with cancer (i.e., rural/remote, immunocompromised, young adult populations) by utilizing synchronous, supervised, and group-based telehealth exercise oncology programs.

2.6 Research Purpose

Due to the quick change imposed by the restrictions of COVID-19, and the lack of previous research in online, group-based, synchronous exercise oncology program delivery, the purpose of this project was to gather perspectives of cancer survivors who have experienced the transition from an in-person to an online exercise program. Specifically, evaluating participants' perspectives of exercise program barriers and facilitators, exercise delivery mode preferences, and BCTs that are part of the ACE Exercise and Educate model, as well as gathering feedback on the effectiveness of the two exercise program delivery modes, was necessary to optimize future program delivery.

2.7 Research Objectives

The primary research objective was to examine the relationship between exercise levels, exercise barriers and facilitators, and BCTs based on participant experiences in both an in-person and an online exercise oncology program. Specific research questions that were addressed by employing both quantitative and qualitative methods included:

1. What are participants' barriers and facilitators to exercise in both an in-person and an online exercise program?
    i. Assessed in the survey as well as the follow-up interviews.
2. What is the relationship between exercise levels, exercise barriers and facilitators, and BCTs in both delivery modes?
    i. Quantitative analysis (correlational analysis) from the survey and qualitative analysis from the follow-up interviews.
3. What are the differences in participant experiences between an in-person and an online exercise program?

i. Qualitative analysis from the interviews that were built upon quantitative analysis from the survey.

We hypothesized, based on information to be gathered from both the survey responses and the interviews, that (1) Exercise barriers and facilitators for in-person and online exercise programs will exist, but the type of barriers and facilitators will change depending on the program delivery mode; (2) Less reported experience with or use of BCTs will be associated with more barriers, less facilitators, and lower exercise levels; and (3) No a priori hypothesis, as we were gathering participant perspectives on their varying in-person and online exercise oncology experiences.

Chapter Three: Methods

3.1 Participants

This study was approved by the University of Calgary Health Research Ethics Board of Alberta (HREBA) – Cancer Committee (CC) (HREBA.CC-20-0379). All participants were part of a larger hybrid research-implementation project, ACE. All ACE participants who had participated in at least one in-person and one online ACE program were asked to participate in this present study. Specifically, all participants had completed ACE baseline in-person, with some participants also completing maintenance in-person. All participants had completed at least one maintenance session online. Participants included in this study included people living with or beyond cancer and/or their support person. Additional exclusion criteria included an inability to read or write in English. For this mixed-methods study, participants were invited via email to complete a single survey and an optional interview, conducted online via Survey Monkey and Zoom, respectively. Consent was documented via a secure website for managing online surveys (Survey Monkey). Survey recruitment and completion occurred over 1 month, November 2020-December 2020. Interview recruitment and completion occurred over 1 month, January 2021-February 2021.

3.2 Mixed Methods: Explanatory Sequential Design

For this study, an explanatory sequential mixed methods design was used (70). This design was conducted in two phases, as seen in Figure 3-1. Quantitative data collection and analysis was conducted first, followed by qualitative data collection and analysis. This design allowed the exploration of qualitative results to expand upon and further understand the quantitative findings (70). This mixed methods design was used to identify particular quantitative findings of interest and the participants who provided those survey responses in order to expand upon these results (70).

3.2.1 Mixed Methods: Methodology

The philosophical approach to the qualitative portion of this mixed-methods research was pragmatism. This is a philosophical approach largely grounded in practicality and is commonly used in mixed methods research. The ontology of pragmatism states that multiple perspectives of reality exist concurrently. The epistemology of pragmatism states that practical solutions to problems are the ultimate goal of research, which aligns with the goal of this research to ensure a safe and effective online exercise program that satisfies participants and delivers BCTs to enhance facilitators and diminish barriers to exercise.

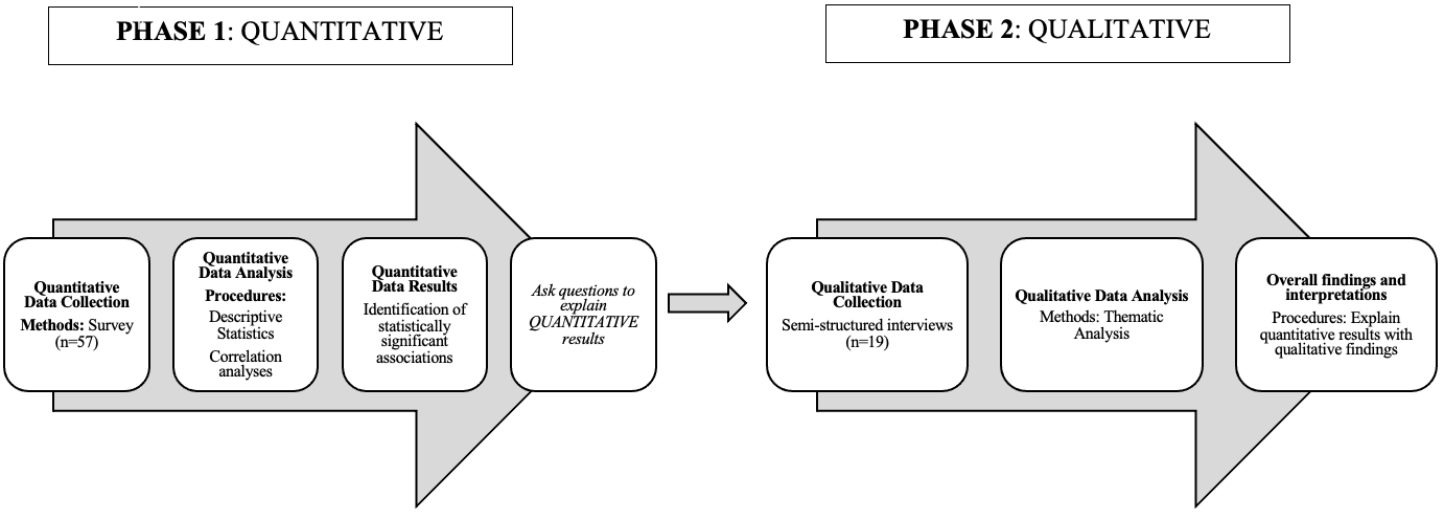

Figure 3-1. Explanatory Sequential Design Mixed Methods Process

3.2.2 Mixed Methods Phase 1: Survey

Surveys were designed in Survey Monkey and distributed via email (Appendix A). Survey data was collected between November and December 2020. Participants were informed via email one week prior to the survey being distributed (Appendix A). The surveys were created in collaboration with members of the research team, incorporating feedback via three iterations before the final survey was distributed. First and last names were collected on this survey and

were subsequently anonymized, providing each participant with a unique identifying code. Throughout data collection and analysis, data was stored on a secure server. See Appendix B for a full copy of the survey distributed to participants.

3.2.3 Outcome Measurements

3.2.3.1 Demographics

The survey included participant demographic information including full name, date of birth, marital status, education level, annual family income, employment status, cancer diagnosis (type, date), start date of ACE baseline program participation, self-identified gender, and self-identified race.

3.2.3.2 Exercise Levels: Self-Report

The modified Godin Leisure-Time Exercise Questionnaire (GLTEQ) was used as a measure of subjective exercise levels (69). The questionnaire asks participants to identify their frequency and duration over the last week of four physical activity categories: light activity, moderate activity, strenuous activity, and resistance training. The GLTEQ allows for a total calculation of physical activity, moderate-to-vigorous physical activity (MVPA), and levels of resistance activity on a weekly basis. The GLTEQ was calculated into scores for MVPA (to include moderate and strenuous exercise), resistance training (to include only resistance exercise), and MVPA plus resistance training, to determine the percentage of participants who were currently meeting cancer survivor guideline activity recommendations (71).

3.2.2.3 Exercise Levels: ACE Class Attendance

To measure objective exercise levels, attendance data for participants' most recent in-person exercise oncology program (date variable between participants: ranged from Winter 2017 to Winter 2020) and online exercise program (Summer 2020 to Winter 2021) was pulled from

the ACE database. In-person attendance was pulled from either participants' baseline or maintenance classes, while online attendance was only collected from maintenance classes.

3.2.2.4 Exercise Setting Preferences

To measure participants' exercise setting preference, participants were asked to indicate one of the following as their preferred exercise setting: online, in-person, or no preference. Participants were given the option to provide reasons for their exercise setting preference in a comment box.

3.2.3.3 Exercise Barriers and Facilitators

To measure participants' barriers and facilitators to exercise, the modified version of the Exercise Barriers/Benefits Scale (EBBS) was used (72). EBBS scores were used to identify barriers and benefits (facilitators) to exercise in this population for both exercise settings. This is a 43-item, 4-point Likert scale that has shown to have strong reliability and validity (73–75). The total EBBS score ranges from 43 to 172. When benefits and barrier answers are scored together, higher scores indicate a more positive perception towards exercise, with barrier scale items being reverse scored (72). When scored individually, barrier scores are not reverse scored. Higher individual benefits or barrier scores indicate a higher positive perception towards exercise or more barriers to exercising, respectively. EBBS question prompts were modified slightly to be adapted to cancer populations. Three questions were offered an alternative answer of 'not applicable', including 'I will prevent heart attacks by exercising', 'exercising will keep me from having high blood pressure', and 'my spouse (or significant other) does not encourage exercising'. Additionally, one question was completely removed: 'I will live longer if I exercise'. By removing this question that may have elicited some negative feelings in participants, the total EBBS score ranged from 39 to 168.

3.2.3.4 Behaviour Change Techniques

To measure participants' experiences with behaviour change techniques (BCTs), they were asked to report their BCT use and frequency during their in-person and online ACE programs. In both settings, participants were specifically asked to identify if they used or engaged with a particular BCT. If a BCT was used, participants were further probed on how often they used the BCT during the duration of either program session. BCTs evaluated were selected based on the ACE behaviour change education topics that are frequently used within the ACE classes (23,49,52–57). Specifically, eight BCTs were evaluated in the surveys. Five were derived from the ACE behaviour change education topics: 1. Principles of exercise and cancer, 2. Goal setting, 3. Behaviour change, relapse prevention, and motivation, 4. Stress management and fatigue, and 5. Social support and long-term maintenance. Additional BCTs that are commonly used within ACE were also evaluated, including: 1. Verbal persuasion to boost self-efficacy, 2. Providing feedback on performance, and 3. Prompting review of behavioural and outcome goals.

3.2.4 Mixed Methods Phase 2: Interviews

Semi-structured interviews were conducted with a subset of survey participants. Interviews were conducted after survey analyses, with participants contacted based only on those who indicated an interest (on survey). Purposive sampling for interviews considered varied demographics, including age, cancer diagnosis, exercise setting preference (in-person, online, or no preference), and gender. This purposive sampling was used to achieve variety across the sample in an attempt to hear varied perspectives (81). We aimed to conduct n=15-20 interviews to achieve a wide range of perspectives. The maximum number of interviews (n=20) was selected in an attempt to allow unique voices to be heard, while still providing in-depth understanding into diverse participant experiences with the transition from an in-person to an online exercise oncology program.

3.2.4.1 Interview Content

Interviews were semi-structured and based on the initial questions asked in the surveys, probing further on participants' experience with the exercise class setting transition. Specifically, questions focused on gaining more insight into individual participant responses regarding exercise delivery mode preferences, barriers and facilitators, experiences with BCTs, and the relationship of these factors with their experience in both delivery modes. Probes were included to elicit key experiences in both in-person and online exercise oncology programs and to discern reasons behind participant preferences. The interviewer (DD) had qualitative training, had conducted numerous interviews within prior research studies, and used techniques such as ensuring anonymity for interview responses to establish or build upon previous rapport with participants to elicit meaningful and deep information. See Appendix C for the interview guide.

3.3 Data Analysis

3.3.1 Survey Results: Quantitative Methods

Results from the survey were summarized using descriptive statistics and all analyses were run using SPSS 26 and Microsoft Excel v16.46. Missing data accounted for less than 10% of all data obtained, and therefore no missing data was imputed (82). To test our hypotheses, correlation models were used to evaluate the relationships between 1) EBBS scores and ACE class attendance, 2) EBBS scores and BCTs, and 3) BCTs and ACE class attendance in both delivery modes. Specifically, we examined the relationships between EBBS scores, exercise levels, and BCTs in both in-person and online exercise programs. Descriptive characteristics of the participants and outcome measures are presented as mean ± standard deviation (SD) or percentages. For the survey, responses with no data were excluded from analysis (n=4). Where applicable, the significant difference was reported for outcome measures.

3.3.2 Survey Results: Content Analysis

Content analysis was used to analyze open-ended questions posed on the survey, using Hsieh and Shannon's conventional content analysis approach (83). This type of content analysis uses an inductive approach. Therefore, researchers conducting this type of content analysis do not employ predetermined categories when analyzing data, instead allowing the category names to be derived from the data itself.

3.3.3 Interview Results: Thematic Analysis

The qualitative content was analyzed used thematic analysis. According to Braun and Clarke (84), there are several advantages to using thematic analysis. Advantages specific to the application of thematic analysis include its flexible nature, accessibility, and its usefulness in producing research for public consumption (84). Using thematic analysis in its flexible form appropriately aligns with the philosophy of pragmatism as it will allow multiple realities to be identified through the data. Interviews were transcribed verbatim by one author (DD). Coding was conducted by the same author (DD), analyzed using thematic analysis, and conducted using NVivo 12.0 software (QSR International). A theme table was created through an iterative process between authors (DD, NCR, WB, MM), in which multiple opportunities for feedback were completed before the table was finalized (Appendix C). Representative quotes were selected for each identified theme. Quotes were simplified by eliminating aspects of quotes that decreased readability, including repetitive and filler words, and substituting long pauses or digressions with "[…]".

Chapter Four: Results

It is important to recognize that a cancer diagnosis in and of itself can be a powerful motivator to engaging in exercise to promote overall health and well-being. Overall, participants described exercising within ACE as facilitating an increased feeling of control for their physical health. The theme, 'my goal is to have a good QOL and maintain my level of functionality through moving more', was particularly prevalent when discussing participant reasons for engaging in activity. In addition, the cancer journey, and specifically where individuals were along their care trajectory, impacted participants' experience with both delivery modes.

4.1 Phase 1: Survey

For the survey, 124 ACE participants who had taken part in both in-person and online ACE classes were identified and contacted via email (Appendix A). Of those contacted, 61 opened the survey and 57 provided complete data sets (46% response rate, 93% completion rate). Figure 4-1 displays the study design and participant flowchart, including recruitment, completion, and response rates for survey and interviews.

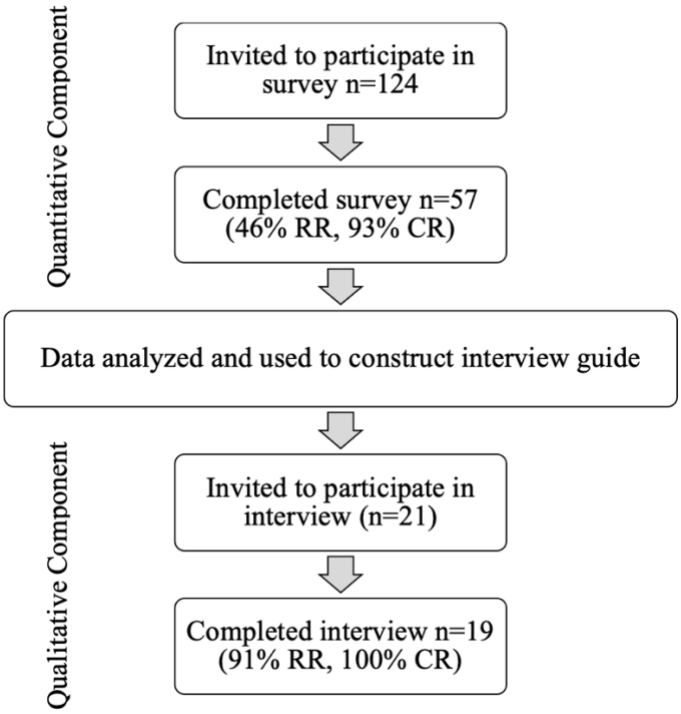

Figure 4-1. Overall Study Design and Participant Flowchart. Recruitment, Survey, and Interview Timepoints
CR, completion rate; RR, response rate.

4.1.1 Survey Participant Characteristics and Demographics

The majority of participants who completed the survey were female (84%) and had breast cancer (60%). The age of participants ranged from 44 to 84 years (mean ± SD; 62 ± 9 years) at the time of survey completion. A complete overview of survey participant demographics and clinical characteristics (i.e., cancer type) can be found in Table 4-1.

Table 4-1. Clinical Characteristics and Demographics of Survey Participants.

Clinical Characteristic	No. of Patients
Age: Mean ± SD, year	61.7 ± 9.2 (Range 44-84)
Time since date of diagnosis: Mean ± SD, year	5.0 ± 5.01 (Range 1.3-27.4)
Time since ACE baseline session start: Mean ± SD, year	2.4 ± 1.1 (Range 1.1 – 4.1)
Gender*	
Male	8 (14.0%)
Female	48 (84.2%)
Another	1 (1.8%)
Primary Cancer Type	
Breast Cancer	34 (59.6%)
Leukemia or Lymphoma	7 (12.3%)
Multiple Myeloma	3 (5. 3%)
Prostate Cancer	2 (3.5%)
Lung Cancer	2 (3.5%)
Endometrial Cancer	2 (3.5%)
Multiple Cancers	2 (3.5%)
Colon Cancer	1 (1.8%)
Ovarian Cancer	1 (1.8%)
Thymus Cancer	1 (1.8%)
No Cancer (Support Person)	2 (3.5%)
Demographic Variable	**No. of Patients**
Race*	
Caucasian or white	43 (75.4%)
White Anglo-Saxon Protestants	3 (5.3%)
Chinese	2 (3.5%)
Did not specify	2 (3.5%)
Italian	1 (1.8%)
German	1 (1.8%)
Black	1 (1.8%)
Eurasian	1 (1.8%)
Mixed	1 (1.8%)
Oriental	1 (1.8%)
Arab	1 (1.8%)
Employment Status	
Full-time	10 (17.5%)
Retired	29 (50.9%)
Homemaker	3 (5.3%)
Part-time	6 (10.5%)
Temporarily unemployed	0 (0.0%)
Temporarily unemployed due to COVID-19	2 (3.5%)
Disability/sick leave	7 (12.3%)
Student	0 (0.0%)
Annual Family Income, CDN$	

<$20,000	0 (0.0%)
$20,000-$39,999	3 (5.3%)
$40,000-$59,999	3 (5.3%)
$60,000-$79,999	9 (15.8%)
>$80,000	20 (35.1%)
Prefer not to specify	22 (38.6%)
Education Level	
Some high school	0 (0.0%)
Completed high school	2 (3.5%)
Some university/college	4 (7.0%)
Completed university/college	34 (59.6%)
Some graduate school	3 (5.3%)
Completed graduate school	14 (24.6%)
Marital Status	
Never married	1 (1.8%)
Married	41 (71.9%)
Common law	4 (7.0%)
Separated	1 (1.8%)
Widowed	7 (12.3%)
Divorced	3 (5.3%)

Some values may not sum to 100% due to rounding.
SD, Standard Deviation; ACE, Alberta Cancer Exercise.
*Race and gender demographic variables were self-identified.

4.1.2 Exercise Levels: Self-Report

Average weekly minutes for strenuous, moderate, mild, and resistance exercise training types are shown in Table 4-2. Table 4-2 also includes the average number of sessions (per week) and duration (each session) in each exercise category across the study sample. The average sum of strenuous and moderate exercise, otherwise known as MVPA, was 186 ± 169 minutes/week. Of those contributing to this average, 43 respondents (75%) were meeting the weekly MVPA recommendations of 90 minutes for cancer survivors (71). 45 respondents (79%) met the resistance training (RT) weekly recommendations of 2 sessions per week. A total of 34 participants (60%) met both the MVPA and RT recommendations.

Table 4-2. Godin Leisure Time Exercise Questionnaire (GLTEQ) Response Data.

Training Type	Number sessions/week: Mean ± SD, number of sessions	Duration/session: Mean ± SD, minutes	Total weekly minutes: Mean ± SD, minutes
Strenuous	1.66 ± 1.45	30.49 ± 30.24	68.71 ± 101.91
Moderate	3.32 ± 2.58	38.1 ± 27.10	117.5 ± 121.9
Mild	3.45 ± 2.77	36.76 ± 19.33	103.54 ± 98.0
Resistance	2.12 ± 1.30	30.78 ± 20.31	67.5 ± 56.93

SD, standard deviation.

4.1.3 Exercise Levels: ACE Class Attendance

Attendance data was pulled from survey respondents' most recent recorded in-person and online ACE baseline or maintenance classes. In-person class attendance was either from participants' baseline class (*n*=27, 52%) or maintenance class (*n*=25, 48%). In-person class attendance data could not be found for some participants (*n*=5). All online class attendance was taken from maintenance classes. No statistically significant differences were identified between in-person and online attendance data. The average for online attendance, taken from the most recent session, was 79.8% of total classes attended. For participants' most recent in-person classes, average attendance was 76.8%. It is important to note that the Winter 2020 in-person session ended early due to the announcement of the global pandemic on March 12, 2020. This shortened the proposed 12-week program to approximately 8 weeks.

