Physical activity among Nova Scotian cancer survivors

by

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Abstract

Background: Physical activity (PA) has been shown to improve health among cancer survivors yet the majority of survivors do not meet the recommended public health guidelines. In addition, research suggests that the influence of PA correlates may vary between cancer types but little research exists that directly compares correlates among groups. Recent PA behaviour change interventions among cancer survivors have used methods such as face-to-face, telephone counselling, email, and print-based materials, however, based on the broad reach and possible cost savings, internet-delivered programs may be a more viable option to achieve PA behaviour change.

Purpose: The purpose of this dissertation was to examine and compare the correlates and preferences among cancer survivors living in Nova Scotia, and to develop and test an internet-delivered, home-based behaviour change program.

Methods: Study I was a cross-sectional, population based survey that measured the PA, Theory of Planned Behaviour (TPB)-based social cognitive constructs, PA preferences, and demographic and medical characteristics of 741 breast, prostate, and colorectal cancer survivors. Study II was a randomized controlled behaviour change trial that examined the feasibility and preliminary efficacy of an internet-delivered behaviour change program designed to increase PA levels among 95 breast, prostate, and colorectal cancer survivors. Participants in the intervention group (n=48) visited a web site to track their PA and receive TPB based educational materials over 9 weeks. The usual care group (n=47) was asked to maintain their current routine. Assessments were conducted at baseline, post-intervention and 12-week follow-up. Study II secondary outcomes assessed quality of life (QoL) and motivational outcomes.

Results: In Study I, it was found that the majority of survivors were insufficiently active for health benefits. There were differences found when assessing the correlates of PA among the three cancer groups, specifically intention was significantly associated with PA for colorectal cancer survivors only; planning was significantly associated with PA for breast and prostate cancer survivors only; and perceived behavioural control (PBC) was significantly associated with PA for prostate cancer survivors only (Paper 1). Study I also concluded there were differences in PA program and counselling preferences based on cancer group (Paper 2). Results showed low rates of strength exercise and correlates did not vary much between cancer groups (Paper 3). In Study II, we had a 23% recruitment rate with 88% and 84% retention at post-intervention and 12-week follow-up respectively. Engagement rate were low at 26% of participants completing the modules, however participant satisfaction was high (Paper 4). Non-significant increases in total PA were found between the groups, specifically among those who were not meeting PA guidelines at baseline (Paper 4). However, there were no changes for QoL outcomes (Paper 5). There were no positive changes in TPB outcomes, with negative effects found for self-efficacy, affective and instrumental attitude, and many underlying control beliefs (Paper 5).

Conclusions: This dissertation demonstrates the importance of directly comparing cancer groups to determine differences in PA related correlates and preferences (Study I, Papers 1 and 2). Using this information to target specific correlates may help to increase the success of PA programs for these groups. For strength exercise, it appears that targeting motivational outcomes may be most successful. Study II determined that using web-based delivery for a PA behaviour change program may be feasible among cancer survivors. A trend towards increased PA was found for the intervention group. Despite this positive trend, there was no

change in QoL outcomes (Study II, Paper 1) and a negative trend for motivational outcomes (Study II, Paper 2). Further research needs to focus on the best way to use web-delivery media to increase engagement and retention, as well as the best methods to elicit positive changes in motivation and self-efficacy. This dissertation adds valuable data to the very limited literature in web-based PA behaviour change among cancer survivors.

Preface

This dissertation is an original work by Cynthia Forbes. Study I received research ethics approval from the Capital Health Research Ethics Board and the University of Alberta, Project Name "Promoting Physical Activity in Nova Scotian cancer survivors", No. CDHA-RS/2012-128, September 6, 2011. Study II received research ethics approval from the University of Alberta Health Research Ethics Board – Health Panel, Project Name "Efficacy of an internet-delivered home-based PA intervention among Nova Scotian breast, prostate and colorectal cancer survivors", No. Pro00047138, May 21, 2014.