4.1.4 Exercise Delivery Mode Preferences

Survey data indicated a majority preference for the in-person ACE maintenance classes, with 33 participants (57.9%), followed by 18 (31.6%) who preferred online, while 6 (10.5%) indicated no preference. Table 4-3 summarizes reasons selected by survey participants for indicating their specific exercise delivery mode preference. The most commonly cited reasons for preferring the in-person classes were social interaction (32/33, 94%), equipment (27/33, 79%), and safety (24/33, 71%). For the online classes, the most commonly selected reasons for

preferring this delivery mode included diminished commuting-related factors (17/18, 94%) and convenience (17/18, 94%). For those who selected no preference between delivery modes, reasons for enjoying the in-person program included the social interaction (6/6, 100%) and safety (4/6, 67%), whereas reasons for appreciating the online classes included the convenience (5/6, 83%).

Table 4-3. Reasons Selected for Chosen Exercise Delivery Mode Preference.

In-Person Preference (*n=33*)	Count	% pref chosen (*n*=33)	% from total (*n*=57)
Commute	0	0	0
Social interaction	32	94.1	56.1
Equipment	27	79.4	47.4
Safety	24	70.6	42.1
Convenience	1	2.9	1.8
Exercise intensity and type	19	55.9	33.3
Exercise instructor quality	15	44.1	26.3
Exercise volunteer/moderator quality	8	23.5	14.0
Online Preference (*n=18*)	Count	% pref chosen (*n*=18)	% from total (*n*=57)
Commute	17	94.4	29.8
Social interaction	3	16.7	5.3
Equipment	2	11.1	3.5
Safety	2	11.1	3.5
Convenience	17	94.4	29.8
Exercise intensity and type	4	22.2	7.0
Exercise instructor quality	5	27.8	8.8
Exercise volunteer/moderator quality	6	33.3	10.5
No Preference (*n=6*)	Count	% pref chosen (*n*=6)	% from total (*n*=57)
In-person			
Commute	0	0.0	0.0
Social interaction	6	100.0	10.5
Equipment	3	50.0	5.3
Safety	4	66.7	7.0
Convenience	0	0.0	0.0
Exercise intensity and type	2	33.3	3.5
Exercise instructor quality	1	16.7	1.8
Exercise volunteer/moderator quality	1	16.7	1.8
Online			
Commute	3	50.0	5.3
Social interaction	0	0.0	0.0
Equipment	0	0.0	0.0
Safety	0	0.0	0.0

Convenience	5	83.3	8.8
Exercise intensity and type	3	50.0	5.3
Exercise instructor quality	0	0.0	0.0
Exercise volunteer or moderator quality	1	16.7	1.8

Note. Multiple reasons were allowed to be selected. 'Count' refers to the number of individuals who selected each reason after indicating their preference. '% pref chosen' refers to the percentage of respondents who selected the reason out of the total number of respondents who selected that delivery mode preference. '% from total' refers to the percentage of respondents who selected the reason out of the total number of survey respondents (*n*=57).

4.1.4.1 Exercise Delivery Mode Preferences: In-Person

Table 4-4 shows the most frequently cited facilitators and barriers to the in-person delivery mode for participants who preferred the in-person classes, analyzed using content analysis. As shown by the number of participants who indicated facilitators and barriers (*n*), facilitators were cited more frequently and with more variety than barriers for the in-person setting. Survey descriptive and content analysis revealed that most participants preferred the in-person environment for the improved social connections and support, and the ability to receive more tailored, one-on-one feedback from instructors in-class. Other reasons noted for preferring the in-person classes included better equipment, enjoying having a location to drive to in order to feel engaged with the outside world, and improved BCT support (i.e., goal setting, education on exercise, social support).

Table 4-4. Survey Content Analysis of Facilitators and Barriers to the In-Person Delivery Mode.

Category	*n*
Facilitators	
Better socialization, including group cohesion, encouragement, social support, and ease of forming connections with peers	33
In-person environment more conducive to working harder due to social support and being inspired by watching peers exercise	17
More personalized instruction, encouragement, or feedback on technique and form from instructors	14
More available and larger variety in exercise equipment, exercises, and physical space	10
Helps get out of the house to ultimately be more committed to attending	2
Barriers	
Takes more time	1
Easier to talk self out of attending if weather is bad	1
Do not like co-ed aspect of in-person classes	1

Note. These responses are only from participants who indicated a preference for the in-person delivery mode on the survey. '*n*' refers to the number of participants who mentioned the facilitator or barrier to in-person in comment boxes on the survey. 'Category' represents facilitators or barriers, grouped based on similarities in responses.

4.1.4.2 Exercise Delivery Mode Preferences: Online

Table 4-5 shows the most frequently cited facilitators and barriers to the online delivery mode for participants who preferred the online classes. A wider variety of facilitators, versus barriers, were more frequently described for the online delivery mode. The online environment was preferred for the convenience and overall time efficiency that this delivery mode afforded. Additionally, some participants felt that they received greater physical benefits in the online environment due to only focusing on themselves versus focusing on or being concerned about others while exercising, an increased confidence to try new things in the online environment, and the ability to work harder during class without feeling as if they were making other participants who were in worse physical condition feel bad. Positive aspects of exercising in the online

environment included not having to travel in inclement weather, pay for parking, or waste energy on the commute to the in-person classes.

Table 4-5. Survey Content Analysis of Facilitators and Barriers to the Online Delivery Mode.

Category	*n*
Facilitators	
Online programming is more convenient, including shorter commute time, no parking costs, and the ability to complete classes anywhere	28
More comfortable being in own home, safer environment due to COVID-19, less stressful overall	3
Online classes create a better environment, including a lack of judgment and criticism from self or other participants	2
More conducive to working harder	1
Exercising online allows participants to reserve more energy and be less fatigued overall	1
Better real-time coaching on exercise education	1
Barriers	
Insufficient internet	2
Decreased social support, including having difficulties meeting others and less opportunities for socialization	2
Commitment difficulties	1
Family or children at home as a barrier to exercising	1

Note. These responses are only from participants who indicated a preference for the online delivery mode on the survey. '*n*' refers to the number of participants who mentioned the facilitator or barrier to online in comment boxes throughout the survey. 'Category' represents facilitators or barriers grouped based on similarities in responses.

4.1.4.3 Exercise Delivery Mode Preferences: No Preference

Comments made regarding participant descriptions as to why no preference was indicated between online and in-person delivery modes are included in Table 4-6. This table also includes experiences with the transition to the online delivery mode. Participants with no preference indicated aspects of both delivery modes that were considered pros and cons. Online classes were seen as convenient but lacking the social support that was accrued in-person.

Table 4-6. Survey Content Analysis for Reporting Ambivalence to Exercise Delivery Mode

Category	*n*
Online classes are the 'next best thing' to in-person classes, both have their pros and cons	6
Instructors demonstrate the same level of instruction and enthusiasm, no difference online and in-person	2
Online exercise classes are good for physical fitness, but not for social interaction	2
Would not have initially chosen online classes, but this delivery mode now works well for lifestyle	2
It is best for participants to start with in-person classes to learn physical technique, but online classes are now best due to COVID-19 related restrictions	1

Note. These responses are only from participants who indicated having no preference between delivery modes on the survey. '*n*' refers to the number of participants who mentioned any comment regarding the transition from in-person to online in comment boxes throughout the survey. 'Category' represents facilitators or barriers grouped based on similarities in responses.

4.1.5 Exercise Delivery Mode: Exercise Barriers and Facilitators

EBBS scores between in-person and online exercise classes indicated significant decreases in both barriers ($p<0.01$) and benefits (facilitators) ($p<0.01$) for the online delivery mode (see Table 4-7). Individual EBBS question items with the largest values for the in-person exercise delivery mode for facilitators were 'exercising improves my mental health', 'exercising lets me have contact with friends and person I enjoy', 'I am fatigued by exercise', and 'exercising is a good way for me to meet new people'. Barriers noted as lower in the online exercise delivery mode were 'exercising takes too much of my time', 'places for me to exercise are too far away', 'there are few too places for me to exercise', and 'I am too embarrassed to exercise'.

Table 4-7. Average Exercise Benefits and Barrier Scale (EBBS) Scores: Total, Benefit, and Barrier Scores and Differences between In-Person to Online.

	In-Person Score: Mean ± SD	Online Score: Mean ± SD	P Value
EBBS Total	138.02 ± 14.29	137.05 ± 13.99	$p = 0.35$
Benefits	94.23 ± 10.69	91.16 ± 10.96	$p = 0.00$
Barriers	25.16 ± 5.13	23.05 ± 4.31	$p = 0.00$

*Not*e. Two-tailed, paired t-tests were conducted.
SD, standard deviation.

4.1.6 Behaviour Change Technique Support

The average number of BCTs each participant indicated using or receiving from their instructors was significantly lower ($p<0.01$) in the online environment, with an average of 5.5 (out of 8) BCTs used in-person and 4.6 used online. Differences between in-person and online delivery modes for feelings of support from BCTs on a group level were approaching significance ($p=0.065$), trending to indicate more support experienced for in-person versus online classes. As seen in Table 4-8, the BCTs with the largest differences in feelings of support between delivery modes included social support and education on exercising with a cancer diagnosis, creating consistent exercise habits, and stress management and fatigue. Feelings of support remained relatively the same for BCTs involving exercise instructors and goal setting.

Table 4-8. Feelings of Behaviour Change Technique Support Between In-Person and Online.

Behaviour Change Technique	In-Person, *n*	Online, *n*
Education on exercising with a cancer diagnosis	34	22
Education on how to manage stress and fatigue	31	26
Using or incorporating feedback from instructors provided during class (i.e., on exercise technique)	55	54
Social support	41	20
Goal Setting	31	33
Reviewing your goals	28	29
Education on how to create consistent exercise habits and build motivation to be active.	33	26
Using your instructor's or your own encouragement to boost your self-efficacy	52	48

Sum:	305	258

Note. Number of survey respondents who indicated feeling supported in specific behaviour change techniques in either an in-person or online exercise delivery format.

4.1.7 Correlation Analyses

Correlation analyses indicated no significant relationships between EBBS scores, BCTs, and attendance data in either in-person or online classes. Tables 4-9 shows the correlational analyses run between our three key variables of focus in both online and in-person delivery modes.

Table 4-9. Correlation Analyses for EBBS Scores, BCTs, and Attendance Data

Online Delivery Mode			
	EBBS Score	BCT Number	Attendance %
EBBS Score	-		
BCTs	0.12	-	
Attendance %	0.02	0.15	-
In-Person Delivery Mode			
	EBBS Score	BCT Number	Attendance %
EBBS Score	-		
BCTs	0.09	-	
Attendance %	-0.20	0.23	-

Note. **'**BCT Number' refers to the total number of BCTs indicated to be used by each participant in both delivery mode. 'Attendance %' refers to the number of classes attended divided by the total number of classes available that session.

4.2 Phase 2: Interviews

4.2.1 Interview Participant Characteristics and Demographics

Interview participants were purposively sampled from the pool of survey respondents. Nearly all survey participants (53/57, 93%) agreed to be contacted for an interview. A total of 21 participants were contacted via email (Appendix A) to participate in an interview, with 19 responding and completing interviews (91% RR, 100% CR). One participant provided no response to interview invitation emails and the other participant had a death in the family and

was unable to participate at that time. The majority of participants who completed an interview were female (68%), had breast cancer (37%), identified as Caucasian (84%), were retired (68%), married (74%), with an age range of 44-77 years (average age 63 years) at the time they completed the initial survey. An equal number of participants who had selected each of the three delivery mode preferences were attempted to be recruited for interviews. Eight (42%) participants who had indicated a preference for the in-person delivery modes were interviewed, 6 (32%) indicating an online preference, and 5 (26%) indicating no preference.

4.2.2 Thematic Analysis

While acknowledging the importance of all the themes generated out of the participants' knowledge, given the particular focus of this research, the results and discussion will focus on participant experiences with the transition to the online from the in-person delivery mode, and unique experiences or differences in both settings. Additional themes that were more relevant to the overall ACE program, satisfaction with the program, and future program offerings or improvements are not included. These themes may be explored in future research and incorporated into quality improvement cycles for ACE and other exercise oncology programs.

The four themes that emerged from participant interviews include: 1) It's been the best route that we could take, given the circumstances, 2) A lot of good came out of this opportunity to continue with ACE online, but there were still barriers to exercising from home, 3) My in-person experience was great, but I still faced barriers to attending, and 4) My goal is to have a good quality of life and maintain my level of functionality through moving more. The first three themes encapsulate participant experiences with online and in-person delivery mode experiences, while the fourth theme centers upon participant QOL and the ACE program more generally. Additional participant quotes are presented in Appendix C.

Theme 1: It's been the best route that we could take, given the circumstances

Participants described feeling isolated during COVID-19 and how ACE transitioning to an online format allowed them to continue to exercise and reap the physical and social benefits of ACE that they had previously experienced (i.e., in in-person classes). This was described as a key component to participants' mental and physical health throughout the duration of the pandemic.

> *Initially, when the lockdown came along, I thought [I was] going to lose all these things that are actually keeping me from losing my mind. So, when the ACE program talked about going online, […] I was just so happy and relieved […]. It's been such an important way for me to feel like I'm connecting with other human beings during the day, in a time when I can't do normal things […]. I think I would actually be in a far worse place mentally if [ACE classes had] been stopped altogether. I consider it a huge gift that you've been able to find a way to keep classes going virtually […]. That's been kind of the guiding light for my mental health is just knowing that there's consistency that I'm seeing the same group of people every week, and that there's interaction […]. I think that's made a huge difference to me.* ***P42***

Despite participants expressing gratitude for the opportunity to continue with ACE during the pandemic, individual differences were still reflected in exercise barriers and/or facilitators. Individual factors that participants described as creating either a successful or difficult transition included having or not having exercise equipment and a physical space to exercise in, being familiar or unfamiliar with Zoom, and having a sufficient or insufficient internet connection. A key factor to a successful transition frequently noted by participants was having prior experience with the in-person classes. Additionally, the effort put forward by instructors contributed to participants' successful transitions online.

> *The only thing with the transition is [a lack of] equipment access […]. But [the instructors] have done a good job adapting in terms of circuits and modifying for what people might have at home.* ***P2***

> *To be honest, had it been proposed me as online straight off, I probably would have passed […]. I tend to think if it's physical, then I need someone else there with me […]. But I think the fact that I was already in the [ACE] system meant that […] I'll try it. If it doesn't work, well, I'll just move on. And seeing some familiar faces in the group was good […] and [the online classes] work pretty well.* ***P77***

Despite the online classes not being seen as equivalent to the in-person classes by some participants in terms of the social support and personalized feedback provided by instructors, the ability to continue to see others and to reap the benefits of continued instruction from exercise experts were described as important. This theme also includes when participants described the online ACE classes as being "the next best thing" to in-person.

> *It's not quite the same interaction, because Zoom's one person at a time. So, you don't get the same type of conversation. But there's that opportunity to ask questions and have discussion […]. So, for a lot of classes, people are logging in early, getting set up, and then there's some socialization […]. I've done some of those online ones where there's no interaction […], it's not quite the same. So, to have live instructors, real time, and adapting as you go, that's probably been the best route that we could take, given the circumstances.* ***P56***

Theme 2: A lot of good came out of this opportunity to continue with ACE online, but there were still barriers to exercising from home

This theme captures the varied experiences of participants while exercising with ACE in the online environment. Despite the attempts made by the ACE team to create a beneficial environment online, participants noted that generally, they received less benefits in the online environment, including decreased physical and social benefits. The decrease in benefits was often attributed to inherent limitations associated with the online Zoom platform, in which instructors were unable to provide one-on-one feedback to participants.

> *I'd say that's what's different [about online] […]. I know you guys have a bit of time before class and after class, but it's not the same thing as getting together with a group and going for coffee […]. […] that's what I miss the most is the physical connection and interaction.* ***P2***

> *What I miss about the in-person is [the instructors] don't really have the ability online to walk around and check on us […]. […] it [wa]s easier to get that kind of that kind of help one-on-one. When […] I'm in a square in the Zoom thing, it's difficult to give that kind of help […]. So that kind of chance to have that private conversation is something that I miss. And it's a bit more difficult to get a really good handle on what people's limitations are when it's online.* ***P77***

However, some participants noted an increase in physical benefits online.

> *I honestly think that the physical aspects have been enhanced. I don't feel strongly that that the instructors have been missing me doing something imperfectly or the wrong way or anything like that […].* ***P39***

Additionally, one participant noted encouragement and feedback being better in the online environment.

> *The positive reinforcement that's given by the moderators and the instructors has taken on a whole new dimension […]. So, [the instructors are] actually speaking up more often in terms of […] encouragement, than actually happened in the live session […]. The constant, 'great form', 'you guys are doing good', 'you're killing it' […], that's really great […]. Because the instructors are more focused on your form and structure. And I know you've had to adapt from the in-person environment […]. But I think that's a real boost for each person individually […]. I would say the encouragement [online] is more affordable now than it was before [in-person].* ***P18***

Despite instructors' best efforts to encourage social connections between participants, limitations still existed for fostering personal relationships between participants, although some participants described social support within classes improving over the last year.

You get a chance to know the other people a little bit more [in-person]. You know, whether they've got sons, daughters, if they've got trips planned […]. As opposed to online, other than the people I was in the classroom [in-person] with, I don't know anything about these other 10 people. I'm further ahead with the group I came with than the ones I've been with […] since March [online]. ***P6***

You didn't even want to do it at the start, when it was online […] Because he said he needs the people. He wants to be around people. And even after the first few months, he kept saying, I'm not going to continue, […] "what's the point", he would say. And so […] I sent a message [to ACE] […] and said, there's more to this exercise class than just exercise. We need the social part […]. […] we now allow 10 or 15 minutes for the social part. And that's made a huge difference. He's far more engaged because of it, […] we really appreciate the fact that that was accommodated. ***P6***

Despite potential limitations in social benefits, participants noted other benefits to exercising online. New benefits or facilitators included more time throughout the day, less exacerbation of fatigue symptoms, and an increased level of confidence while exercising due to the comfort afforded by attending in the home environment.

One benefit of [online] is that it's way less easy for me to talk myself out of a class […]. When you have to physically leave your house and drive somewhere, on the days when I'm feeling a little bit low, it's much easier for me to [attend] […]. I don't want to be trying to concentrate on driving and all this. But doing classes online, I just have to get myself down to the gym in my basement. There's no reason I can't do that. ***P42***

I had the courage […] to try new things more online […]. You're watching me, but I'm more alone […]. And I never tried [new exercises] in class […]. I never did. [But now], I do. Because I might as well […]. I think I'm less intimidated […]. […] what I'm learning now actually is [exercising online is] giving me the confidence […] to listen to my body to do what I need to do now […]. I do sometimes try new things. ***P75***

In addition, participants described less barriers to attending the online classes, including no commute time and no need to walk or drive in poor weather. Motivation to attend classes was potentially both increased and decreased across participants by these factors.

> *The accessibility, especially when it's 20 below, 30 below, so much easier to be motivated to go online and do a program than it is to get bundled up and then walk […] to the [exercise venue].* ***P2***

> *And […] you just didn't feel like you had the same incentive to attend when it just meant going upstairs as opposed to preparing to go somewhere.* ***P6***

Lastly, this theme describes participant experiences with BCTs in the online classes, which some participants described as being similar or slightly less prevalent online. BCTs described in the online environment included receiving education on exercise, feedback from instructors, and additional education seminars that were hosted online.

> *I would say [my experience with behaviour change techniques online is] the same […]. It's human nature when [the instructors] are going through [the participants] and commenting on different people, whether you hear your name called. So, […] it's different [online]. [The instructors are] looking at a small screen, you've got your gallery view up. It's just a different experience, it's hard.* ***P2***

> *I found those seminars that were a part of the formal exercise, like on self-efficacy, […] they were quite helpful […]. And that was done online. So, I didn't see that much difference from an education point of view. And […] [the education] might even be better online [for creating consistent] exercise habits.* ***P18***

> *The education piece [helps my exercise habits]. And having [the instructors] individually educate me on proper technique to get the benefit. So even though it's difficult via Zoom, it still happens […]. So, it still modifies the behavior, it still creates that desire […] I'm still learning new exercises.* ***P56***

Theme 3: My in-person ACE experience was great, but I still faced barriers to attending

This theme captures the varied experiences of participants while exercising within ACE in the in-person environment. One of the most important aspects described about exercising in-person were the social benefits received from peers, instructors, and volunteers while exercising. Some participants described the social benefits derived from class as beneficial but considered these benefits as a 'bonus' as opposed to an essential component of ACE. Others felt that the social interaction in-person was the best part of ACE and struggled to attend online. These participants noted exercise as being a secondary component of ACE, behind the social interaction aspect.

> *When I first got involved, […] I was just absolutely overwhelmed by the interaction with [others] […]. […] by quite a wide margin, my preference would be in-person. Because of the value to me of some sort of social contact. And as a result, the sense of community connection, engagement with the undergraduates, the sense of safety that comes from the instructor telling you how to do it right, the presence of a large number of people in the room, and in small ways, […] trying to help other people are in the same situation as I am, or maybe farther down the road than I am.* ***P18***

> *I think the social support thing is more important to some people than others. I'm lucky, I've got a really strong support system. And if we weren't able to do any more in-person classes forever, I'd still be okay […]. For me, it wasn't necessary. It was just a really nice bonus […]. That one-to-one and the help when I needed it. And a couple of good friends that I've made. Those were all bonuses.* ***P16***

Despite the beneficial social support that occurred in-person, attending classes in this delivery mode regularly was still difficult for some participants. Barriers to in-person classes included poor weather, commute time (walking or driving), exacerbated fatigue, and parking costs in-person.

> *When it was a cold and wintery and slippery day […] And if I was having a day where I wasn't feeling that strong, […] by the time I got ready, drove through the weather, and*

parked and walked to the university. I'm like, whew, okay, I think I'll just go back. That part of it is easier being at home […]. It was a bit challenging to do that walk. ***P16***

Some people felt as if the social support aspect and the benefit of interacting with the instructors in-person was worth combatting these barriers to come in-person, whereas others felt that the convenience of the online was superior to the social support received in-person.

But […] it didn't matter what the weather was like, you still showed up [to see others in the class]. ***P6***

While I enjoy the social support and the interaction, […] I have a pretty busy life […]. So, for me, the ACE program, while it's been really useful to interact with other cancer survivors, […] the social aspect for me isn't a massive thing […]. But in terms of reduction of barriers [online], that I did find was really high, because we don't have the commute time, it was much easier to interweave it and fit it into the day […]. I found a lot of the barriers to regular exercise actually did drop for me. ***P109***

This theme also describes participant experiences with BCTs in the in-person classes, which largely surrounded the social support benefits derived from in-person, the education received on exercising, and the feedback and encouragement from instructors, which were generally described as being better or more prevalent in the in-person environment.

Obviously, [behaviour change techniques are] better in-person than they are online. Especially when [the instructors] have 20 people [in class], […] that's a lot. I've actually noticed the difference. Because even with the 12 people, […] somebody would be saying oh, that's good, [NAME], keep that up. But now, [online], it's not very often that you hear that. ***P25***

Theme 4: My goal is to have a good quality of life and maintain my level of functionality through moving more

This theme captured when participants spoke about their overarching goals of maintaining a good QOL and how they did not feel they needed 'other skills' to engage in

exercise. For example, participants described that they do not focus on setting specific physical goals that they need to achieve. Instead, for them, being generally active was their goal in order to maintain healthy physical functioning. For some participants, showing up to class was seen as meeting their goal. For others, daily activity was their benchmark.

> *My goal, if you want to call it that, is to do the exercises, as best as I can, and hopefully better than I did them the last time. Maybe that's pushing myself a little bit harder, doing more cardio, whatever. Those are my sorts of goals […]. It's just keeping my body moving and functioning properly that's important to me […]. I don't set an exercise goal, per se, […] some days even showing up is a challenge in itself.* ***P39***

Ultimately, participants described a wide variety of experiences with the in-person and online classes. These delivery modes had a variable impact on participant barriers and facilitators and experience with BCTs, ultimately leading to variable exercise delivery mode preferences across participants. The impact of their cancer diagnoses, other factors in their lives (including the impact of COVID-19), where they were along the treatment trajectory – these all influenced perspectives, participation, and experiences of ACE participants.

Chapter Five: Discussion

5.1 Thesis Summary

As COVID-19-related restrictions continue to impact the psychological and physical health of cancer survivors, innovative ways to deliver supportive care resources to help mitigate negative side effects associated with the disease are necessary (85). The current study was designed to evaluate the experiences of cancer survivors who transitioned to the online delivery mode of the ACE maintenance program. This study collected the perspectives of participants who experienced at least one in-person and one online ACE session, allowing them to speak to their barriers and facilitators, transitions, and experiences with the ACE 'Exercise and Educate' BCT components across delivery modes. Findings indicate a variety of participant experiences during the transition to an online exercise oncology program delivery format. From both survey and interview data, the exercise delivery mode was related to many of the barriers and facilitators that support exercise maintenance, including social support, feedback from instructors, technology literacy, and commute time or convenience, among others. ACE has delivered a unique online exercise experience, and there are opportunities to both further explore this type of exercise program through research and to more effectively deliver remote exercise oncology programs that support exercise maintenance moving forward.

5.1.1 Synchronous and Supervised Exercise Class Instruction

An advantage to synchronous delivery described in the literature is increasing the potential to deliver interventions via telecommunication technologies with higher levels of participant engagement, compared to asynchronous delivery (12,86). Delivering synchronous interventions that are also supervised may further increase participant engagement and safety (87). Supervision by trained professionals is a key element of both the in-person and online ACE programs that was viewed as beneficial and facilitated participant attendance and satisfaction

with classes. This is consistent with other literature, in which cancer survivors have spoken to the importance of receiving supervision to overcome feelings of insecurity in their own physical functioning (57). While expert supervision was a valued component of online ACE classes, it was often described by participants as subpar when compared to in-person, where tactile, one-on-one feedback was available. Exercise feedback on technique was still offered online, but in a manner that was viewed as not equivalent to in-person classes. Participants' desire to receive high quality and tailored exercise programs has also been described in previous reviews (57). This is consistent with our results describing the importance of receiving immediate exercise modifications online, made possible by synchronously delivered exercise instruction – even if this continued instructor feedback was not viewed as identical to in-person. Calls for telehealth interventions that deliver synchronous, supervised, and group-based exercise sessions, similar to what has been done for in-person exercise programs (i.e., by utilizing videoconferencing telehealth platforms) for cancer survivors, have been made and will be important to further examine in the future (8). The increased safety as well as the social aspects experienced from online ACE as it was delivered was highly valued by participants, as opposed to delivering an asynchronous, unsupervised, individually-based exercise program.

5.1.2 Group-Based Program: Social Support

Social support is an important determinant of QOL in cancer survivors (10,88–93). Amidst a pandemic where social interactions are limited for all, and potentially even more so for immunocompromised cancer survivors, providing opportunities for interactions with other cancer survivors is important. This was described by some participants who were grateful to have an opportunity to connect with others during a time when alternative social outlets and opportunities were restricted. Ultimately, the group-based aspect of the ACE program was seen as a facilitator for attending on a regular basis in both delivery modes. The importance of social

support as a facilitator while undertaking exercise oncology and building exercise habits has been described in previous literature (94–97). Recently, a cross-sectional study conducted during the COVID-19 pandemic evaluated the importance of social support to active cancer survivors (85). Themes derived from this data included the importance of utilizing remote platforms, such as Zoom, to encourage social support during COVID-19 and the overall value of social support to exercise. The current results are consistent with these, as participants often spoke to the importance of social support when exercising. However, participants also described that receiving the 'usual' level of support as in-person was difficult in the online environment. This was largely attributed to an inability to have informal, one-on-one conversations with peers or instructors on the Zoom platform, limiting opportunities for social interactions. This potential lack of social support from simply 'chatting' with other participants was an important facilitator of exercise attendance for in-person classes that was not as available (due to technology limitations) in the online ACE setting.

5.1.3 Exercise Facilitators and Barriers

Beyond social support as a facilitator in the two delivery modes, participants experienced differences in other barriers and facilitators that affected their exercise experiences. As indicated in both the survey and interviews, participants experienced less perceived barriers but also less benefits from exercising in the online classes. Previous research has described home-based or remotely delivered exercise programs as advantageous by requiring less time or travel to attend in-person programs, higher privacy, and overcoming costs of transportation and/or parking, which were also found in our sample (55,57,58). A unique facilitator supporting the transition to the online classes for our sample was previous experience with the in-person ACE classes, which provided a comfort level with the program format, instructors, and other participants. This is a unique finding in this research as there has not been an evaluation of a previously offered in-

person exercise oncology program transitioning to online. Despite noting a tendency to overcome some barriers inherent to the in-person environment, other barriers in our sample also arose while exercising online, including technology or internet connection issues. These challenges are consistent with past reviews mentioning technical problems or technology illiteracy as barriers to online exercise in cancer populations (49,55,58). Participants also described having experience with technology or a sufficient internet connection as facilitating their attendance online, consistent with other literature (58). Engagement with technology by older adult populations (65 years+) has been increasing since the onset of the COVID-19 pandemic (57). Participants in this sample also described acquiring an increased comfort with using technology, describing learning more about using technology, and Zoom specifically, through the ACE program. For cancer survivors hesitant to begin an online exercise program, educational or instructional opportunities on using Zoom or other technology should be provided. For example, before beginning an online ACE session, participants are provided with a step-by-step "how to" Zoom guide (Appendix D). This may foster an easier transition to exercising online for this population.

5.1.4 Behaviour Change Techniques

Participant experiences in the in-person and online ACE programs with behaviour change techniques (BCTs) varied widely. Ultimately, participants felt more supported through BCTs in the in-person classes because of the ability to engage in one-on-one and group conversations with their peers and/or instructors. This lack of opportunity to have individual conversations with others was seen as an inherent negative component to the online environment that could not be overcome. For instance, goal setting, education, and instructor feedback on technique and form were viewed as superior in-person because of the availability to ask questions about setting goals or specific exercises directly to the instructor without disrupting the flow of the class. However,

some participants did concede that they could join the class early, stay after class, or even send an individual email to instructors if they truly wanted to have conversations on these topics. Conversely, many participants described not needing to engage with BCTs to increase their exercise levels, due to already being active, or wanting to increase their activity, because of their cancer diagnosis. In our findings, some participants noted that goal setting (i.e., physical exercise goals) at this stage in their life was not important. Instead, they noted goals of simply staying as healthy as possible by remaining active and functional; for these participants, ACE was seen as a tool to help achieve those goals in both delivery modes.

5.1.5 Exercise Delivery Mode Preferences

The variety in exercise preferences found in our sample is similar to some previous reviews evaluating exercise location preferences in cancer populations (98). In this study, reasons for indicating an exercise delivery mode preference varied largely in relation to individual health status, commute time/convenience, physical benefits, social support, or other unique barriers and facilitators. Exercise delivery mode preference varied widely, but overall, in-person classes were more preferred than online. This differs from other work that has also identified variations in preferences, but with the majority preference being for home-based exercise (57,98,99). This majority preference for home-based or online exercise is larger than found in our study, which may be a factor of the current COVID-19 environment. Specifically, the majority of participants in this research may prefer in-person exercise due to the receipt of social support and the inability to achieve such support in the COVID-19 environment, whether from ACE or other sources. This ‘new’ pandemic environment may have led this sample to more notably miss the support previously received during in-person ACE classes. This highlights a difference in the circumstances this research was conducted in, compared to other literature in which participants were not limited by mandated physical distancing restrictions and had the

opportunity to engage socially with others. This past research demonstrating higher preferences for home-based exercise may thus be partially due to participants having other opportunities to engage in socialization outside of the exercise intervention, leading these participants to place less value on social support specifically gained through exercising. As social support, or the perception of social support, is an important benefit that has the potential to facilitate engagement in exercise, offering support in an online environment via a group-based program may enhance exercise levels in the online environment (100,101). The social support that was offered through the online environment due to the continued use of the group-based format of ACE may have contributed to the consistent average attendance rates across delivery modes within our sample.

5.1.6 Influence of Delivery Mode on Exercise Levels

The majority of the survey sample were meeting the recommended exercise guidelines for cancer survivors, demonstrating a more active sample relative to the larger cancer survivor population (22,32). This is not surprising, given that all participants had recently participated or were participating in the ACE program on a weekly basis. Participants spoke to the fundamental role that ACE has played in maintaining their consistent exercise levels throughout COVID-19. The offering of the ACE maintenance program, at an affordable cost, was seen as a strong facilitator and as bolstering the opportunity to maintain exercise levels in this sample, particularly considering that alternative exercise options were limited due to mandated restrictions. Examination of attendance and adherence rates in previously offered remotely delivered exercise oncology programs indicates variable adherence rates, depending on the intervention (18,49,55,58,65). From the reviews of remotely delivered telehealth exercise interventions using web-based platforms with tailored exercise or telephone call support, adherence has been shown to be generally high, even when compared to in-person interventions

(55,58,65). For instance, Batalik et al. (55) reported seven out of nine studies using telephone calls as having high adherence rates ranging between 71-90% (sessions completed or percentage of sample reaching prescribed exercise guidelines). Conversely, telehealth interventions that use technology such as email, SMS text messaging, or online educational workshops have been shown to have lower adherence or attendance rates (i.e., 50% uptake of online educational module in week 1 compared to 10% in week 9; 48). Roberts et al. (49) postulated their findings of lower intervention adherence to the lack of supervision and social support. In our study, similar attendance averages were found between in-person and online delivery modes. This relatively high engagement in the online delivery mode may be due to the elements of ACE maintenance delivery, including the synchronous, supervised, and group-based nature of the online program, that facilitated greater engagement. This is consistent with past interventions that demonstrate higher engagement and attendance through videoconferencing, albeit in asynchronous intervention platforms (12,55,58,65).

5.1.7 Implications for Future Online Exercise Oncology Programs

With the continued impact of the COVID-19 pandemic on the Canadian population, it is impossible to predict the duration of physical restrictions, and thus limitations in offering exercise oncology programs for cancer survivors in-person. With that said, the lessons learned from this research can be applied to current online exercise oncology offerings. Practical applications from this research can also be applied to online programs past COVID-19 to reach more cancer survivors, particularly those who cannot typically access in-person classes, such as rural and remote cancer survivors. One such program is the Exercise for Cancer to Enhance Living Well, or EXCEL, program (102). EXCEL builds upon the ACE program, extending outreach to rural and remote cancer survivors across Canada. EXCEL offerings online began in September 2020, delivering exercise as supportive cancer care to individuals living with cancer

who typically do not have access to such resources (18). In order to optimize online delivery within EXCEL, or other exercise oncology programs, some lessons learned from this research should be applied.

First, current results reinforce that social support and a sense of community need to be continually fostered in the online exercise oncology environment. Steps taken by ACE over the last year to foster community within participants included adding additional social time before and after class, sharing participant emails with the class with permission, and providing participants with the choice to stay unmuted during class to foster within-class conversation. A disadvantage to the online environment continually noted by participants was the inability to have personal conversations with peers or instructors. This speaks to current limitations in videoconferencing technology in which only a single person can speak at a time. Looking towards the future, the development of videoconferencing technology that allows one-on-one conversations or more flexible breakout rooms (i.e., one-on-one, or small group conversations permitted without having to leave the main Zoom room) may bolster the success of utilizing videoconferencing as a tool for exercise, and exercise oncology specifically. This may specifically address participant needs to improve their perceived social support provided online. Such technology may also create the ability for instructors to provide private feedback or answer participant questions without disrupting class flow. Exploring other methods of bolstering social support in the online environment will be a key component to consider when attempting to deliver, design, or improve future exercise oncology programs.

Second, more steps need to be taken to provide participants with feedback on exercise technique to optimize potential physical program benefits as well as ensure safety. Increasing moderator engagement as a potential way to improve the amount and quality of feedback

received from the instructional team should be further explored. Having well-trained and experienced moderators is a key component of the online ACE and EXCEL classes. Moving forward, it may be beneficial for moderators to take on more active roles within online classes, including providing individual and tailored feedback to participants on exercise technique and modifications. Another way ACE facilitated the instructor-participant relationship outside of class time has been by having instructors send weekly pre-class communication emails containing the class exercise plan, the Zoom link and password, and a list of necessary equipment needed for each class. The intention of these emails was to allow participants to ask questions on specific exercise modifications or ways to challenge themselves during class time. Participants described these emails as fostering a more open line of communication between participants and instructors and allowed participants to feel more prepared to exercise each class. This was noted as a key benefit enhancing feelings of readiness for exercising online that may be applied in ongoing programs, including EXCEL.

Third, evaluating the cost of designing and offering online exercise oncology programs is an integral part of building a sustainable program that can continue to help cancer survivors adhere to consistent exercise, and built a habit of moving more. For participants, offering online programming limits the cost of attending, negating the need for travel or parking costs (18). For providers, examination of cost analyses in future research will be essential to enhance sustainability (18). mHealth and other telehealth interventions have already demonstrated the potential to decrease the cost of providing complementary healthcare services such as exercise (12,55,58,64). A call for the future examination of cost-effective interventions demonstrating real-world feasibility and applicability have been made and will be crucial moving forward (49).

Last, the wide variety of findings on participant barriers and facilitators, experiences with BCTs, and exercise delivery mode preferences highlights the uniqueness of every cancer survivor and their journey. The cancer experience may be a tumultuous journey affected by diagnoses and treatment status, factors outside of their disease (impacts on family and work life), the supports provided, and numerous other considerations. In the field of exercise oncology, other factors such as previous exercise history, other chronic conditions, and exercise preferences need to be considered in order to deliver the most effective exercise experience possible to these survivors who have chosen to use exercise as a tool to manage their disease status and enhance their QOL. Whether this is online for rural and remote cancer survivors or in-person after the end of the COVID-19 pandemic, attempting to take participant variation into account when designing and offering exercise oncology programs is essential. This tailored approach is essential for successful implementation and requires moving beyond a generic 'one-size-fits-all' exercise prescription. ACE and EXCEL are doing so successfully in a group-based setting and provide an exercise oncology model for continued program implementation.

5.2 Strengths and Limitations

This study had some notable strengths, including rich data derived from both quantitative and qualitative data collection methods and a strong response rate for surveys (46%) and interviews (91%). Additionally, the interviewer (DD) had prior personal relationships with most of the interview participants (16/19, 84%), leveraging an already established rapport to generate meaningful and candid qualitative data. Limitations to this work included the cross-sectional nature of the survey, only collecting data at one point in time. This may have introduced a recall bias when prompting participants to recall their barriers, facilitators, and BCT use in the-person exercise delivery mode in particular. As demonstrated by collected exercise levels of this sample, ACE maintenance participants are generally more active than the general cancer population. This

is important to note, as exercise interventions may attempt to target low exercisers or non-adhering cancer survivors where changes are typically more readily found (57,66). Therefore, the insights and experiences of this population may be less generalizable to less active cancer populations. Future directions for this research are necessary to ensure cancer survivors remain supported as complementary therapy services, such as exercise, remain out of reach for many due to the COVID-19 pandemic, and potentially beyond. The sample for this study and the ACE population as a whole tend to be wealthy, Caucasian, and retired. This population may have potentially been subject to less negative effects from the pandemic on their overall well-being. Therefore, the results from this study may not be generalizable to all cancer survivors who are engaging in exercise during or beyond the pandemic.

5.3 Conclusion

In conclusion, the present study indicates that ACE participants experience a range of barriers and facilitators to both in-person and online exercise oncology delivery modes. Despite a decrease in both barriers and facilitators in the online class environment, attendance to ACE maintenance classes online remained the same as when in-person. BCT support was perceived as higher in the in-person class environment, but many participants appreciated the effort put forward by ACE and their instructors to make participants feel supported in this new environment. Ultimately, participants felt fortunate to have continued access to ACE during the pandemic to keep them active and connected to other cancer survivors. Participants stated that ACE remained a key driver to maintaining their exercise habits regardless of being offered in-person or online. The potential benefit of such an accessible exercise program and the continued benefits incurred by cancer survivors with a range of diagnoses through COVID-19 warrant future research into improving such programs. Beyond COVID-19, synchronous, supervised, and group-based exercise oncology programs offered online show promise of offering accessibility

and physical and psychosocial benefits for cancer populations in need of such programming, such as rural and remote survivors.

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Appendices

APPENDIX A – Recruitment and Consent Documents

A.1 Email Study Notice to ACE Participants

To: [ACE Participant]

From: Health and Wellness Lab

Sent: [Insert Date]

Subject: Research Study Opportunity: Understanding in-person and online exercise oncology program delivery: Participant perspectives

Dear ACE Participant,

We are excited to announce a new project with the University of Calgary's Health and Wellness Lab, under Dr. Nicole Culos-Reed. This project will examine the experiences of ACE Maintenance members who have undergone a transition from an in-person to an online ACE program. We hope to use these findings to better understand and improve your ACE experience.

An email will come to you from the Health and Wellness Lab at the University of Calgary in the next 1-2 weeks. A link will be included in this next email that will direct you to the online survey if clicked. Participation in this research project is voluntary and you may choose not to participate. If you do choose to participate, a survey link will be included in the email. You will be asked to provide your consent and then complete the survey. You will be asked to complete a total of 3 surveys over a 3-month period. Each survey should take approximately 20-30 minutes of your time.

All responses are anonymous, and data is only seen by the University of Calgary research team. This study has been approved by the University of Calgary Conjoint Health Research Ethics Board – Cancer Committee (HREBA.CC-20-0379). If you have any questions, please reach out to Dr. Culos-Reed and her team at wellnesslab@ucalgary.ca.

Thank you for your time and feedback,

Delaney Duchek

Phone: [redacted]

Email: wellnesslab@ucalgary.ca

Address: [redacted]

A.2 Survey Invitation Email

To: [ACE Participant]

From: University of Calgary Health and Wellness Lab

Sent: [Insert Date]

Subject: Survey Link: Understanding in-person and online exercise oncology program delivery: Participant perspectives

Dear Valued [ACE Participant],

You recently received an email from the Health and Wellness Lab about our research study at the University of Calgary, examining the perspectives of ACE maintenance participants who have transitioned from an in-person to an online exercise oncology program.

Below is a link for the informed consent, which provides additional details of our study. If you agree to participate, you will be directed to the first survey. This study has been approved by the University of Calgary Conjoint Health Research Ethics Board – Cancer Committee (HREBA.CC-20-0379).

https://survey.ucalgary.ca/jfe/form/SV_5cMB01WrG8QtzRX

Thank you for your interest and support.

Delaney Duchek

University of Calgary
Office: [redacted]
Email: [redacted]
Lab Phone: [redacted]

Dr. Nicole Culos-Reed, PI

University of Calgary
Office: [redacted]
Email: [redacted]
Office Phone: [redacted]

A.3 Interview Invitation Email

To: [ACE Participant]

From: University of Calgary Health and Wellness Lab

Sent: [Insert Date]

Subject: Interview Invitation: Understanding differences between in-person and online exercise class delivery

Dear ACE Participant,

Thank you for participating in the "Understanding differences between in-person and online exercise oncology program delivery" survey.

We are contacting you today to inform you of a follow-up interview we are conducting as part of this research project. This follow-up interview seeks to build upon the survey responses and will provide us with more in-depth understanding of factors that impact both online and in-person programming.