Chapter 2 of this dissertation has been published as Forbes CC, Blanchard CM, Mummery WK & Courneya, KS. (2014). A comparison of physical activity correlates across breast, prostate and colorectal cancer survivors in Nova Scotia. *Supportive Care in Cancer, 22(4),* 891-903. I was involved in the acquisition of data. KS Courneya and I drafted the manuscript and WK Mummery and CM Blanchard revised it critically for important intellectual content. KS Courneya, CM Blanchard and I performed the statistical analyses and were responsible for the interpretation of the data. All authors read and approved the final manuscript.

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Chapter 1 – Introduction

Overview of Cancer in Nova Scotia

Approximately half of Canadians will develop cancer in their lifetime and 30% of deaths in Canada can be attributed to cancer (1). Incidence rates in the Atlantic provinces are among the highest in Canada (1). Upon examination of the age standardized incidence rates (ASIR) of new cases and deaths per 100,000, Nova Scotia emerges as having among the highest rates of new cases in all cancer among men (466 vs. 431 average) and women (385 vs. 372 average), and also among the highest among deaths in females (135 vs. 130 average) and for males (210 vs. 175 average) (1). In general, the demographic characteristics of the Atlantic Provinces reveal lower average incomes, lower physical activity levels, higher obesity rates and higher unemployment rates than the Canadian average (2, 3). Nova Scotia is the largest of the Atlantic provinces and approximately 43% of Nova Scotia's estimated 940,000 residents are considered rural (4). Studies show there may be differences in activity levels among urban and rural cancer survivors (5-7). Exploring the correlates of cancer diagnoses could shed some light on the increased incidence rates among Atlantic Canadians.

As with the larger Canadian population, the most commonly diagnosed cancers in Nova Scotia are prostate, breast, lung and colorectal which make up about half of all cancer cases. ASIR (per 100, 000) for men are 98, 71 and 68 for prostate, colorectal and lung cancer respectively. Among women, the ASIR are 101, 56, and 48 for breast, lung and colorectal cancer respectively. Research has suggested that lifestyle behaviours, such as physical activity levels, may be linked to incidence of cancer, specifically colorectal, breast and prostate cancer (1, 8, 9). We chose to focus on these three cancer types for this dissertation.

Prostate is the most commonly diagnosed cancer among men. The current 5- and 10-year survival rates for prostate cancer 96% and 93% respectively. Common treatments for

prostate cancer include active surveillance, surgery, radiation and hormone therapy. Active surveillance, or the "wait-and-see" or "watchful waiting" protocol is recommended for those with small, slow-growing cancer and involves frequent appointments to monitor any symptoms or growth. There are no drugs or invasive procedures and therefore, no side effects associated with this treatment. Surgery involves removing a portion of or the entire prostate gland. Long-term side effects of this treatment can include incontinence, erectile dysfunction and infertility. Radiation therapy is a high-energy beam that is aimed at the affected area to reduce growth or irradiate potential cancer cells not removed though surgery. Radiation therapy alone may be used if a surgery would be too risky due to age or health, or in combination with other treatments to ensure maximal success. Possible side-effects are a slow urinary stream from scar tissue, infertility, erectile dysfunction and in very rare cases, cancer. Finally, androgen deprivation therapy (ADT) is most commonly administered as one of many types of medication to decrease androgen (male sex hormones) levels. As in breast cancer, some prostate cancers are classified as "androgen-dependent" or "androgen-sensitive" using androgens to grow. ADT can have many side effects such as erectile dysfunction, weight gain, lean muscle loss, depression and loss of energy among others (10).

The most commonly diagnosed cancer among women is breast cancer. 5-year survival rates are 88% and 10-year rates are 82%. Treatment for breast cancer will most often include surgery and may be accompanied by adjuvant therapies such as chemotherapy, radiation therapy and hormone therapy. Breast cancer patients undergoing surgery will generally have either a lumpectomy, removal of the tumour and small portion of surrounding normal breast tissue, or a mastectomy, removal of the entire breast and in some severe cases part of the underlying muscle. Usually, during surgery lymph nodes will be removed to test