We are hoping you may be willing and able to participate. This would involve completing a 30-60-minute interview, scheduled at a time that is convenient for you. To participate, please reply to this email with your availability (i.e., time/days that work for you) and we will confirm your interview Zoom time.

Prior to completing the interview, you will need to complete the informed consent form using this link: https://survey.ucalgary.ca/jfe/form/SV_5cMB01WrG8QtzRX.

I have also attached this document in a Word format for your records. If you have any questions about this informed consent form, please respond to this email.

Thank you,

Delaney Duchek

University of Calgary
Office: [redacted]
Email: [redacted]
Lab Phone: [redacted]

Dr. Nicole Culos-Reed, PI

University of Calgary
Office: [redacted]
Email: [redacted]
Office Phone: [redacted]

A.4 Informed Consent Form for Participants (Survey)

Informed Consent Form for a Participation in a Research Study

TITLE: Understanding in-person and online exercise oncology program delivery: Participant perspectives

PROTOCOL ID: HREBA.CC-20-0379

RESEARCHER:
S. Nicole Culos-Reed, PhD
Professor
Faculty of Kinesiology
[redacted]

STUDY COORDINATOR:
Delaney Duchek
Masters Student
Faculty of Kinesiology
[redacted]

INTRODUCTION

Dr. Nicole Culos-Reed and associates from the Kinesiology Department at the University of Calgary are conducting a research study.

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, please ask. Take the time to read this carefully and to understand any accompanying information. You will receive a copy of this form for your records.

You were identified as a possible participant in this study because of your participation in both an in-person and an online Alberta Cancer Exercise (ACE) program. Your participation in this research study is voluntary.

WHY IS THIS STUDY BEING DONE?

The purpose of this research study is to better understand the experience of people living with or beyond cancer in the transition from an in-person to an online exercise oncology program. Due to the impact of COVID-19, in-person exercise programs for vulnerable populations have been temporarily suspended. Therefore, the ACE program has transitioned to being offered via an online platform to continue to provide opportunities to exercise for cancer populations. With this study, we want to assess your perspective on your experience during this transition.

HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

About 100 people will take part in this study Alberta wide. All people taking part in this study will be recruited through the Health and Wellness Lab at the University of Calgary.

WHAT WILL HAPPEN IF I TAKE PART IN THIS STUDY?

If you volunteer to take part in this study, the researcher will ask you to do the following:

- Take part in 1 online survey distributed via email. These surveys will ask about your barriers and facilitators to exercise, your exercise habits, your exercise preferences, and your experiences with behaviour change techniques in both an in-person and an online class setting. The initial baseline survey will also include demographic data. Each survey will take approximately 20-30 minutes to complete.
- When consent is received, a select number of survey respondents will also be asked to conduct interviews within 4 weeks of survey completion. Interviews will take approximately 1 hour to complete. Interviews will be used as a tool to gain a more in-depth insight into information gained from the survey responses.
- Your exercise attendance data and pertinent medical information will be pulled from the ACE attendance database.

HOW LONG WILL I BE IN THIS STUDY?

Participation will last for a total of 4 weeks (1 month). Within those 4 weeks, the total time commitment required is between 30 minutes (survey) or 1.5 hours (survey and interview).

ARE THERE ANY POTENTIAL RISKS OR DISCOMFORTS THAT I CAN EXPECT FROM THIS STUDY?

There are little to no risks associated with this study.

The first risk regards participant data protection due to the nature of the surveys. To diminish this risk, we have chosen an online survey generator, Survey Monkey. This company requires minimal personal information and has its own secure data storage system, minimizing the chance of any data sharing or stealing. Survey Monkey will ask for your full name (first, last). Survey Monkey will collect your full name and will only to link your survey responses. After making this link, all survey responses and data will be deidentified and stored on a secure drive at the University of Calgary. No further personal identification will occur after this matching of full name to survey responses.

The second minimal risk is associated with the nature of the survey questions that you will be asked. We understand that speaking about your exercise habits may be upsetting or considered a sensitive topic. If you find any questions in the surveys upsetting, you will have the option to skip the question and not answer it with no negative repercussions.

ARE THERE ANY POTENTIAL BENEFITS IF I PARTICIPATE?

There will be no direct benefit to you from participating in this study. However, as an ACE participant, taking part in this research may improve your future exercise experiences with this program. This study aims to improve understanding of ACE participants' experiences with both in-person and online exercise programs. The information from this study may provide the ACE program with information to improve their current practices.

DO I HAVE TO PARTICIPATE?

Participation in this study is voluntary and you may withdraw from it at any time with no penalty. If you do choose to withdraw from the study before its conclusion, we encourage you to contact the Health and Wellness Lab to inform us.

WILL I BE PAID FOR PARTICIPATING, OR DO I HAVE TO PAY FOR ANYTHING?

Participation in this study will not cost anything to you, nor will you be financially compensated.

WILL INFORMATION ABOUT ME AND MY PARTICIPATION BE KEPT CONFIDENTIAL?

Only information necessary for the study will be collected.

Survey Monkey, an online survey generator company. collects minimum personal information. They are a company located in the USA and are thus accountable to American regulations. Survey Monkeys' servers do record IP addresses of the computer that you use to complete the survey, but no connection between you and this IP address will be made. If you choose to take part in these surveys, you consent to storing this information and that it may possibly be accessed in the USA. This survey company has an internal data protection system to keep all information private.

Authorized representatives from the following organizations will have access to your identifiable exercise attendance data at the site where these records are held. This is for quality assurance purposes and/or to verify that the information collected for the study is correct and follows proper laws and guidelines:

- The Health Research Ethics Board of Alberta, which oversees the ethical conduct of this study;
- The study team listed on the first page of this form from the University of Calgary.

All information collected during this study will be kept confidential and will not be shared with anyone outside the study unless required by law.

You will not be named in any reports, publications, or presentations that may come from this study.

Even though the likelihood that someone may identify you from the study data is very small, it can never be completely eliminated. Every effort will be made to keep your identifiable information confidential, and to follow the ethical and legal rules about collecting, using, and disclosing this information.

By clicking "I agree" at the end of this form, you are allowing the study team to collect, use, and disclose information about you from your personal responses.

After the study is done, we will still need to securely store your data that was collected as part of the study. We will keep your data and study records stored for 5 years after the end of the study.

Authorized representatives from the University of Calgary and the Health Research Ethics Board may look at your identifiable study records held at the University of Calgary, Dr. Culos-Reed's Health and Wellness Lab, for quality assurance purposes.

WHAT WILL HAPPEN IF I CHOOSE TO WITHDRAW FROM THE STUDY EARLY?

You can choose to end your participation in this research study (called early withdrawal) at any time. You can withdrawal without having to provide a reason and without penalty. If you choose to withdraw early from the study without finishing the surveys. you are encouraged to contact the researcher or study staff. The research team may also withdraw you from the study if they feel it is in your best interest.

Information recorded before you withdrew may be used by the research team for the purposes of this study. But, no more information will be collected after you withdraw your permission. If you choose to withdraw, the research team will give you the option to also withdraw your data (i.e., survey, interview responses) up to 1 month after study withdrawal.

WHAT ARE MY RIGHTS AS A PARTICIPANT IN THIS STUDY?

You will be told about new information that may be relevant to your willingness to stay in this study.

You have the right to be informed of the results of this study once the entire study is complete. If you would like to be informed of these results, please contact the researcher.

Your rights to privacy are legally protected by federal and provincial laws that require safeguards to ensure that your privacy is respected.

By clicking "I agree" at the end of this form, you do not give up any of your legal rights against the researchers, sponsor, institutions or their agents involved for compensation, nor does this form relieve these parties from their legal and professional responsibilities.

USE OF DATA FOR FUTURE RESEARCH

My research data may be kept for use in future research to learn about the experiences of ACE participants during the transition from an in-person to an online exercise program.

- ❑ YES
- ❑ NO

CONTACT FOR FUTURE RESEARCH

University of Calgary researchers may contact me in the future to ask me to take part in other research studies.

- ❑ YES

❑ NO

AGREEMENT TO PARTICIPATE

Your decision to complete and return this survey will be interpreted as an indication of your agreement to participate. In no way does this waive your legal rights nor release the investigators or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time.

If you have further questions concerning matters related to this research, please contact:

Dr. Nicole Culos-Reed (Researcher)	[redacted]
Name	Telephone

Delaney Duchek (Study Coordinator)	[redacted]
Name	Telephone

If you have questions about your rights as a participant or about ethical issues related to this study and you would like to talk to someone who is not involved in the conduct of the study, please contact the Office of the Health Research Ethics Board of Alberta.

Telephone: [redacted]

UNDERSTANDING AND SIGNATURES PAGE

	Yes	No
Do you understand that you have been asked to take part in a research study?	❑	❑
Do you understand why this study is being done?	❑	❑
Do you understand the potential benefits and risks/discomforts of taking part in this study?	❑	❑
Do you understand what you will be asked to do should you decide to take part in this study?	❑	❑
Do you understand that you are free to leave the study at any time, without out having to give reason or without penalty?	❑	❑
Do you understand that we will be collecting information about you for use in this study only?	❑	❑
Do you understand that by clicking "I agree" at the end of this form you are allowing the study team to collect, use, and disclose information about you from your personal responses and exercise attendance data?	❑	❑
Do you understand that the research team will initially be linking your full name to your survey responses before deidentifying you as a participant?	❑	❑
Do you understand who can potentially see your study records, including those that identify you?	❑	❑
Do you understand that by clicking "I agree" at the end of this form that you do not give up any of your legal rights?	❑	❑
Do you feel that you had enough time and opportunity to consider the information provided to you by way of asking questions, having conversations with others and considering your options?	❑	❑

INFORMED CONSENT

☐ I agree to participate in this study
☐ I do not agree to participate in this study

INTERVIEWS

☐ I agree to that I also wish to be selected to potentially participate in an online interview
☐ I do not agree to participate in an online interview

This survey is estimated to take 20-30 minutes to complete. Click the button below to start the survey.

The "Informed Consent Form" page contained all relevant information related to this project. If you would like a PDF copy of the study information sheet for your records, please contact Delaney Duchek at [redacted]

A.5 Informed Consent Form for Participants (Interview)

Informed Consent Form for a Participation in a Research Study

TITLE: Understanding in-person and online exercise oncology program delivery: Participant perspectives

PROTOCOL ID: HREBA.CC-20-0379

RESEARCHER:
S. Nicole Culos-Reed, PhD
Professor
Faculty of Kinesiology
[redacted]

STUDY COORDINATOR:
Delaney Duchek

Masters Student

Faculty of Kinesiology
[redacted]

INTRODUCTION

Dr. Nicole Culos-Reed and associates from the Kinesiology Department at the University of Calgary are conducting a research study.

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, please ask. Take the time to read this carefully and to understand any accompanying information. You will receive a copy of this form for your records.

You were identified as a possible participant in this study because of your participation in both an in-person and an online Alberta Cancer Exercise (ACE) program. Your participation in this research study is voluntary.

WHY IS THIS STUDY BEING DONE?

The purpose of this research study is to better understand the experience of people living with or beyond cancer in the transition from an in-person to an online exercise oncology program. Due to the impact of COVID-19, in-person exercise programs for vulnerable populations have been temporarily suspended. Therefore, the ACE program has transitioned to being offered via an online platform to continue to provide opportunities to exercise for cancer populations. With this study, we want to assess your perspective on your experience during this transition.

HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

About 15-20 people will take part in the interview portion of this study. All people taking part in this study will be recruited through the Health and Wellness Lab at the University of Calgary.

WHAT WILL HAPPEN IF I TAKE PART IN THIS STUDY?

If you volunteer to participate in the interview portion of this study, the researcher will ask you to do the following:

- Conduct an interview with a member of the study team from the University of Calgary remotely (via Zoom or Microsoft Teams) at a time convenient for you. Interviews will take approximately 1 hour to complete. Interviews will be used as a tool to gain a more in-depth insight into information gained from the survey responses.

ARE THERE ANY POTENTIAL RISKS OR DISCOMFORTS THAT I CAN EXPECT FROM THIS STUDY?

There are little to no risks associated with this study.

The first minimal risk regards participant data protection. For interview participants' responses, we will deidentify each participant and store all responses/data on a secure storage drive at the University of Calgary.

The second minimal risk is associated with the nature of the survey questions that you will be asked. We understand that speaking about your exercise habits may be upsetting or considered a sensitive topic. If you find any questions in the surveys upsetting, you will have the option to skip the question and not answer it with no negative repercussions.

ARE THERE ANY POTENTIAL BENEFITS IF I PARTICIPATE?

There will be no direct benefit to you from participating in this study. However, as an ACE participant, taking part in this research may improve your future exercise experiences with this program. This study aims to improve understanding of ACE participants' experiences with both in-person and online exercise programs. The information from this study may provide the ACE program with information to improve their current practices.

DO I HAVE TO PARTICIPATE?

Participation in this study is voluntary and you may withdraw from it at any time with no penalty. If you do choose to withdraw from the study before its conclusion, we encourage you to contact the Health and Wellness Lab to inform us.

WILL I BE PAID FOR PARTICIPATING, OR DO I HAVE TO PAY FOR ANYTHING?

Participation in this study will not cost anything to you, nor will you be financially compensated.

WILL INFORMATION ABOUT ME AND MY PARTICIPATION BE KEPT CONFIDENTIAL?

Only information necessary for the study will be collected.

For interview participants, all personal information will be deidentified and not personally associated with you. All collected information will be kept confidential to the extent permitted by the applicable laws, and will not be disclosed or made publicly available, except as described in this consent document.

Authorized representatives from the following organizations will have access to your deidentified interview responses at the site where these records are held. This is for quality assurance purposes and/or to verify that the information collected for the study is correct and follows proper laws and guidelines:

- The Health Research Ethics Board of Alberta, which oversees the ethical conduct of this study;
- The study team listed on the first page of this form from the University of Calgary.

All information collected during the interview portion of this study will be kept confidential and will not be shared with anyone outside the study unless required by law.

You will not be named in any reports, publications, or presentations that may come from this study.

Even though the likelihood that someone may identify you from the study data is very small, it can never be completely eliminated. Every effort will be made to keep your identifiable information confidential, and to follow the ethical and legal rules about collecting, using and disclosing this information.

By clicking "I agree" at the end of this form, you are allowing the study team to collect, use, and disclose information about you from your personal responses.

After the study is done, we will still need to securely store your data that was collected as part of the study. We will keep your data and study records stored for 5 years after the end of the study.

Authorized representatives from the University of Calgary and the Health Research Ethics Board may look at your identifiable study records held at the University of Calgary, Dr. Culos-Reed's Health and Wellness Lab, for quality assurance purposes.

WHAT WILL HAPPEN IF I CHOOSE TO WITHDRAW FROM THE STUDY EARLY?

You can choose to end your participation in this research study (called early withdrawal) at any time. You can withdrawal without having to provide a reason and without penalty. The research team may also withdraw you from the study if they feel it is in your best interest.

Information that was recorded before you withdrew may be used by the research team for the purposes of this study. But, no more information will be collected after you withdraw your permission. If you choose to withdraw, the research team will give you the option to withdraw your data (i.e., interview responses) up to 1 month after study withdrawal.

WHAT ARE MY RIGHTS AS A PARTICIPANT IN THIS STUDY?

You will be told about new information that may be relevant to your willingness to stay in this study.

You have the right to be informed of the results of this study once the entire study is complete. If you would like to be informed of these results, please contact the researcher.

Your rights to privacy are legally protected by federal and provincial laws that require safeguards to ensure that your privacy is respected.

By clicking "I agree" at the end of this form, you do not give up any of your legal rights against the researchers, sponsor, institutions or their agents involved for compensation, nor does this form relieve these parties from their legal and professional responsibilities.

USE OF DATA FOR FUTURE RESEARCH

My research data may be kept for use in future research to learn about the experiences of ACE participants during the transition from an in-person to an online exercise program.

- ❑ YES
- ❑ NO

CONTACT FOR FUTURE RESEARCH

University of Calgary researchers may contact me in the future to ask me to take part in other research studies.

- ❑ YES
- ❑ NO

AGREEMENT TO PARTICIPATE

Your decision to complete this interview will be interpreted as an indication of your agreement to participate. In no way does this waive your legal rights nor release the investigators or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time.

If you have further questions concerning matters related to this research, please contact:

Dr. Nicole Culos-Reed (Researcher)	[redacted]
Name	Telephone

Delaney Duchek (Study Coordinator)	[redacted]
Name	Telephone

If you have questions about your rights as a participant or about ethical issues related to this study and you would like to talk to someone who is not involved in the conduct of the study, please contact the Office of the Research Ethics Board of Alberta.

Telephone: [redacted]

UNDERSTANDING AND SIGNATURES PAGE

	Yes	No
Do you understand that you have been asked to take part in the interview portion of research study?	❑	❑
Do you understand why the interview portion of this study is being done?	❑	❑
Do you understand the potential benefits and risks/discomforts of taking part in the interview portion of this study?	❑	❑
Do you understand what you will be asked to do should you decide to take part in the interview portion of this study?	❑	❑
Do you understand that you are free to leave the interview portion of study at any time, without out having to give reason or without penalty?	❑	❑
Do you understand that we will be collecting information about you for use in this study only?	❑	❑
Do you understand that by clicking "I agree" at the end of this form you are allowing the study team to collect, use, and disclose information about you from your personal responses and exercise attendance data?	❑	❑
Do you understand who can potentially see your study records, including those that identify you?	❑	❑
Do you understand that by clicking "I agree" at the end of this form that you do not give up any of your legal rights?	❑	❑
Do you feel that you had enough time and opportunity to consider the information provided to you by way of asking questions, having conversations with others and considering your options?	❑	❑

INFORMED CONSENT

☐ I agree to participate in the interview portion of this study
☐ I do not agree to participate in the interview portion of this study

The "Informed Consent Form" page contained all relevant information related to this project. If you would like a PDF copy of the study information sheet for your records, please contact Delaney Duchek at wellnesslab@ucalgary.ca.

APPENDIX B – Survey Resources

B.1 Online Survey

Location: Survey Monkey

This survey utilized 'logic'. Therefore, not all question stems were shown to participants if a prior answer was or was not selected. This survey copy shows all possible questions that may have been answered by participants.

[**Participant introduction]:** This survey will be asking you about your demographic information, your exercise habits, your barriers and facilitators to exercise (in-person and online), and about behaviour change techniques employed between in-person and online exercise classes.

Demographic Information:

The information below will be used to describe our respondents as a group. You may leave any questions blank that you do not wish to answer.

1. **Please provide your full name: _____**
2. **Date of Birth:**
3. **Marital Status:**
   - Never Married
   - Married
   - Common Law
   - Separated
   - Widowed
   - Divorced
4. **Education Level (please check highest level attained):**
   - Some High School
   - Completed High School
   - Some University/College
   - Completed University/College
   - Graduate School
   - Completed Graduate School
5. **Annual Family Income:**
   - < $20,000
   - $20,000 – $39,999
   - $40,000 - $59,999
   - $60,000 - $79,999
   - >$80,000
6. **Current Employment Status:**
   - Full-time
   - Retired
   - Homemaker
   - Part-time
   - Temporarily unemployed
   - Disability/sick leave

- Student

7. **Cancer diagnosis:**
   - Type:
   - Date:
8. **When did you first become a participant with the ACE program?**
   - Winter 2020
   - Fall 2019
   - Summer 2019
   - Spring 2019
   - Winter 2019
   - Fall 2018
   - Summer 2018
   - Spring 2018
   - Winter 2018
   - Fall 2017
   - Summer 2017
   - Spring 2017
   - Winter 2017
9. **How do you identify in terms of gender?**
   - Prefer not to specify
10. **How do you identify in terms of race and/or ethnicity**?
    - Prefer not to specify

Modified Godin Leisure-Time Exercise Questionnaire (GLTEQ)

We would like you to recall your *average weekly exercise* over the *past month*. How many times per week on average did you do the following kinds of exercise over the past month?

When answering these questions please remember to:

- Consider your average weekly exercise over the past month
- Only count exercise sessions that lasted ***15 minutes or longer*** in duration
- Only count exercise that was done during free time (i.e., do not include occupation or housework)
- Note the main difference between the three categories is the intensity of the exercise
- Type the average frequency in the first box and the average duration in the second box

A. STRENUOUS EXERCISE (Heart beats rapidly, sweating)
(e.g., running, jogging, hockey, soccer, squash, cross country skiing, judo, roller skating, vigorous swimming, vigorous long-distance bicycling, vigorous aerobic dance classes, heavy weight training)

In an average week I was involved in strenuous exercise _____ times/week for an average duration of _____ minutes/each session.

B. MODERATE EXERCISE (Not exhausting, light perspiration)

(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

In an average week I was involved in moderate exercise _____ times/week for an average duration of _____ minutes/each session.

C. MILD EXERCISE (Minimal effort, no perspiration)
(e.g., easy walking, yoga, archery, fishing, bowling, lawn bowling, shuffleboard, horseshoes, golf, snowmobiling)

In an average week I was involved in mild exercise _____ times/week for an average duration of _____ minutes/each session.

D. RESISTANCE EXERCISE
(e.g., lifting weights, doing body weight exercises, working on balance)

In an average week I was involved in resistance exercise _____ times/week for an average duration of _____ minutes/each session.

Exercise Setting Preferences

11. Which group class exercise setting do you prefer?
    - In-person
    - Online
    - No preference
12. Briefly explain in the space provided why you prefer this exercise class setting?
    - (Comment Box)

Benefits and Barriers to Exercise In-Person and Online
Directions: Below are statements that relate to ideas about exercise. Please indicate the degree to which you agree or disagree with the statements by circling 1 for strongly agree, 2 for agree, 3 for disagree, or 4 for strongly disagree.