metastasis. Depending on the stage of cancer adjuvant treatments may be necessary. Chemotherapy is usually taken intravenously or in pill form. There are a large number of chemotherapy drugs specifically for breast cancer and any of these drugs can be prescribed on their own or in multiple different combinations. The most common side effects are fatigue and nausea however, due to the method of administration, i.e., through the bloodstream, side effects are many and can affect the entire body. As with prostate cancer, radiation therapy targets the area of the excised tumour to damage any cancer cells missed during surgery. Fatigue and skin soreness and irritation are the most common side effects from this type of breast cancer therapy. For those patients that have "estrogen-dependent" cancers, hormone therapy is prescribed, most commonly tamoxifen or herceptin. These drugs reduce growth and reproduction of breast cancer cells. Onset of menopausal type symptoms are commonly associated with these hormonal therapies (10).

Colorectal cancer is the second and third most commonly diagnosed cancer among men and women respectively. Again, the primary treatment for colorectal cancer is surgery to remove the portion of the digestive tract containing the tumour. This surgery may require a temporary or permanent ileostomy or colostomy bag. As in the case of prostate and breast cancer, surgery may be followed up with chemotherapy, targeted therapy or radiation for those with higher staged cancers. Similar to breast and prostate adjuvant therapies, common side effects from treatment among colorectal cancer survivors are fatigue and nausea. In addition, many survivors have short- or long-term peripheral neuropathy which can affect their ability to walk and mobility (10).

Survivorship and Physical Activity among Cancer Survivors

Advances in treatment and screening have increased the survival rate for cancer survivors overall. However, long-term side effects of these treatments can have a large impact on health-related quality of life (HRQoL). The benefits of physical activity (PA) among cancer survivors have been well documented in research. Recent meta-analyses and systematic reviews provide evidence that participating in regular PA can lead to many improvements in physical functioning and quality of life (QoL) after receiving a cancer diagnosis (8, 9, 11-17). Meta-analyses report that cancer survivors who participated in PA interventions indicated having a higher QoL post-intervention; in addition, these positive effects were still apparent in follow-up assessments (11, 16, 18). Improvements in physical and emotional indicators of health due to PA have been documented, for example, aerobic endurance, muscular strength, fatigue, depression, anxiety, self-esteem, functional ability, and overall quality of life (8, 9, 15). Regular PA is also associated with a lower risk of disease recurrence and longer survival in breast and colorectal cancer survivors (14, 19, 20). Reviews and meta-analyses have shown that post-diagnosis PA reduced breast cancer specific mortality for those overweight or obese participants, as well as reducing all cause mortality regardless of BMI (14).

Despite these benefits, many cancer survivors do not accumulate the required amount of PA to meet the public health guidelines of 150 minutes or more of moderate intensity activity (8, 21, 22). The 2005 Canadian Community Health Survey (CCHS) indicated less than 22% of Canadian cancer survivors were physically active at recommended levels (23). Similar results exist in the United States. Self-report data from the National Health Interview Survey (NHIS) found levels of physical inactivity were relatively high across all the cancer

groups examined (24). The American Cancer Society states that between 20-30% of cancer survivors will be active after treatment recovery (9).

Determinants of Physical Activity among cancer survivors

The significant and unique benefits of PA for cancer survivors, combined with the low participation rates, have highlighted the importance of research into the determinants of PA in cancer survivors. Understanding the determinants of PA in cancer survivors is crucial for the development of successful behaviour change interventions designed to increase PA and change PA behaviour. PA determinants research in cancer survivors uses observational designs (e.g., cross-sectional, prospective) and studies using intervention designs (e.g., randomized controlled trials, uncontrolled trials). Although other theories have been used, in both of these designs, the majority of the research has used the Theory of Planned Behaviour as a template (25).