Scale:

Strongly Agree	Agree	Disagree	Strongly Disagree

Both items asked at once – i.e., "I enjoy exercise".
For in-person ACE: Strongly agree to strongly disagree
For online ACE: Strongly agree to strongly disagree

In-person Benefits/Barriers	Online Benefits/Barriers
Question Stem: During the in-person ACE program…	*Question Stem:* During the online ACE program…
1. I enjoy exercise. 2. Exercise decreases feelings of stress and tension for me.	1. I enjoy exercise. 2. Exercise decreases feelings of stress and tension for me.

3. Exercise improves my mental health.
4. Exercising takes too much of my time.
5. I will prevent heart attacks by exercising.
6. Exercise tires me.
7. Exercise increases my muscle strength.
8. Exercise gives me a sense of personal accomplishment.
9. Places for me to exercise are too far away.
10. Exercising makes me feel relaxed.
11. Exercising lets me have contact with friends and persons I enjoy.

12. I am too embarrassed to exercise.
13. Exercising will keep me from having high blood pressure.

14. It costs too much to exercise.
15. Exercising increases my level of physical fitness.
16. Exercise facilities do not have convenient schedules for me.
17. My muscle tone is improved with exercise.
18. Exercising improves functioning of my cardiovascular system.
19. I am fatigued by exercise.
20. I have improved feelings of well-being from exercise.
21. My spouse (or significant other) does not encourage exercising.
22. Exercise increases my stamina.
23. Exercise improves my flexibility.
24. Exercise takes too much time from family relationships.
25. My disposition is improved with exercise.
26. Exercising helps me sleep better at night.
27. I will live longer if I exercise.
28. I think people in exercise clothes look funny.
29. Exercise helps me decrease fatigue.
30. Exercising is a good way for me to meet new people.

3. Exercise improves my mental health.
4. Exercising takes too much of my time.
5. I will prevent heart attacks by exercising.
6. Exercise tires me.
7. Exercise increases my muscle strength.
8. Exercise gives me a sense of personal accomplishment.
9. I find exercising from home difficult.

10. Exercising makes me feel relaxed.
11. Exercising lets me have virtual contact with friends and persons I enjoy.

12. I am too embarrassed to exercise at home.
13. Exercising will keep me from having high blood pressure.
14. It costs too much to exercise.
15. Exercising increases my level of physical fitness.
16. Exercise facilities do not have convenient schedules online for me.
17. My muscle tone is improved with exercise.
18. Exercising improves functioning of my cardiovascular system.
19. I am fatigued by exercise.
20. I have improved feelings of well-being from exercise.
21. My spouse (or significant other) does not encourage exercising.
22. Exercise increases my stamina.
23. Exercise improves my flexibility.
24. Exercise takes too much time from family relationships.
25. My disposition is improved with exercise.
26. Exercising helps me sleep better at night.
27. I will live longer if I exercise.
28. I think people in exercise clothes look funny.
29. Exercise helps me decrease fatigue.
30. Exercising is a good way for me to meet new people.

31. My physical endurance is improved by exercising. 32. Exercising improves my self-concept. 33. My family members do not encourage me to exercise. 34. Exercise increases my mental alertness. 35. Exercise allows me to carry out normal activities without becoming tired. 36. Exercise improved the quality of my work. 37. Exercise takes too much time from my family responsibilities. 38. Exercise is good entertainment for me. 39. Exercise increases my acceptance by others. 40. Exercise is hard work for me. 41. Exercise improves overall body functioning for me. 42. There are too few places for me to exercise. 43. Exercise improves the way my body looks.	31. My physical endurance is improved by exercising. 32. Exercising improves my self-concept. 33. My family members do not encourage me to exercise. 34. Exercise increases my mental alertness. 35. Exercise allows me to carry out normal activities without becoming tired. 36. Exercise improves the quality of my work. 37. Exercise takes too much time from my family responsibilities. 38. Exercise is good entertainment for me. 39. Exercise increases my acceptance by others. 40. Exercise is hard work for me. 41. Exercise improves overall body functioning for me. 42. There are too few places for me to exercise. 43. Exercise improves the way my body looks.

Behaviour Change Techniques

Behaviour change techniques are strategies that can be used to help increase exercise levels via a variety of methods. The following questions will ask about your use of behaviour change techniques that help you exercise.

For the most recent in-person class you attended, please indicate below which behaviour change techniques or skills you used:

1. Education on the principles of exercise and cancer
2. Education on stress management and fatigue
3. Provide feedback on performance (i.e., exercise form)
4. Planning and using social support (practical, general, and emotional)
5. Goal setting (behaviour and outcome)
6. Prompt review of behavioural and outcome goals
7. Education on behaviour change, relapse prevention, and motivation
8. Verbal persuasion to boost self-efficacy

LOGIC [If a BCT is selected as use, this prompt will follow:] How frequently did you use this behaviour change technique?

Daily	Weekly	Once every few weeks	Once a month	Less than once a month

Additional Suggestions or Comments

13. Do you have any additional comments or suggestions (i.e., ways we can improve in-person or online classes, etc.) for the ACE team? Please provide them in the comment box below.

APPENDIX C – Interview Resources

C.1 Interview Guide

Understanding differences between in-person and online exercise oncology program delivery: Participant perspectives
Interview Guide: ACE Participants
Location: Remote via Zoom

SCRIPT

WELCOME

Hello [participant name]. Thank you for taking the time to meet with me today. Before we get started, I would like to go over some of the details of this interview. As you know, we have already conducted a survey addressing your various experiences associated with exercise in-person and online with the ACE program.

PURPOSE

Thus, building off your responses, today, the purpose of our interview is to ask some further questions to get your perspective on your preferences to exercise, barriers and facilitators to online and in-person exercise. We will also talk more about your experiences with behaviour change techniques during your time with ACE.

CONSENT/ETHICS

While you have already completed the consent form, I would like to remind you about your rights during this interview. All information you provide will be kept confidential. Should you need a break or wish to withdraw during the interview, we can break or stop at any time. I have some questions prepared, but if you wish not to answer any, that is completely fine. The interview should take about 45-60 minutes to complete and will be audio recorded with a recorder.

Lastly, I want to reinforce that there are no right or wrong answers. We are looking to gain your perspective on your personal experiences with ACE and there are no predetermined correct answers.

Do you have any questions before we begin? Ready?

QUESTIONS

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1. **I would like to begin by asking about your overall experience as a participant of ACE to date.**

   Probes:
   - *Can you give me an example of why your experience has been positive/negative?*
   - *Could you tell me more about what leads you to feel this way about your experience?*
   - *Are there any other positive/negative aspects of your experience that you would like to share?*
   - *Can you briefly describe your overall experience in the in-person ACE program?*
   - *Can you briefly describe your overall experience in the online ACE program?*

2. **Can you tell me about the reasons that you choose to continue to be an ACE participant, in the maintenance program?**

3. **Can you tell me about the reasons why you continued on with ACE when it transitioned to an online platform?**

   Probes:
   - *And why do you say those particular reasons? [Ask to elaborate on specific reasons given].*
   - *Have there been any particular experiences that stand out to you as a key driver in you remaining with ACE?*
   - *Do your interactions with instructors contribute to your decision to remain an ACE participant?*

[**Interviewer**]**:** Now, I will be asking a few questions about your experiences during the transition of our exercise program from being in-person to online, that was due to covid-19. These questions will help us determine the impact and differences between these two fitness delivery settings.

4. **Have your exercise levels been affected by COVID-19? If yes, how have they been affected?**

   Probes:
   - *Can you give me an example? Why has this affected your exercise levels? What changed from pre- and post-COVID that caused your exercise levels to change?*

5. **Can you tell me about your exercise preferences?**

   Probes:
   - *For example, do you have a preference for online or in-person classes? Or do you have no preference?*
   - *Can you give me a few reasons why you prefer this exercise setting?*

6. **What have been the most significant changes for you during the transition from in-person to online exercise classes?**

   Probes:
   - *Can you give me an example? What sort of impact did this have on your exercise levels? Was there anything about this transition that you found to be difficult? Easy? Was there anything that we did as an exercising providing service to make this transition easier? Harder?*

7. **If we are to continue to offer exercise classes online, what do you think we should change? Improve? What should we keep the same?**

   Probes:
   - *Changes regarding: Communication, class delivery, online registration, class sizes, class length/structure, class workout plans, etc.*
   - *If the option exists, would you continue to exercise online, in a blended online and in-person format, or strictly in-person?*

[**Interviewer**]**:** Now, I will be asking a few questions about your experiences with behaviour change techniques. BCTs are strategies that can be used to help increase exercise via a variety of methods. These questions will help us determine the impact of these techniques in this fitness facility setting.

8. **Regarding the surveys that you completed, we asked you about 'behaviour change techniques' that instructors may have spoken with you about during your time with ACE. How have your experiences with behaviour change technique conversations been during your time with ACE?**

   Probes:
   - *And why do you say that?*
   - *Did you notice any changes between the in-person and online programs?*
   - *Do you believe that this impacts your overall exercise experience? Can you explain to me why you believe it does/does not?*
   - *Probe about specific BCTs: goal setting, social support, feedback on performance/behaviour, self-efficacy, education on various topics, etc.*

9. **From the survey, we see that some ACE participants experienced changes in their use of or experience with BCTs between the in-person and online ACE program. Overall, the trends indicated that participants felt less supported or utilized BCTs less in the online setting than in the in-person setting. Frequency of BCTs that were used generally decreased as well.**

   Probes

- *For instance, the number of people using social support dropped in half from the in-person to the online setting. What was your experience with your feelings of social support during this transition?*
- *The next largest drop in feeling supported by BCTs were in the education topics (exercising with a cancer diagnosis, consistent exercise habits, and stress and fatigue). What was your experience with these education topics during this transition?*
- *Using your own encouragement or your instructors to boost your self-efficacy and using feedback on technique and form remained relatively the same in terms of feeling supported. What was your experience with these two BCTs during the transition?*
- *The only two BCTs that participants felt more supported in were goal setting and reviewing your goals. What was your experience with goal setting during this transition?*

[**Interviewer]:** Next, I would like to ask you about your barriers and facilitators to exercising consistently. Barriers refer to a variety of things or situations that may prevent you from exercising, whereas facilitators are things or situations that enable consistent exercise.

10. **From the survey, we see that some ACE participants experienced a trend towards both decreased benefits of exercise online, but also decreased barriers to exercising online. What was your overall experience your barriers and facilitators to exercise between the in-person and online exercise settings?**

    Probes

    - *Benefits of exercise that decreased included improving mental health, having contact with friends and people that you enjoy, and exercising being a good way to meet new people.*
    - *Barriers to exercise that decreased included taking too much time, places to exercise being too far away, and being too embarrassed to exercise.*
        - For any barrier/facilitator mentioned, ask about frequency and the impact of the barriers/facilitators on their exercise levels. If a barrier/facilitator that was evaluated in the surveys is not mentioned by participant, ask if they experience this barrier or facilitator.
    - *Content analysis from the surveys showed that overall, participants felt that:*
        - Online is much more convenient (less time out of day, no commute time or driving on icy roads) but the socialization has decreased. Difficult to form connections, create group cohesion, chat 1-on-1 about things that are not exercise.
        - Instruction online is equally as good or have received mixed feedback (better real-time vs. taking too long to explain exercises). People appreciate the effort that instructors are going through to make this experience possible, to give participants to have a space to exercise safely during COVID-related restrictions. But the time spent at the beginning of each circuit to explain technique and exercises is often too long. This is often done to accommodate everyone's fitness level or technique knowledge. How do you suggest this can be remedied?

- The in-person environment is more conducive to higher motivation, easier learning by watching other participants, easier to work harder and the class flow works better.

11. **What factors (barriers) do you think prevent you from exercising consistently? Have you noticed a difference in barriers that prevent you from exercising in-person and exercising online?**

    Probes:

    - *Common barriers include lack of time, lack of motivation, lack of facilities, lack of equipment, etc.*
    - *How do you think those barriers could be overcome? Have these barriers changed or decreased since beginning ACE? From beginning online exercise? How often do these barriers prevent you from exercising?*

12. **What factors (facilitators, benefits) help you to exercise consistently? Have you noticed a difference in facilitators that prevent you from exercising in-person and exercising online?**

    Probes:

    - *Common facilitators include improving body image, improving health, building a community, etc.*
    - *How do you think you could maximize these factors to help you exercise consistently? Have these facilitators changed or decreased since beginning ACE? From beginning online exercise? How often do these facilitators encourage you to exercise?*

13. **When considering the impact of your exercise barriers and facilitators on your exercise habits, how do you think using behaviour change technique impacted your exercise habits?**

    Probes:

    - *Which BCTs do you believe impacted your exercise habits the most? The least? Which contributed to overcoming your barriers? Which helped you support your facilitators?*

14. **Is there anything else that you would like to add that we have not yet discussed?**

15. **Is there anything that we have talked about that you would like to return to?**

Thank you very much for participating in today's interview. Please do not hesitate to contact me if you have any outstanding questions.

C.2 Additional Representative Quotes from Participants from Chapter 5

Themes	Participant Quotes
It's been the best route that we could take, given the circumstances	<u>I was grateful to continue exercising with ACE during COVID</u> • P42: initially, when the lockdown came along, I thought, oh, great, I'm going to lose all these things that are actually keeping me from losing my mind. So, when the ACE program talked about going online […] I was just so happy and relieved […] it's been such an important way for me to feel like I'm connecting with other human beings during the day, in a time when I can't do normal things […]. I think I would actually be in a far worse place mentally if [ACE classes had] been stopped altogether. I consider it a huge gift that you've been able to find a way to keep classes going virtually […] that's been kind of the guiding light for my mental health is just knowing that there's consistency that I'm seeing the same group of people every week, and that there's interaction […]. I think that's made a huge difference to me. • P69: it's nice to have that connection with other people, even though you're not really connected. But you can see people, you can hear them. So, with COVID going on, that seemed to be a great option. I don't know why people wouldn't do it. • P77: The social aspect […], right now with COVID […], like many people in the class, my immune system is fairly compromised. I go to the doctor, I go to treatment. Everything else is delivered […]. So, it's […] a little bit of a window on the world, for a number of us. <u>ACE online classes are the next best thing to in-person</u> • P2: But ultimately, [online classes are] the next best thing. Like Zoom has been a godsend because […] there's still that physical connection […]. It's not the same as the face-to-face, but it is the next best thing. • P56: It's not quite the same interaction, because Zoom's one person at a time. So, you don't get the same type of conversation. But there's that opportunity to ask questions and have discussion […]. So, for a lot of classes, people are logging in early, getting set up, and then there's some socialization […]. I've done some of those online ones where there's no interaction […] it's not quite the same. So, to have live instructors, real time, and adapting as you go, that's probably been the best route that we could take, given the circumstances. <u>The effort of instructors during the transition to online was a positive</u> • P2: the only thing with the transition is equipment access […]. But you guys have done a good job adapting in terms of circuits and modifying for what people might have at home. • P42: And it is a weird way to do an exercise class. But honestly, you just have this ability to make us feel like we're all in the same room, which is amazing […]. we're all in our houses, but I do feel like we're working together. And I think that's been just a really important part of this year for me […] it's been just a really great place to go every week. <u>ACE did a good job transitioning from in-person to online when COVID-19 hit</u> • P47: it really came on you guys kind of suddenly […] if this happened again […] you guys now have the experience to enable us to make that transition smoothly, which you didn't have before. So, […] you guys did a wonderful job.

	• P56: given the circumstances, I was surprised at how well the Zoom has gone. And I'm comfortable to do that. And depending on the situation […] COVID is going to be around for a while, I think it's going to be a while before we're in the gym […]. the instructors and ACE has done a great job in keeping us engaged. <u>I believe I was able to transition successfully because I had completed ACE baseline classes in-person</u> • P23: For people like me, […] the only exercise I used to do before I joined ACE was, I am a walker, I am a hiker, and an outdoor person […]. So, for me, the in classes were critical, because I was never doing anything right […]. And I remember [the instructors] […] would go around and talk to each one individually to make sure [I was exercising properly]. So, that's extremely valuable. In-person […]. So, I really think we are missing that. I have a feeling if I didn't do the in-person before, I wouldn't have been able to do [the online]. And by the time I did the online, I was familiar with the routine, I was familiar with you guys, I knew most of the people in class […]. So, I would definitely recommend in-person classes initially. • P77: To be honest, had it been proposed me as online, straight off, I probably would have passed […]. […] it would have depended how it was presented to me. I tend to think of it as, if it's physical, then I need someone else there with me […]. But I think the fact that I was already kind of in the system meant that […] I'll try it. If it doesn't work, well, I'll just move on. And seeing some familiar faces in the group was good.
A lot of good came out of the opportunity to continue with ACE online, but there were still issues with exercising from home	<u>There was decreased social support and camaraderie building in the online environment</u> • P2: I'd say that's what's different […]. I know you guys have a bit of time before class and after class, but it's not the same thing as getting together with a group and going for coffee […]. that's what I miss the most is the physical connection and interaction. • P6: You also get a chance to know the other people a little bit more [in-person]. You know, whether they've got sons, daughters, if they've got trips planned […]. as opposed to online, other than the people I was in the classroom [in-person] with, I don't know anything about these other 10 people. I'm further ahead with the group I came with than the ones I've been with […] since March [online]. <u>The Zoom platform is not conducive to group conversations</u> • P16: But the ones that do [talk] are probably ones that already know each other or are just more outgoing. Because you get the same ones always that do talk […] I would never talk much in a group ever. That's not me […]. Like, some [other] Zoom things […] do breakout sessions. But you couldn't really do that […] I can't see how you can accommodate that. That's the only way you get to know somebody a little bit more intimately. So, I think it just comes with the territory […]. So, I think that's the limits of our technology, at least for now. <u>While the online classes have less social support, they are unmatched in convenience</u> • P56: if you'd asked me six months ago [what my delivery mode preference was], it would have been in-person. But now I see some real advantages to the online […]. it's a real time saver […]. So, I gain an hour in in my day. But we lose that connection […]. So, […] the preference is face-to-face. But it's not a resounding 100% […] I'm okay with the online for different reasons. <u>The ability to gain social connections in online ACE classes has improved over the last year</u> • P6[a]: you didn't even want to do it at the start, when it was online [..] Because he said he needs the people. He wants to be around people. And even after the first few months. And he kept saying, I'm not going to continue, […] "what's the point", he would say. And so […] I sent a message […] and said, there's more to this exercise class than just exercise. We need the social part […]. we

	now allow 10 or 15 minutes for the social part. And that's made a huge difference. He's far more engaged because of it, […] we really appreciate the fact that that was accommodated. a. P6: Spouse was present during this interview. <u>The physical aspects of exercising were enhanced online</u> • P18: I was kind of a poor student for the first several [in-person] sessions. Because that social element was so big for me that I just went through the motions. I didn't find the exercises hard […]. And I didn't even do them right. But in time, I started to appreciate the significance of form […]. And of course, has now become the primary overriding benefits in the online sessions […]. And […] I actually get through much more exercise [online] than I did [in-person] […]. Because you're not talking. And the instructors have more control over when you start. They jump right into the exercises […]. And, so, that's actually quite a positive […] the objectives can be attained, maybe even attained to a greater level in the online session than [in-person]. • P25: because I'm finding the classes a bit easy, I try and do a little bit more, or change the exercises if I want to. And that's really hard to do in-person. Because then your instructor thinks that you just didn't listen to them and if they see it, you're doing it wrong. I'm like, no, I'm doing this on purpose. And even with being around people that are really struggling, […] you don't want to be the person that's being the, 'oh, I got so much energy today, I need to burn it off'. Because then that person feels bad. So, you're much more regimented when it's in-person. Whereas when I'm just in my basement, I can do whatever I want […]. I'm working a little harder at home than I was in class, 'cause I can do my own thing. • P39: It is easier to attend, as long as you can deal with issues like Internet. I honestly think that the physical aspects have been enhanced. I don't feel strongly that that the instructors have been missing me doing something imperfectly or the wrong way or anything like that […]. I don't really see a net negative to going online […]. I would definitely want to continue doing the exercise classes [online]. <u>The physical aspects of exercising were decreased online</u> • P69: I feel I don't really get a good aerobic workout in the Zoom version. Because we did have the option sometimes in the in-person to go for like the full six minutes on the bike or something. When you felt you could really get your heart rate up. • P109: I think while I may be exercising more, I still think I may not be improving as much […] because I don't have the variety of weights to slowly increase things or even the plan to be able to do that. So, probably something that's lacking a little bit in terms of exercise. <u>The personalized, one-on-one instruction available in-person was not necessarily possible online</u> • P77: what I miss about the in-person is you don't really have the ability online to walk around and check on us […] it [wa]s easier to get that kind of that kind of help one-on-one. When […] I'm in a square in the Zoom thing, it's difficult to give that kind of help […]. So that kind of chance to have that private conversation is something that I miss. And it's a bit more difficult to get a really good handle on what people's limitations are when it's online. <u>There is a difficulty in asking questions and 'holding up the class' in an online environment</u> • P74: people can obviously ask [questions to the instructor] when we're in class, but because you're stopping everybody, it's a little bit like, you keep it short […] whereas [in-person, the instructor] would usually take the time, because he was going around and that's obviously handy again, for the in-person. <u>The encouragement and feedback from ACE instructors has changed from in-person to online classes, but has transitioned well</u>

	• P18: the positive reinforcement that's given by the moderators and the instructors has taken on a whole new dimension that has caused you to have to learn new ways of doing it […]. So, you're actually speaking up more often in terms of […] encouragement, then actually happened in the live session […]. The constant, 'great form', 'you guys are doing good', 'you're killing it' […], that's really great […]. Because the instructors are more focused on your form and structure. And I know you've had to adapt from the in-person environment […]. I But I think that's a real boost for each person individually […].would say the encouragement [online] is more affordable now than it was before [in-person]. <u>Online classes are easier to attend due to less exacerbation of my fatigue</u> • P42: the one benefit of [online] is that it's way less easy for me to talk myself out of a class […]. when you have to physically leave your house and drive somewhere, on the days when I'm feeling a little bit low, it's much easier for me to say, […] I don't want to be trying to concentrate on driving and all this. But doing classes online, I just have to get myself down to the gym in my basement. There's no reason I can't do that […]. Definitely fewer physical barriers, […] it is much easier to just know that I can go downstairs and get going […] [and] I don't think I've seen that decrease of the overall benefit. • P77: And those of us that are still in active treatment, there are highs and lows that come with this. I suppose one of the advantages [to online] is that there's probably days when I'm pretty committed to this, but there probably would have been days where I would have […] not gone in. But the fact it's online means that I can do it. <u>Online classes more conducive to pulling back when I'm fatigued or overworked</u> • P77: to pull back from that competitive thing to, yes, getting a good workout, […] but not necessarily pushing it right to the limit. So, it's a little easier to pull back in that online […]. to see people at different stages and realize that we just have to listen to our own bodies and work in a manner that best suits us […]. the online makes it easier for people to do that. It's a little less intimidating, when you're not quite as in public views of people. <u>My confidence has increased in the online environment</u> • P75: I had the courage more […] to try new things more online […]. You're watching me, but I'm more alone […]. As I was thinking about technique, because I couldn't do […] a V-sit. So, that's a big thing for someone that hasn't exercised before to learn how to do. And so, I never tried in class […]. I never did. [But now], I do. Because I might as well […]. I think I'm less intimidated […] now that I think about that […]. what I'm learning now actually is it's giving me the confidence […] to listen to my body to do what I need to do now […]. I do sometimes try new things. But now I know how to adapt enough. <u>Lack of motivation is less of a barrier in online class setting</u> • P2: the accessibility, especially when it's 20 below, 30 below, so much easier to be motivated to go online and do a program than it is to get bundled up and then walk […] to the [venue]. <u>I have less incentive, motivation to attend classes online</u> • P6: And […] you just didn't feel like you had the same incentive to attend when it just meant going upstairs as opposed to preparing to go somewhere. <u>Online classes are easier to attend</u> • P77: [Online] is really convenient and it works pretty well […]. I am getting very used to the to the fact that [online classes are] so easy for me. • P103: in the summer, [online] was really convenient. So, I appreciated that […]. [and in] winter, icy roads would be a factor.