A chapter written by Pinto and Ciccolo (22) in the book *Physical Activity and Cancer* provides an excellent overview of the various theories used in cancer survivor research. Briefly, some other theories that have been used include Social Cognitive Theory (SCT), Transtheoretical Model (TTM), and Self-determination Theory (SDT). Using observational studies to determine the relationship between SCT constructs and motivation has yielded unclear results (22). While interventions using SCT have found significant increases in activities such as walking (26, 27), many observational and intervention studies using SCT tend to focus on the construct of self-efficacy as opposed to testing the entire theory's constructs (22). With regards to TTM, in cross-sectional analyses, correlations between stage of readiness for PA, QoL and symptom management were found to be significant (28). Interventions using TTM to target one or multiple behaviours have been found to be effective

in increasing PA in the intervention groups (26, 29, 30). It is worthwhile to note that many interventions using the TTM have been in conjunction with the SCT among cancer survivors (26, 30-33). A handful of studies have also used SDT as a guide for research among cancer survivors (34-37). These studies have yielded promising results in predicting PA motivation. Further research needs to be conducted to support these results.

The TPB is a motivational, social cognitive model that suggests intention (i.e., motivation) is a key determinant of any behaviour. Intention itself is influenced by three constructs: 1) attitude which includes instrumental (expected benefits from behaviour) and affective (expected enjoyment of behaviour) components; 2) subjective norm which includes injunctive norm (expected support from others for behaviour) and descriptive norm (extent to which important others engage in a behaviour); and 3) perceived behavioural control (PBC; the perceived controllability of engaging in a behaviour). Planning has been recently added to the model to attempt to bridge the "intention-behaviour gap". Planning mediates behaviour and intention. Recent studies in the cancer domain have found this model to be very robust when predicting PA. Multiple reviews and studies have found that among cancer survivors the TPB explains 23 to 69% of variance in PA intentions (7, 22, 38-43) which is similar to other behavioural models. In contrast to models such as the TTM, SCT and SDT, the entire TPB is easily operationalized when developing intervention materials. The TPB is also a well validated and tested theoretical framework. A detailed description of the studies that have used the TPB to examine the determinants of PA among cancer survivors can be found in Appendix A.

Another important step in increasing PA levels among cancer survivors is assessing PA counselling and program preferences to ensure PA programs are targeted to the specific

preferences of a group (38, 39). Investigating the preferences of the population of interest is necessary to effectively design these targeted PA interventions. A review of the literature examining the PA preferences of cancer survivors can be found in Appendix A. Among the fifteen studies reviewed (5, 6, 38-50) all reported that the majority of participants were interested in receiving information about and capable of engaging in a PA program targeted to cancer survivors. Studies that solicited information regarding specific programming preferences reported an overwhelming preference for recreational activities with walking being most preferred specific activity. Many preferences vary among cancer survivor groups and are influenced by demographic and medical variables (6, 42-44).

Physical Activity interventions among cancer survivors

In order to make PA interventions more successful with regards to adaptation and maintenance, many are based on theoretical models. Research designed to illicit PA behaviour change among cancer survivors has focused most heavily on the TPB. Interventions among cancer survivors have incorporated the TPB when developing educational sessions face-to-face or via print materials such as a guidebook. Jones and colleagues (51) tested the effect of an oncologist's recommendation to participate in PA. The study was a single-blind, 3-armed randomized controlled trial. Participants were randomized to receive an oncologist exercise recommendation only, an oncologist exercise recommendation plus a referral to an exercise specialist or usual care. The main outcome they examined was total exercise time calculated in METs and found that the recommendation from an oncologist may increase PA behaviour in women newly diagnosed with breast cancer.

Vallance and colleagues (52) examined the effectiveness of a PA guidebook and or pedometers versus a standard PA recommendation. Participants received one of the following a standard public health recommendation for PA, breast cancer–specific PA print materials, a pedometer, or a combination of breast cancer–specific print materials and pedometers. The main outcome assessed was moderate/vigorous PA minutes per week. Researchers found that all the intervention groups reported significantly greater increases in PA minutes than the standard group. The combined group also reported significantly improved QoL and reduced fatigue compared to the standard group.

Most recently, Trinh and colleagues (53) examined the usefulness of adding behaviour change counselling to supervised exercise among 32 kidney cancer survivors living in Edmonton, Alberta. Participants were randomized to either a supervised PA group with additional TPB-based behavioural counselling or a supervised PA group with additional standard PA counselling. The researchers concluded that adding behavioural counselling to supervised PA was feasible for kidney cancer survivors and found small, non-significant effects on PA minutes favouring the behavioural counselling group.