	• P109: But in terms of reduction of barriers that I did find that was really high, because again we don't have the commute time, it was much easier to interweave it and fit it into the day, much easier to adapt. <u>My exercise equipment or space at home was a facilitator to exercising online</u> • P42: I think too, sometimes, the space sometimes feels a little confining, […] we have a little gym in our basement, but it's not a huge room and it has an elliptical in that too. So, I think sometimes I just feel like I wish I had a little bit more space […]. • P56: one of the biggest things […] is access to the different equipment. I'm lucky I have a treadmill, […] weights, […] an exercise ball […] but, without going out and spending hundreds of dollars or 1000s. We don't have a rowing machine, we don't have the bikes, we don't have the weight machines. And I miss the different exercises […]. you can do squats all day long and get the same workout. But it's the variety. And it challenges different muscles. So, that's one of the biggest drawbacks to the online. • P109: And having a little bit of the exercise equipment here at home already. So, I found a lot of the barriers to regular exercise actually did drop for me, and I didn't find there was a huge decrease in the benefits […]. Having that little bit of equipment certainly helps facilitate things. <u>Having issues with Zoom or my internet connection was a barrier to attending online</u> • P6: I had never worked with Zoom […]. Technology was an issue […]. And for our demographic it was a learning curve for us, for some more than others […]. Barriers – well, a couple of times [I've] had trouble signing into Zoom […] we've had technical problems […]. And you just didn't feel like you had the same incentive to attend when it just meant going upstairs as opposed to preparing to go somewhere. • P42: I think my big frustration in the last few months has just been our general network capacity. We've been having some issues with our home network. <u>Potential SES disparities may be a problem for some cancer survivors in the online environment</u> • P23: You know that when you go online, there are some equity issues. I know a lot of your participants are well off […]. But if you really want to get online and attract people from different socioeconomic backgrounds, because I'm sure they get cancer […]. Then I really think we need to address the technology. How do we set it up? What access do you have? […]. So, for people to do online things. They really have to be technologically literate. And they can't afford it. Because there are some equity issues. <u>My experience with behaviour change techniques online has changed</u> • P2: I would say [my experience with behaviour change techniques online is] the same […. it's human nature when [the instructors] are going through and commenting on different people, whether you hear your name called. So, […] it's different [online]. You're looking at a small screen, you've got your gallery view up. It's just a different experience, it's hard. • P18: I found those seminars they had that were a part of the formal exercise, like on self-efficacy, […] they were quite helpful […]. And that was done online. So, I didn't see that much difference from an education point of view. And […] [the education] might even be better online [for creating consistent] exercise habits. • P56: the education piece. And having them individually educate me on proper technique to get the benefit. So even though it's difficult via Zoom, it still happens […]. So, it still modifies the behavior, it still creates that desire. Because you recognize, as long as I've been working with various exercise groups, I'm still learning new exercises.
My in-person experience was	<u>I enjoy the online classes, but I prefer the in-person due to receiving more social support</u>

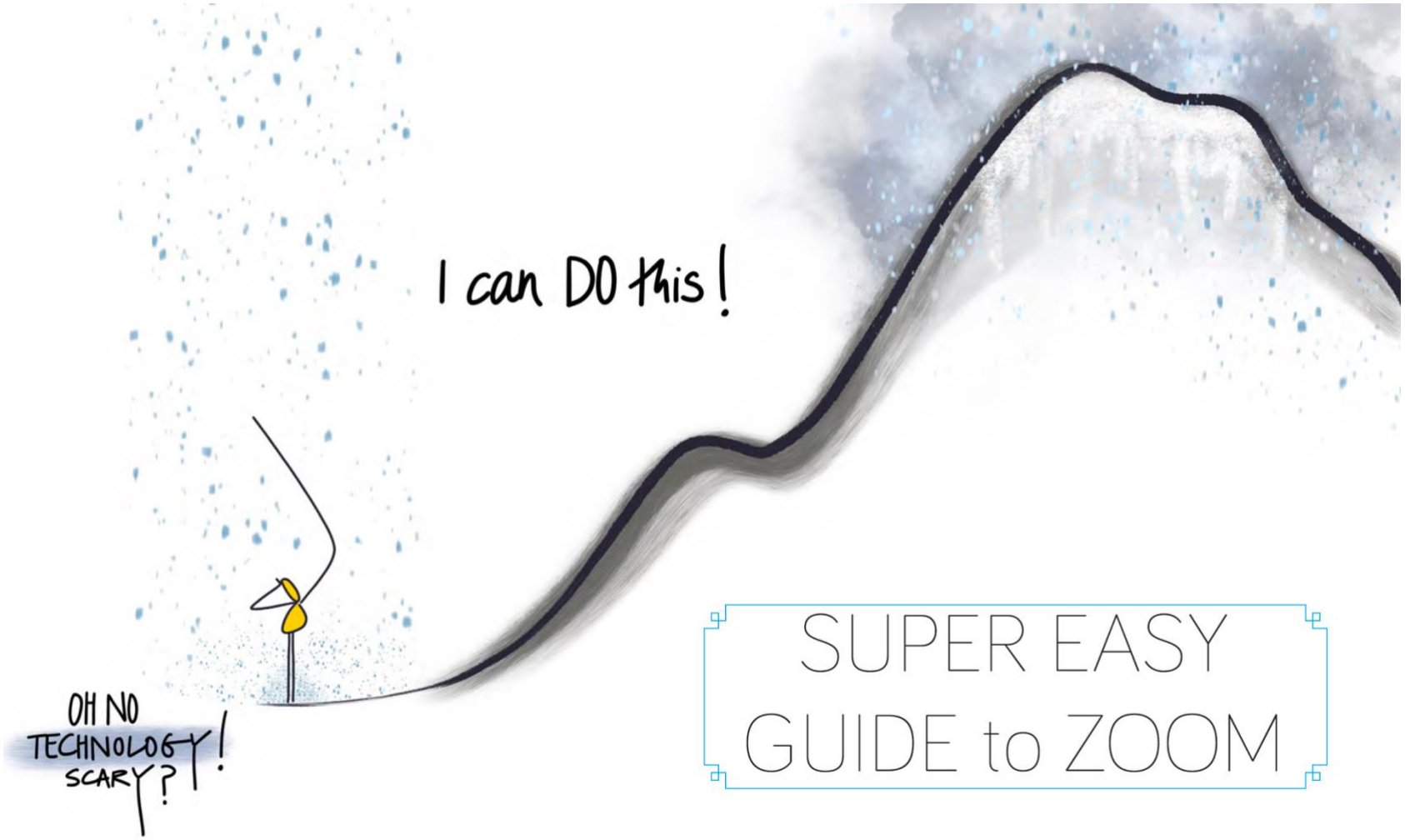
great, but I still faced barriers to attending	• P18: When I first got involved, […] I was just absolutely overwhelmed by the interaction with [others]. […]. I have to say I enjoy the online sessions, but by quite a wide margin, my preference would be in-person. Because of the value to me of some sort of social contact. And as a result, the sense of community connection, engagement with the undergraduates, the sense of safety that comes from the instructor telling you how to do it right, the presence of a large number of people in the room, and in small ways, […] trying to help other people are in the same situation as I am, or maybe farther down the road than I am. <u>I was motivated by others in class while exercising in-person</u> • P16: I kind of maybe need a little bit of a push [from others] sometimes, though? Little incentive, shall we say? Like, oh, she can do it. Maybe I can too […]. So, I think the in-person is probably better for me for that. I think I can get pretty complacent just being at home and showing up, but not making progress. • P25: And so, […] the social connection [in-person] was good […] it was […] motivating because I can't do this now, but hey, this lady couldn't do it before and now she can, so maybe if I keep working on it, I can be like her […]. So, that was motivating when I first started off and I was barely moving. And then you see other people that have been doing it, […] it was like, oh, my God, these women are moving so fast and I'm never gonna be able to keep up with them. And then the second time like, 'I'm doing okay'. And then the third time it was like, 'I'll get there someday'. <u>I enjoyed the informal class chatter in-person</u> • P16: we did a lot of sharing in class too, which was really helpful. People would ask questions […] that often benefit[ted] other people, too. And you could keep exercising while you were listening, but you got a lot […]. it was sort of almost independent of what you guys were doing. It was just the fact that we were all there with something in common. And so that was a really helpful thing […]. Just certainly could never get that here [online]. So, to me, that would be a big, a big loss […]. it was almost equally valuable to the exercise you were doing […]. And some people had other losses while they were in class. And people supported them […]. And it's just one of those trade-offs [between in-person and online classes]. • P21: I just miss going out and walking with people and chatting and asking people how they're doing […]. when someone had something going on, they would mention it. And then we'd all follow up. And we're lacking that. <u>Social support was a strong enough driver to overcome barriers to attending in-person</u> • P6: But […] it didn't matter what the weather was like, you still showed up [to see others in the class]. <u>Importance of getting feedback from instructors on exercise form and technique in-person</u> • P6: And there's also a lot more incentive [in-person], because there's actually people watching what you do […] and [the instructors] would come and do some one-on-one coaching if I wasn't doing something the right way. Whereas quite frankly, […] it's kind of hard for you to do that online, to [give] one-on-one to give feedback to that person, as opposed to [doing] it more discreetly on site. • P25: In-person's better to correct my form if I'm not doing something properly, or to ask a question about something, especially if you need to do modifications for an injury […]. So, in-person was definitely better for more personalized instruction. • P109: you guys do a totally awesome job with keeping an eye on us and helping correct our form [online] […]. Obviously, […] in-person, there would be even more of that happening. You'd be able to keep an eye on us even closer. <u>The exercise equipment options were better in-person</u> • P6: What I did enjoy on-site was the equipment […]. and there's a facility, it's a place that encourages exercise, you're there in a group.

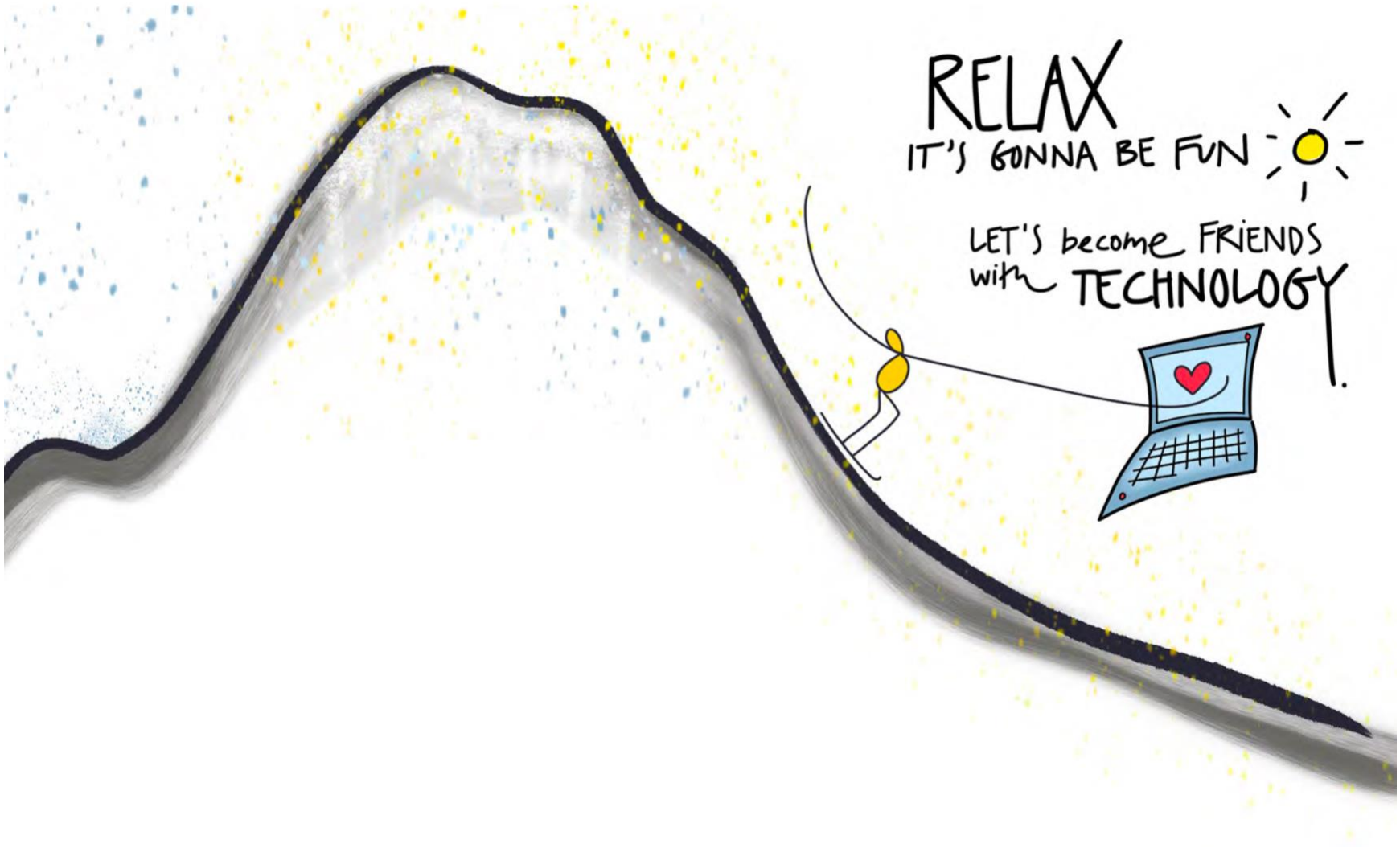
	<u>The cold weather and commute in-person exacerbated my fatigue</u> • P11: Walking across from the church to me was a negative. Having to go too far from where I parked to where I'm going to work out is a negative, because then I'm already tired. • P16: when it was a cold and wintery and slippery day […] And if I was having a day where I wasn't feeling that strong, […] by the time I got ready, drove through the weather, and parked and walked to the university. I'm like, whew, okay, I think I'll just go back. That part of it is easier being at home […]. It was a bit challenging to do that walk. • P33: I'm not sure that I could do [in-person]. Even without COVID right now, until I retire, I'm just still struggling with fatigue. So, yeah […] currently, because of my fatigue level, I will stick with online. <u>A lack of space to exercise in-person was a negative</u> • P21: I can't think of anything negative. Other than the space is too small. 'Cause with a full class of 12, the [in-person venue], is too small. And it's also too hot. <u>The cost of parking to attend in-person was a barrier for me</u> • P11: Okay, so negatives [to in-person]? […]. The costs of parking […] it can be challenging financially. • P18: The barriers to exercising [in-person] […] there's a cost factor, people had to pay for parking. <u>I felt more supported by behaviour change techniques in-person</u> • P25: obviously, [behaviour change techniques are] better in-person than they are online. Especially when you guys have 20 people, […] that's a lot. I've actually noticed the difference. Because even with the 12 people, […] somebody would be saying oh, that's good, [NAME], keep that up. But now it's not very often that you hear that […]. You don't hear very much of that with 20 people. • P47: No, I think [behaviour change technique support is] better in-person. The reason being is that you've got your colleague there. And you can see how they're doing. When you're Zooming, you can't. […] So, I would say that in-person, goal setting is a little bit better.
My goal is to have a good quality of life and maintain my level of functionality through moving more	• P11: I don't think I might have verbalized it as much as I thought about it and did it on my own self and own time. I'm very goal oriented. But with respect to my ACE workouts, I don't set very large or small, tangible, measurable goals that I don't even probably share because one day it can be just getting through it. • P21: And I always stated publicly that my goal is just to be stronger and have a good level of health. That's all. • P25: I don't think [goal setting affects my exercise habits] […] I'm motivated to exercise already […]. my only goal is to try and do something every day for an hour. That's my goal […]. I don't have like, I want to be able to run a mile in [a certain amount of time] […]. those kinds of goals, I have no interest in doing that […]. the couple times that we've had after class talks […] I didn't even bother listening to them, I don't need it. I'm not interested in that. • P39: my goal, if you want to call it that, is to do the exercises, as best as I can, and hopefully better than I did them the last time. Maybe that's pushing myself a little bit harder, doing more cardio, whatever. Those are my sorts of goals […]. It's just keeping my body moving and functioning properly that's important to me […]. I don't set an exercise goal, per se, […] some days even showing up is a challenge in itself. • P56: I have my own personal motivation. I'm not getting my motivation from the instructors. I've been involved in goal setting my whole career, and […] I don't get motivation from that type of goal setting. I know I do it. Mentally, I've set a goal. But I don't write

	them down. And […] I get that that works. And I understand if you verbalize a goal, then you got a greater chance. I understand that. But for me, I don't need to do that. • P74: Goal setting […] I learned long ago that you can want to run 10 kilometers every day. And someday it's going to go great. And other days you won't make the 10. And I don't want to feel bad on the days that I don't make it 10. I will still feel good because I went […]. As long as I go. So, for me goal setting, was, […] I just want to do the things I want to do. So, in my case, that would be if I can go on a hike, if I can just do my daily things and I'm not impeded […] then I'm happy. I don't have a goal that I have to lift 25 kilos of weight, [that's] not important to me at all. • P77: Basically, my goal is, since my cancer is treatable, but not curable, has been to try to maintain strength, balance […]. So, […] to keep working on overall strength and balance is a big thing for me. I'm not looking to push 200 pounds or anything like that […]. I'm happy to keep where I am […]. if I stay where I am, that's a win.

Appendix D – Additional Participant Resources

D.1 'Super Easy Guide to Zoom' – Participant Zoom Instructional PDF




RELAX
IT'S GONNA BE FUN
LET'S become FRIENDS
with TECHNOLOGY

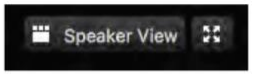

NOW
a few THINGS
that will make it EASY

This is what Zoom looks like... in SPEAKER VIEW.

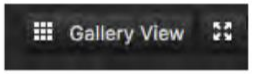
This is the Zoom Tool Bar.

And this is what Zoom looks like... in GALLERY VIEW.

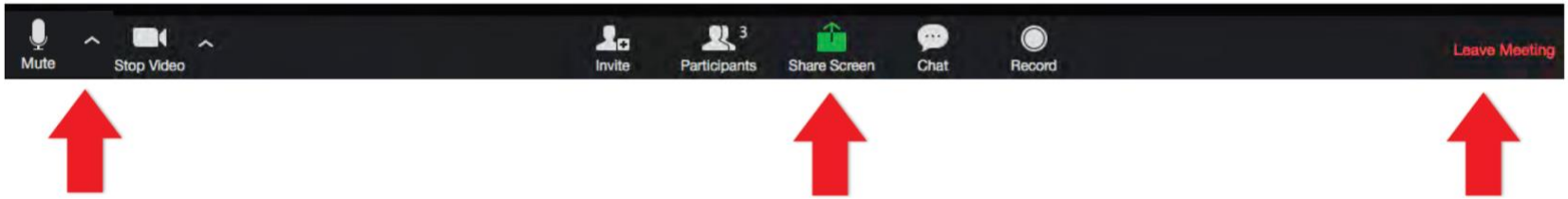
This is where you toggle back & forth between views … YOU Choose!



OR



Here is the Zoom tool bar again.
Let's get acquainted...



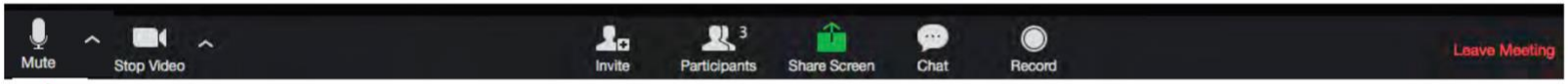
These are the audio & video icons, which have very important roles!

We'll talk about them next.

This icon (Share Screen) is "invitation only" - please don't click it unless you are specifically invited to.

This icon is self-explanatory. Only click it when you are ready to leave Zoom.

AUDIO



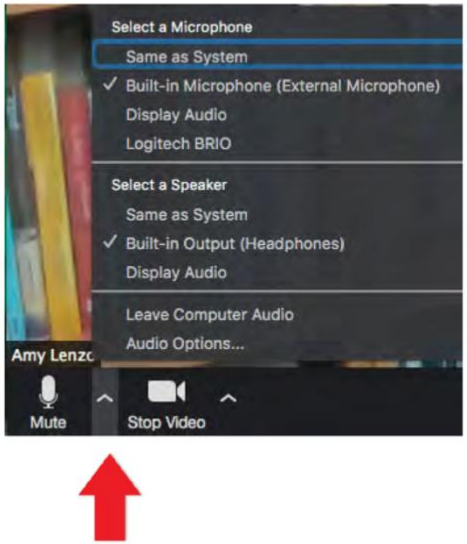
Click the audio icon once to mute yourself.

When you're muted there will be a line through the icon, like this:

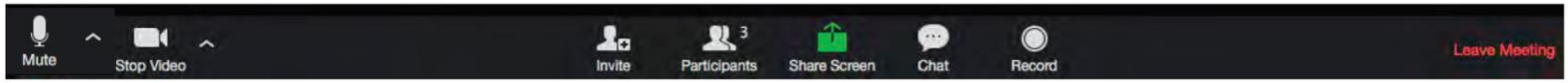
Click the icon again to un-mute yourself!

Click the little arrow to the right of the audio icon to show the Speaker & Microphone options you have installed on your computer.

(Note: Your best choice will often be clicked by default.)



VIDEO



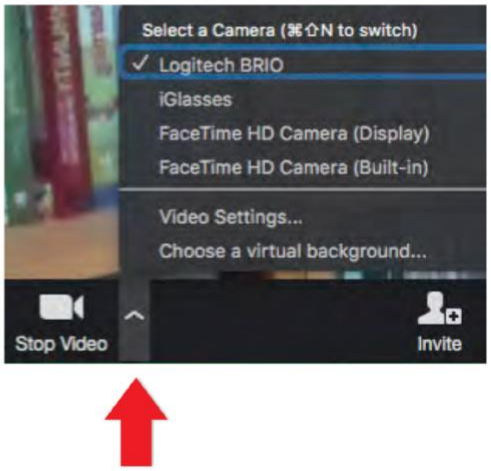
Click the video icon once to stop showing your video.

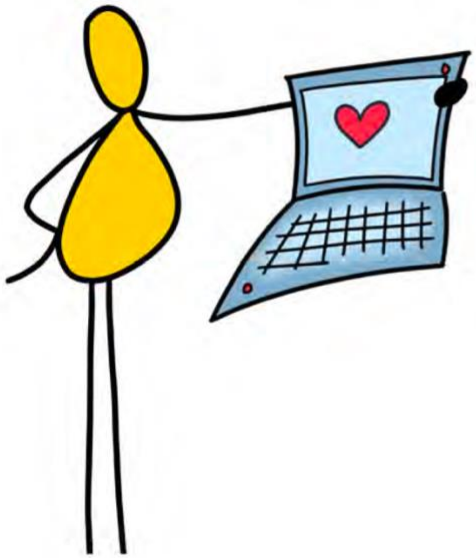
There will be a line through the icon, like this:

Click the icon again when you want to start showing your video.

Click the little arrow to the right of the video icon to show the Video Camera options you have installed on your computer.

(Note: Your best choice will often be clicked by default.)





Hang on!

There are two more Zoom features we want you to know about …

CHAT

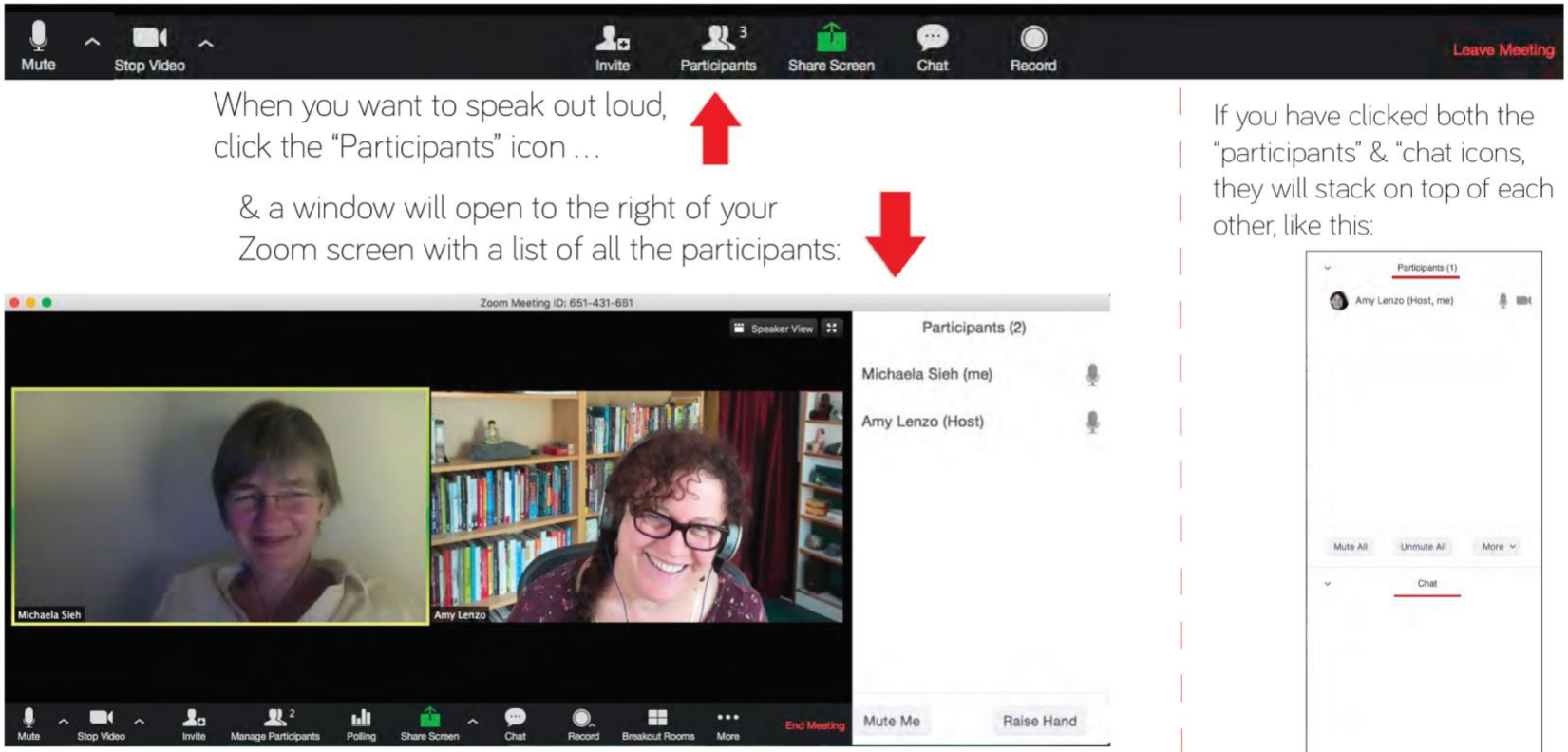
Click the "Chat" icon …

& a window will open to the right of your Zoom screen:

Click the "To" button & a list of all the participants will appear. Click on "everyone" to write to everyone publically or an individual name to write privately to a a specific person.

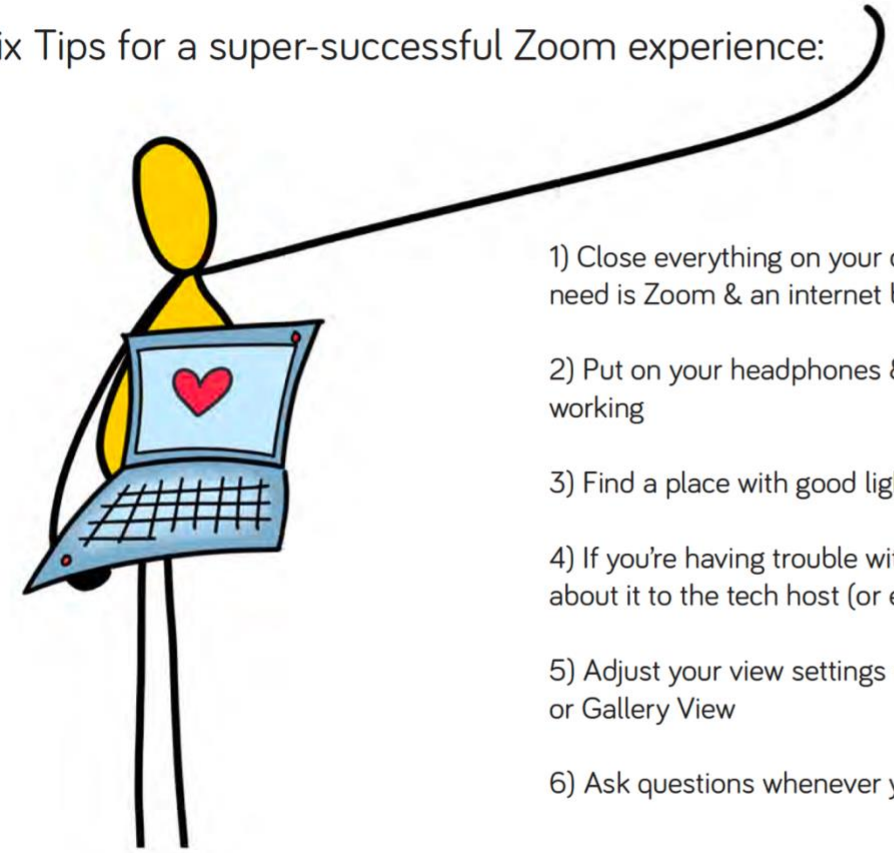
e.g.

RAISE YOUR HAND



If you have clicked both the "participants" & "chat icons, they will stack on top of each other, like this:

Six Tips for a super-successful Zoom experience:



1) Close everything on your computer that you don't need (all you need is Zoom & an internet browser (if we're using Google Docs)

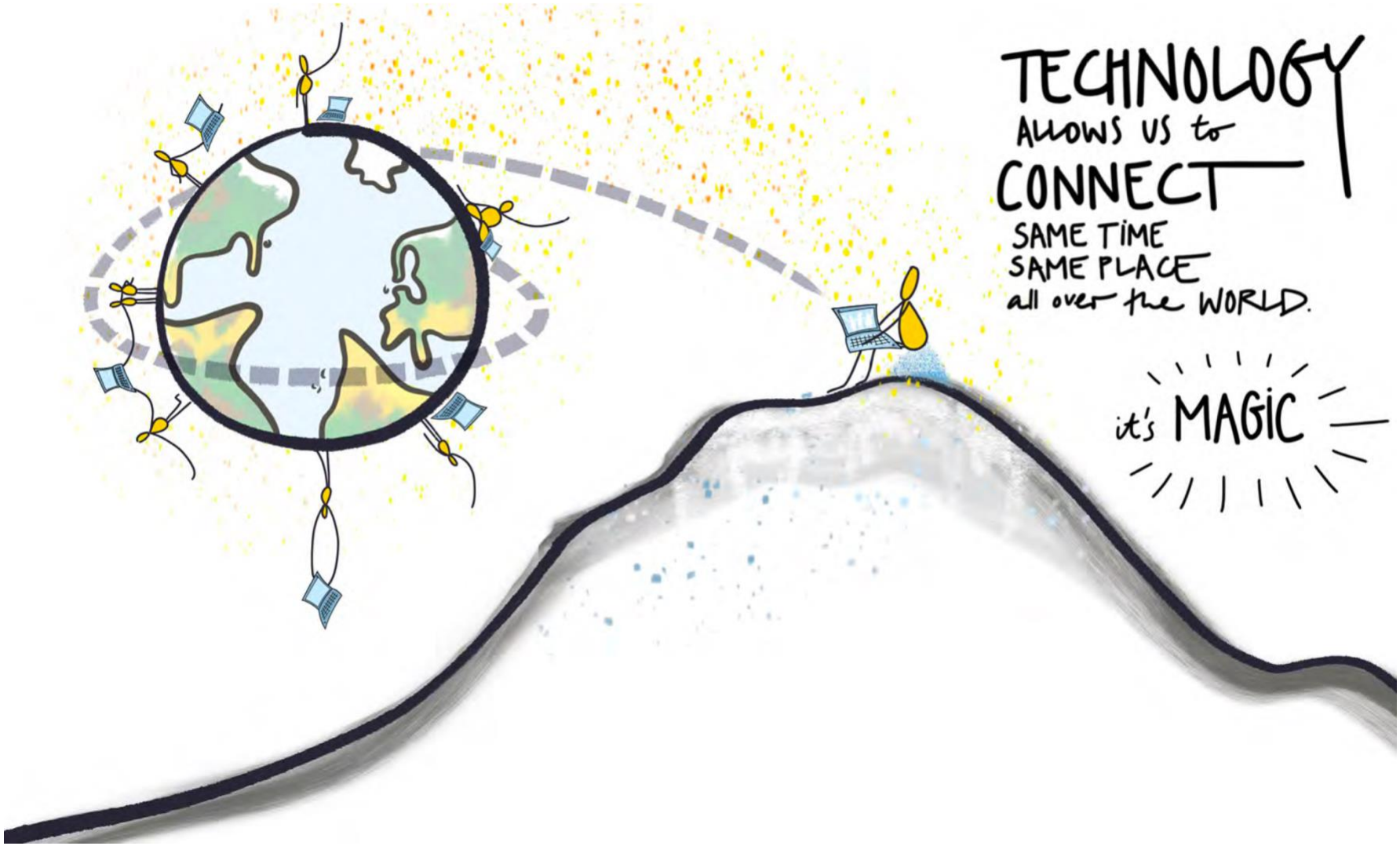
2) Put on your headphones & make sure your audio settings are working

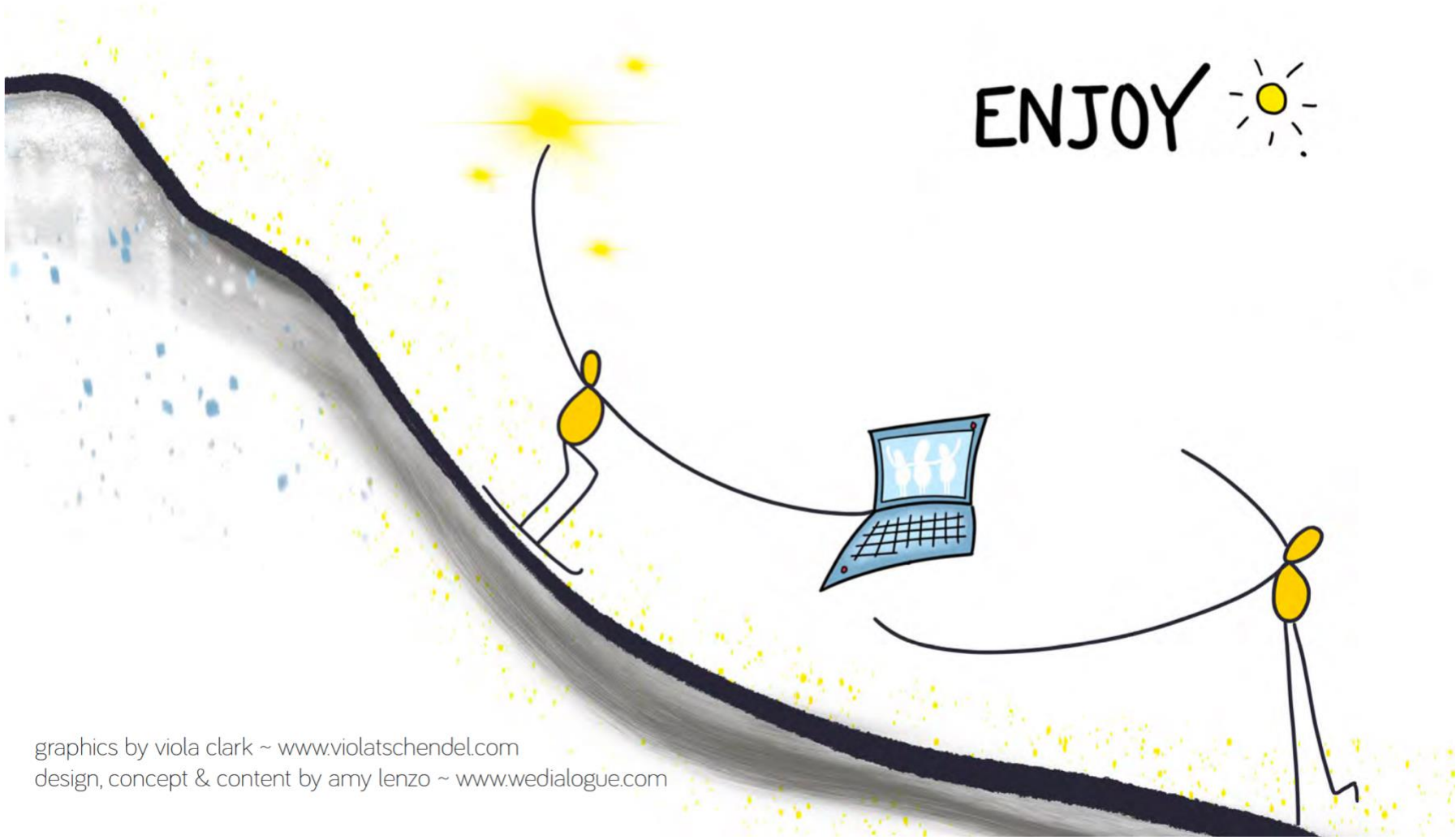
3) Find a place with good light and adjust your video settings

4) If you're having trouble with anything, use "Chat" to communicate about it to the tech host (or everyone)

5) Adjust your view settings to the view you like best - Speaker View or Gallery View

6) Ask questions whenever you need to


TECHNOLOGY
ALLOWS US to
CONNECT
SAME TIME
SAME PLACE
all over the WORLD.
it's MAGIC


ENJOY
graphics by viola clark ~ www.violatschendel.com
design, concept & content by amy lenzo ~ www.wedialogue.com

D.2 ACE Online Adverse Event Protocol

THE HEALTH & WELLNESS LAB

ADVERSE EVENTS (AE) PROTOCOL – ONLINE PROGRAMMING

In case of medical emergency:

1. Dial 911 - MODERATOR
    a. Provide address of the participant (on the continuing care form, moderator to have file open during class)
    b. Follow 911 instructions
    c. Instructor to stay online with the participant, remove all others from the session.
2. Follow-up with a text to Nicole – 403-827-3154
3. Email follow-up with AE event form completed.

If non-emergency (no 911 necessary) during class:

1. Moderator moves impacted participant to a break-out room and address the issue.
2. Instructor to continue teaching the remaining participants
3. Moderator and instructor complete AE form immediately following the class, and send once completed via email to Nicole.
    a. Follow-up as necessary with the participant.

If non-emergency (no 911 necessary) after class:

1. Instructor receives information about an issue/injury from a participant.
2. Instructor completes the AE form as soon as receiving the information, and send once completed via email to Nicole.
    a. Follow-up as necessary with the participant.

In all cases, follow-up as appropriate with other class participants (if event happened during class), and with program lead(s) as needed (i.e., if changes need to be made to program delivery, impact on research, other needs to be addressed).