Internet-delivered Physical Activity interventions

Recent meta-analyses and reviews (54-59) have examined computer-tailored or web-based interventions in the general and chronic disease populations. A recent meta-analysis evaluating the effectiveness of internet delivered interventions showed support for internet-delivered behaviour change programs in the short term, while long term effects remain unclear and require more study (55). As well, recent systematic reviews examined interactive web-based interventions targeting patient empowerment and PA among various chronic disease populations and concluded that web-based interventions may improve health status

and QoL among cancer survivors (56, 59). One study in the review looked at the effectiveness of an internet-support system on symptom distress in cancer patients (60). A review of recent web-based PA interventions among cancer survivors, as well as a review of the most recent reviews and meta-analyses can be found in Appendix A.

There are only two studies that use computer-tailored or internet-delivered programs designed to increase PA among cancer survivors (61, 62). One recent study from Australia tested the effectiveness of computer-tailored newsletters versus targeted newsletters to increase PA among breast cancer survivors (61). They randomized 330 breast cancer survivors living in Australia to receive via mail either three *tailored* (using personal data collected at baseline) 4-page newsletters based on SCT, one previously developed *targeted* booklet based on TPB, or a pamphlet (control group). They found that computer-tailored newsletters may be an effective way to increase resistance training activity, however, had null finding s for all other outcomes. In this study, the interventions were all delivered by mail.

One other study examined the usefulness of a website-based TTM intervention to increase PA and fruit and vegetable intake among South Korean breast cancer survivors. This study randomized 59 women to either a self-management PA and diet online intervention or a control group that received a 50-page educational booklet. The researchers conclude that a web-based program targeting changes in PA using TTM may be effective. As with many other studies using TTM to affect behaviour change (63), the researchers did not operationalize the entire model when developing materials. They only operationalized stages of change and self-efficacy. Therefore, all dimensions of the model are not being represented and the effectiveness of the model cannot be accurately determined.

Overview of Dissertation

The purpose of my dissertation is to examine the correlates of PA among breast, prostate and colorectal cancer survivors in Nova Scotia, Canada and to develop a behaviour change internet-delivered PA program based on these correlates. The dissertation consists of seven chapters. Chapter 1 provided a brief overview of previous research among cancer survivors, including the demographic, medical and social cognitive determinants of PA, the PA counselling and program preferences and PA behaviour change interventions to date. A thorough review of these topics can be found in Appendix A. For Study I of my dissertation, I completed a cross-sectional survey of 741 cancer survivors (248 breast, 253 prostate and 240 colorectal) using the Nova Scotia Cancer Registry (NSCR) operated by Cancer Care Nova Scotia (CCNS). In Paper 1 from Study I (Chapter 2), I compare the determinants of PA among the cancer survivor groups. This paper has been published in *Supportive Care and Cancer.* In Paper 2 from Study I (Chapter 3), I examine the PA counselling and program preferences of Nova Scotian cancer survivors and highlight differences among the cancer groups. This paper is in press at the *Journal of Physical Activity and Health*. Paper 3 from Study I (Chapter 4) explored the correlates of strength exercise among the cancer survivor groups. This paper is published in *Oncology Nursing Forum*. For Study II of my dissertation I developed a an internet-delivered PA behaviour change intervention based on the results of Study I, designed to increase PA minutes in breast, prostate and colorectal cancer survivors in Nova Scotia. Paper 4 (Chapter 5) details the feasibility and efficacy of the internet delivery method and Paper 5 (Chapter 6) explored the motivational outcomes following the intervention. Finally, a general discussion (Chapter 7) presents a summary of findings and conclusions for this dissertation.

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Chapter 2 – STUDY I: Paper 1

A comparison of physical activity correlates across breast, prostate and colorectal cancer survivors in Nova Scotia

Forbes CC, Blanchard CM, Mummery WK & Courneya, KS. (2014). A comparison of physical activity correlates across breast, prostate and colorectal cancer survivors in Nova Scotia. *Supportive Care in Cancer, 22(4),* 891-903.