ACE ALBERTA CANCER EXERCISE

UNIVERSITY OF CALGARY
FACULTY OF KINESIOLOGY
Health and Wellness Lab

Appendix E – Background Literature Tables

E.1 Telehealth Intervention Reviews in Exercise Oncology Literature Table

Author, Year, Country, Type of Review	Outcomes	Number and type of studies	Supervised, group-based, synchronous?	Technology type **total *n* will not equal *n* of total studies due to technology use overlaps	Interventions	Positive Outcomes
Roberts et al. (2017) United Kingdom Systematic review Meta-analysis	PA (15/15), MVPA minutes (11/15), BMI/weight (4/15), fatigue (7/15), cancer-specific measures of QOL (5/15), generic QOL (4/15), depression (3/15), anxiety (2/15), sleep disturbance (2/15)	RCTs (8/15), pre-post comparison studies (7/15)	**Supervised?** (0/15) **Group-based?** (0/15) **Synchronous?** (0/15)	Web-based (10/15), SMS text messaging (2/15), emails (2/15), Nintendo Wii Fit Plus (1/15), mobile app (2/15), wearable technology (1/15), telephone (1/15)	Web-based (7/15) Emails + website (1/15), email + access to counsellor (1/15), Nintendo Wii Fit Plus (1/15), web-based + SMS text messaging (1/15), mobile app (2/15), text messaging + Fitbit + telephone counselling (1/15, Facebook support group + website (1/15)	Meta-analysis indicated increase in MVPA by 40 minutes per week. PA improvements (8/15), QOL (generic) (2/15), QOL (cancer-specific) (3/15), BMI (2/15), diet (3/15), fatigue (4/15), perceived stress (1/15), SE (4/15), weight (2/15), waist circumference (1/15), POMS (1/15), anxiety (2/15), depression (2/15), sleep quality (1/15)
Morrison et al. (2020) Australia Rapid review	PA (18/29), QOL (16/29), HRQOL (1/29), depression (2/29), anxiety (2/29), fatigue (6/29), pain (3/29), insomnia (1/29), patient health (10/29), mental state (1/29),	Mixed methods (2/29), non-randomized studies (9/29),	**Supervised?** (0/29) **Group-based?** (0/29) **Synchronous?** (0/29)	Web-based (15/29), wearable technology (2/29), mobile apps (4/29), SMS texting (2/29), telephone or email counseling (6/29)	Web-based (14/29), web-based + wearable technology (1/29), mobile apps (4/29), SMS texting + wearable technology (1/29),	Across all interventions, a variety of beneficial outcomes (physical or psychosocial) were reported. Strenuous exercise increased (1/29), muscle

No meta-analysis	patient global assessment (3/29), distress (4/29), stress (1/29), stage of change (1/29), physical functioning/mobility (6/29), strength (varying domains) (8/29), CRF (varying domains) (7/29), BMI/weight (16/29), BP/HR (3/29), inflammatory biomarkers (1/29), adherence (1/29), feasibility (1/29 studies), exercise barriers and facilitators (1/29), uptake percentage (1/29), use and acceptability (varying domains) (4/29), nutritional assessment (6/29), smoking status (1/29), body image and appearance (2/29), sexual functioning satisfaction (1/29), motivational processes (1/29), behavioural regulations (1/29),	RCTs (18/29)			telephone or email counseling (5/29), telephone counseling + SMS texting (2/29)	stretching (1/29), 4-meter gait speed (1/29), grip strength (1/29), 6-minute walk test (1/29), bodily pain (2/29), general health (2/29), physical functioning (2/29), BP (1/29), waist girth (1/29), fatigue (3/29), weight loss (4/29), interleukin levels (2/29), PA (9/29), insomnia (1/29), QOL (6/29), social functioning (1/29), mental well-being (1/29), sit-to-stand test (1/29), 2-minute walk test (1/29), weekly step count (1/29), upper body function (1/29), CRF (1/29), anxiety (1/29), depression (1/29), stress (1/29), coping strategies (1/29), physical capacity (1/29), feasibility (24/29)

	reflexive processes (1/29)					
Dorri et al. (2020) Japan Systematic review No meta-analysis	PA (16/16), QOL (5/16), HROQL (2/16), fatigue (6/16), weight loss (2/16), anxiety (2/16), depression (3/16), insomnia (2/16), mood (1/16), promotion of exercise (1/16), motivational readiness (1/16), self-efficacy (1/16), acceptability (3/16), CRF (2/16), PA readiness (1/16), psychosocial construct (1/16), patient activation (2/16)	RCTs (8/16), randomized trial with no control group (3/16), pre-post comparison studies (5/16)	**Supervised?** (0/16) **Group-based?** (0/16) **Synchronous?** (0/16)	Web-based (10/16), wearable technology (4/16), mobile app (5/16), mobile-based (2/16), email (1/16)	Web-based (9/16), wearable technology (4/16), early cancer survivor (1/16) , mobile app (4/16), web and mobile-based (2/16)	All studies reported an increase in PA (10/16 being significant). PA (10/16), patient satisfaction (3/16)
Furness et al. (2021) Australia Systematic review Meta-analysis	PA (19/24), dietary behaviour change (9/24), skin examination during melanoma-related interventions (2/24), smoking cessation (2/24), alcohol intake (1/24)	RCTs (24/24)	**Supervised?** Not reported **Group-based?** (0/24) **Synchronous?** (11/24), (2/24 combined synchronous and asynchronous)	Synchronous: telephone calls, videoconferencing, Skype Asynchronous: Combination of custom or existing websites and mobile apps, SMS, email Combined: web-based intervention and an online	Synchronous (*n*=11): telephone calls, Skype, and Videoconferencing Asynchronous (*n*=11): combinations of websites and mobile apps, with short messaging and email	**PA:** Increases in PA behaviours found with no difference by delivery method. **QOL**: Synchronous interventions: favourable impact. Asynchronous interventions: no improvement compared to control. Synchronous and asynchronous with change scores: favourable impact.

				moderated forum, telephone calls, SMS text messaging Frequencies used not reported.	Combined methods (*n*=2): web-based intervention and an online moderated forum, and telephone and SMS text messaging Frequencies of interventions used not reported.	**Fatigue**: Synchronous and combined: favorable impact. Asynchronous: no intervention effect. Synchronous and asynchronous with change scores: favourable impact. **Depression**: Synchronous: favorable impact. Asynchronous: no intervention effect. **Anxiety**: Synchronous and asynchronous modes: favorable impact. Synchronous and asynchronous with change scores: small favourable impact. Frequency of positive outcomes in interventions not specified.
Batalik et al. (2021) Czech Republic Systematic review	PA/CRF (8/9), feasibility (1/9), fatigue (4/9, HRQOL (3/9), strength (2/9), satisfaction (2/9), cost-effectivity (1/9), body composition (3/9), glucose (1/9)	RCTs (9/9)	**Supervised?** (0/9) **Group-based?** (0/9) **Synchronous?** (0/9)	Wearable technology (6/9), telephone calls (6/9), email (2/9), web-based (1/9)	HB exercise interventions (9/9), aerobic exercise (6/9), aerobic + resistance exercise (2/9), aerobic + resistance +	HB exercise was found to be feasible and safe, providing a variety of benefits. (4/9) studies reported improvements in CRF (pre-post); (5/7) improved PA

No meta-analysis					flexibility exercise (1/9)	levels; (1/5) improved fatigue; (1/4) improved HRQOL; 3/5 improvements in body composition; (1/3) improved strength; (2/2) satisfaction with exercise program
Kiss et al. (2019) Australia Systematic review No meta-analysis	Dietary behaviour (7/16), PA (15/16), HRQOL (9/16), fatigue (6/16)	RCTs (16/16)	**Supervised?** (1/16) **Group-based?** (0/16) **Synchronous?** (0/16)	Web-based (9/16), wearable technology (3/16), DVD (1/16), mobile app (3/16)	Education on exercise, coaching, behaviour change modules, tailored or standard exercise sessions/program. Frequency of interventions used not specified.	HRQOL and fatigue improved post-interventions. Effects on pain, mental health, and insomnia were inconclusive. (8/14) studies reported improvement in PA behaviours; (6/9) improved at least one health-related quality of life subscale; (4/6) improved fatigue; (1/1) improved pain
Haberlin et al. (2017) Ireland Systematic review No meta-analysis	PA (10/10)	RCTs (7/10), non-controlled trials (3/10)	**Supervised?** (1*/10) **Group-based?** (0/10) **Synchronous?** (1*/10) *real-time educational	Web-based (9/10), web and mobile application (4/10), email (1/10)	Web-based (5/10), web and mobile application (4/10), email (1/10)	PA (8/10)

			workshop, not exercise			
Ibeggezene et al. (2021) United Kingdom Systematic review Meta-analysis	*Primary:* Aerobic exercise behaviour (3/3), resistance exercise behaviour (3/3) *Secondary:* Change in aerobic fitness/exercise tolerance*, change in skeletal muscle strength and endurance*, adverse events*, study recruitment rate*, and intervention attrition rate* *Study frequency not reported	RCTs (3/3)	**Supervised?** Not reported **Group-based?** (0/3) **Synchronous?** (0/3)	Telephone calls (3/3), wearable technology (3/3)	HB exercise intervention with weekly phone calls (3/3), an exercise log (3/3), heart rate monitors (3/3), pedometers (2/3), and physical activity counselling (1/3)	--
Smith-Turchyn et al. (2020) Canada Scoping review No meta-analysis	PA (7/8), QOL (7/8), recruitment/retention rate (7/8), adherence/attendance rate (6/8), physical/mental functioning (5/8), anthropometric measures (BMI, weight loss, waist-hip circumference) (4/8), dietary intake (3/8), participant satisfaction (3/8), step count (2/8),	Feasibility RCT (1/8), pilot study (1/8), RCTs (5/8), non-controlled trial (1/8), qualitative (2/8), secondary analysis (2/8), pre-	**Supervised?** (1/8)* **Group-based?** (4/8) **Synchronous?** (0/8) *Conducted in-person	Telephone calls (6/8) [weekly group teleconference session (2/6), monthly group teleconference session (1/6), weekly individual counseling sessions (3/6)], web-based (1/8) , DVD (1/8),	Telephone calls (6/8): [weekly group teleconference session (2/6), monthly group teleconference session (1/6), weekly individual counseling sessions (3/6)], web-based (1/8), in-person sessions	PA (4/7), QOL (4/7), anxiety/depression (3/4), anthropometric changes (2/4)

	fatigue (2/8), depression/anxiety (4/8), body image (2/8), physiological measures (1/8), HRQOL (1/8), distress (1/8), costs (1/8)	test/post-test (1/8)		wearable technology (1/8)	twice per week (1/8)	

PA, physical activity; MVPA, moderate-to-vigorous physical activity; SMS, short message service; BMI, body mass index; RCTs, randomized controlled trials; QOL, quality of life; HRQOL, health-related quality of life; CRF, cardiorespiratory fitness; BP, blood pressure; HR, heart rate.

Note: Numbers in brackets (x/y) indicate the number of studies (x) out of the total number of studies included in review (y) that utilized said outcome; type of study; supervised, group-based, or synchronous interventions; type of technology; type of intervention; and that reported on said positive outcome.

E.2 Telehealth Interventions by Review in Chronological Order Table

Unique Interventions (*n*=92)	**Review Titles** (*n*=9)								
	Roberts et al. (2017) (*n*=15)	Haberlin et al. (2017) (*n*=10)	Kiss et al. (2019) (*n*=18)	Morrison et al. (2020) (*n*=29)	Dorri et al. (2020) (*n*=16)	Furness et al. (2020) (*n*=24)	Smith-Turchyn et al. (2020) (*n*=11)	Batalik et al. (2021) (*n*=9)	Ibeggezene et al. (2021) (*n*=3)
Pinto et al. (2005)							✓		
Vallance et al. (2007)			✓						
Parsons et al. (2008)						✓			
Morey et al. (2009)						✓			
Ligibel et al. (2010)				✓					
Rabin et al. (2011)			✓						
Djuric et al. (2011)						✓			
Kim et al. (2011)						✓			
Hegel et al. 2011									✓
Rabin et al. (2012)	✓				✓	✓			
Eakin et al. (2012)		✓		✓			✓		
Yun et al. (2012)				✓		✓			
Hatchett et al. (2012)			✓						
Ligibel et al. (2012)				✓					
Musanti (2012)									✓
Befort et al. (2012)							✓		
Hatchett et al. (2013)	✓			✓				✓	
Pinto et al. (2013)				✓	✓				✓
Valle et al. (2013)	✓								
Garrett et al. (2013)		✓							
Hawkes et al. (2013)				✓					

Parsons et al. (2013)				✓					
Emmons et al. (2013)				✓					
Gallant et al. 2013							✓		
Bantum et al. (2014)	✓	✓	✓	✓		✓		✓	
Lee et al. (2014)	✓		✓	✓		✓			
Mayer et al. (2014)				✓		✓			
Berg et al. (2014)	✓								
Hoffman et al. (2014)	✓								
Cnossen et al. (2014)		✓							
Chapman et al. (2014)			✓						
Husebo et al. (2014)					✓				
Kyung-Lee et al. (2014)								✓	
Befort et al. (2014)							✓		
Frensham et al. 2014							✓		
Forbes et al. (2015)	✓		✓	✓		✓			
McCarroll et al. (2015)	✓		✓					✓	
Hong et al. (2015)	✓								
Bowen et al. (2015)				✓					
Van Waart et al. (2015)					✓				
Hong et al. (2015)								✓	
Kuijpers et al. (2016)	✓		✓						
Puszkiewicz et al. (2016)	✓		✓						
Quintiliani et al. (2016)	✓	✓	✓						
Short et al. (2016)	✓		✓						
Kanera et al. (2016)	✓	✓		✓		✓			
Galiano-Castillo et al. (2016)		✓				✓			
Haggerty et al. (2016)		✓							
Uhm et al. (2016)			✓						

Dieng et al. (2016)				✓					
Hvid et al. (2016)					✓				
Cornette et al. (2016)					✓				
Gnagarella et al. (2016)						✓			
Sajid et al. (2016)						✓			
Hooke et al. (2016)								✓	
Fazzino et al. 2016							✓		
Kanera et al. (2017)		✓	✓			✓		✓	
Short et al. (2017)		✓						✓	
Galiano-Castillo et al. (2017)		✓				✓			
Uhm et al. (2017)		✓				✓		✓	
Sturgeon et al. (2017)			✓					✓	
Badger et al. (2017)		✓							
Haggerty et al. (2017)		✓							
Rocque et al. (2017)		✓							
Timmerman et al. (2017)		✓							
Lahart et al. (2017)					✓				
Krebs et al. (2017)						✓			
Valle et al. (2017)						✓			
Fazzino et al. 2017							✓		
Gehring et al. (2018)		✓			✓				
Villaron et al. (2018)		✓		✓					
Pope et al. (2018)			✓			✓			
Ormel et al. (2018)				✓		✓			
Cheong et al. (2018)		✓							
Chevile et al. (2018)		✓							
Frensham et al. (2018)		✓							
Hartman et al. (2018)			✓						

Porter et al. (2018)				✓					
Golsteijn (2018)				✓					
Fazzino et al. 2018							✓		
Galvaao et al. 2018							✓		
Peddle-McIntyre et al. (2018)							✓		
Bruns et al. (2019)		✓							
Chung et al. (2019)		✓							
Ji et al. (2019)		✓							
Mohamed et al. (2019)		✓							
Nemli et ala. (2019)		✓							
Vallerand et al. (2019)		✓							
McNeil et al. (2019)					✓				
Alibhai et al. (2019)					✓				
Chung et al. (2020)		✓							

E.3 Aims and Inclusion/Exclusion Criteria of Telehealth Intervention Reviews

Review	Purpose/Aim	Inclusion/Exclusion Criteria
Roberts et al. (2017)	Efficacy of digital behaviour change interventions on PA levels, reducing sedentary behaviour, or improving dietary quality	• Eligible studies included DBCIs delivered remotely and targeting at least one of the following health behaviours: PA, diet and/or sedentary behaviour
Haberlin et al. (2017)	Explore the effects of eHealth in the promotion of PA among cancer survivors	• Studies were eligible for inclusion if they evaluated an eHealth-based intervention (Internet and mobile technologies) delivered to cancer survivors and included PA as a primary or secondary outcome measure. • Studies were excluded if only telephone calls, SMS or conference calls were used.
Kiss et al. (2019)	Efficacy of technology-supported self-guided nutrition and PA interventions	• Studies were included if they investigated a technology-supported nutrition and PA intervention that was largely self-guided and if the technology was accessed primarily outside the clinical setting. • An intervention was deemed self-guided when there was minimal or no facilitation by a clinician. Minimal facilitation could encompass activities such as occasional email reminders, an introductory session on navigating the technology platform, or initial exercise prescription. • Technology platforms for intervention delivery could be online, mobile phone, or tablet apps or wearable technology.
Morrison et al. (2020)	(1) Feasibility of exercise telehealth interventions for individuals diagnosed with cancer (2) Impact of exercise telehealth interventions for people affected by cancer on physical and psychosocial outcomes	• Telehealth interventions were defined as follows: An exercise counseling or intervention delivered via phone, video conferencing, web-based, or smartphone applications (apps) by a qualified health professional • Exercise counseling interventions were also included if they targeted exercise engagement and behavior change strategies
Dorri et al. (2020)	Evaluate studies related to PA designed for breast cancer patients and implemented through eHealth	• Interventions had to be designed with the aim of improving health-related behaviors or changing the lifestyle. More

		specifically, the primary outcomes in this systematic review had to directly or indirectly measure PA.
		• The employed technologies included:
		  ○ Mobile tools which were capable of establishing cellular and wireless communication.
		  ○ The main focus was on smartphone apps, but other formats such as web-based interventions were also acceptable.

Furness et al. (2020)	Synthesize evidence on the success of eHealth behavior change interventions in patients with cancer and survivors delivered by synchronous, asynchronous, or combined methods compared with a control group	• Studies were included if the primary intervention was delivered through an eHealth delivery method such as telephone or internet, either asynchronous or synchronous or combined interventions against a control (including usual care or wait list control or no intervention), random assignment of participants to treatment or comparison groups, and a measure of health behavior change must have been taken after the intervention. • Studies were excluded if there was any face-to-face component, as we sought to examine interventions purely delivered via eHealth approaches.
Smith-Turchyn et al. (2020)	To describe the current literature on available exercise programming for survivors of cancer who live in rural or remote settings	• To be included in this scoping review, studies had to include the following: (1) adult survivors of cancer at any stage of their treatment, (2) use exercise/physical activity/or sporting interventions, (3) explicitly include and discuss the application of programming for survivors living in rural or remote settings, and (4) be published in English.
Batalik et al. (2021)	Identify the literature focusing on the health effects of home-based exercise interventions in cancer survivors and to evaluate the methodological quality of the examined studies	• The interventions that met the criteria were: Aerobic and resistance HB exercise programs that included results and analysis.

Ibeggezene et al. (2021)	Evaluate the effects of remotely delivered interventions to improve exercise behaviour in sedentary adults living with and beyond cancer	• Included studies were RCTs that were aimed at promoting aerobic and/or resistance exercise behaviours in adult who were physically inactive were included. • Only interventions delivered remotely were included (i.e., the intervention was delivered without face-to-face contact or travel to a dedicated facility beyond the first week of the intervention).

DBCIs, digital behaviour change interventions; PA, physical activity; SMS, short message service; HB, home-based; RCTs, randomized controlled trials.

E.4 Barriers and Facilitators Reported in Telehealth Exercise Oncology Intervention Reviews

Author	Participant Barriers/Facilitators	Cancer-Specific Issues	Other
Roberts et al.	Not specifically reported.	No improvements in cancer-specific quality of life or fatigue outcomes were found, contrasting results of other reviews.	Meta-analysis was not possible for certain outcomes (cancer specific and general QOL), anxiety, depression, or sleep, due to insufficient study number. Meta-analyses that were conducted reflected unadjusted data models.
Morrison et al.	<u>Barriers:</u> Decreased physical condition Treatment related barriers Emotional problems Lack of motivation Social barriers Technical problems <u>Facilitators:</u> Increased physical condition Psychological wellbeing Feeling motivated Social Technical facilitators	None noted.	No studies included reported using face-to-face telehealth platforms (i.e., Zoom, Skype, FaceTime), limiting the understanding of barriers and facilitators (benefits) to remotely delivered, online exercise oncology programs from the participant perspective. Long-term engagement and effect on intervention success was unable to be determined due to inconsistent reporting.
Dorri et al.	Not specifically reported.	Interventions were not specified with breast cancer patients.	Final level of effect on PA was unable to be calculated due to various PA measurement tools used between studies. Varying durations of interventions included (Range: 1 to 12 months) in systematic review may have affected stabilization of results.

Furness et al.	Not specifically reported.	Cancer type was not a limiting variable in studies included in this review, leading to a potential moderating effect on intervention efficacy between delivery modes.	Findings demonstrated no differences in delivery mode (synchronous, asynchronous, or combined) on health outcome improvements. Insufficient evidence to determine usefulness of delivery mode in this population. Insufficient evidence to determine changes in health outcomes caused by behaviour change interventions.
Batalik et al.	<u>Barriers:</u> Lack of exercise supervision Less face-to-face contact Lack of social interaction ICT literacy Exercise data integration into medical records Lack of legal clarity and data protection Lack of published guidelines <u>Facilitators</u>: Higher protection from infection Independence in exercise planning Less time and/or travel barriers Integration into daily PA Combination with tele-monitoring and/or counselling Higher privacy Lower costs Physiological and psychological improvements (improved CRF, HQROL, immune function, reduced fatigue, reduced depression)	The diversity of cancer diagnoses and treatment statuses did not permit data synthesis.	Most studies included had study methodology limitations, potentially reducing overall quality of systematic review.

Kiss et al.	Not specifically reported.	Not all included studies (*n*=10) targeted cancer survivors not meeting PA guidelines.	Self-guided interventions are not well described in the literature, making data syntheses difficult.
Haberlin et al.	Not specifically reported.	Not all included studies (*n*=7) targeted cancer survivors not meeting PA guidelines.	Varying durations of interventions included (Range: 14 days to 12 months) in systematic review may have affected stabilization of results. 3 studies in this review did not utilize control groups.
Ibeggezene et al.	Not specifically reported.	All trials reported adverse events (cancer recurrence *n*=1, tendinitis *n*=2, chest pain *n*=1.	Data included was insufficient to conclude an effect on outcomes. All trials had a high risk of bias. Reporting of PA levels was incomplete, limiting understanding of intervention fidelity and outcomes.
Smith-Turchyn et al.	Identifies need to evaluate unique barriers to rural and remote cancer populations. Barriers identified include issues with access to reliable and affordable internet services and additional costs of travel.	None noted.	Specifically evaluated rural and remote exercise programs available to cancer survivors. Lack of online resources evaluated in this review.

QOL, quality of life; PA, physical activity; ICT, information and communications technology; CRF, cardiorespiratory fitness; HRQOL, health-related quality of life