Introduction

Despite the benefits of physical activity (PA) in cancer survivorship, the majority of survivors do not meet the recommended PA guidelines (1). Examining the demographic, medical, and social cognitive correlates of PA can help inform the development of effective PA intervention programs for cancer survivors (2). Studies suggest there may be different correlates of PA among different cancer survivor groups (2-4) but few studies have directly compared correlates across different cancer survivor groups using the same sampling frame and measures. The primary purpose of the present study was to examine social cognitive correlates of PA using the Theory of Planned Behaviour (TPB) (5) across samples of breast, prostate and colorectal cancer survivors. A secondary purpose was to explore the medical, demographic and behavioural correlates of PA among the cancer survivor groups.

The TPB posits that intention (i.e., motivation) is a key determinant of behaviour. Intention is, in turn, influenced by: 1) attitude which includes instrumental (expected benefits from performing a behaviour) and affective (expected enjoyment from performing the behaviour) components (6-8); 2) subjective norm which includes injunctive norm (expected support from others for performing the behaviour) and descriptive norm (extent to which important others perform a behaviour) (6-8); and 3) PBC (the perceived controllability of performing a behaviour). To attempt to bridge the "intention-behaviour gap", planning has been added to the model (9, 10) as a mediator between behaviour and intention. Recent studies in the cancer domain have found this model to be highly effective when predicting PA (2, 11, 12). In a recent meta-analysis, the TPB constructs of intention and PBC were found to have strong correlations with PA adherence among cancer survivors (13).

We examined these correlates in cancer survivors living in Nova Scotia, an understudied province in Canada. According to the Canadian Cancer Society (CCS), the Atlantic Provinces have some of the highest cancer rates in Canada (14). Nova Scotia is the largest province in the Atlantic region with just over 921,000 residents (15). Unlike the majority of Canada, much of the population in Atlantic Canada is rural. Approximately 45% of Nova Scotia in 2006 were considered rural, which is significantly higher than Canada's average of about 20% (16). When compared to Canadian averages, the Atlantic provinces have lower average incomes, lower physical activity levels, higher obesity rates, and higher unemployment rates (17).

Based on previous research in cancer survivors (1, 2, 4, 18-21), we hypothesized that the majority of NS cancer survivors would not be meeting PA guidelines. We also hypothesized that the TPB would provide the strongest correlates of PA. Finally, we hypothesized that a more favourable medical profile (e.g., less treatment, earlier disease stage, better health) and certain demographic variables (e.g., being male, younger age) would also be associated with higher PA. Comparisons across the three cancer survivor groups were considered exploratory.

Materials and Methods

Ethical approval was obtained from the Nova Scotia Capital Health District Authority and the University of Alberta. The research design was a cross-sectional, mailed survey. The NSCR generated a stratified random sample of 2100 breast, prostate, and colorectal cancer survivors (700 from each survivor group) currently residing in Nova Scotia. Participants were eligible if they were: 1) aged between 18 and 80 years, 2) current residents of Nova Scotia, and 3) had a diagnosis of breast, prostate, or colorectal cancer. The survey was

conducted by Cancer Care NS (CCNS) and the NSCR on behalf of the researchers between October 2011 and February 2012. Participants were mailed a study package containing: 1) an invitation letter from the director of CCNS explaining why they were receiving the package and the registry's role, 2) a letter from the researchers detailing the purpose of the study, 3) a questionnaire, and 4) a postage paid return envelope. The survey protocol consisted of mailing the initial survey package and a reminder postcard 3-4 weeks later for those who had not responded.

Measures

Demographic and medical information

Demographic and medical variables were assessed using self-report. Demographic variables included age, sex, marital status, education level, income, employment status, ethnicity, and height and weight to compute body mass index (BMI). Medical variables included date of diagnosis, cancer site, disease stage, previous treatments, current treatment status, cancer recurrence, and current cancer status ('cancer is gone' versus 'still have cancer'). Variables were grouped according to standard metrics used among researchers in the cancer domain and can be viewed in Table 1.

Physical activity

PA was measured using a modified version of the Leisure Score Index from the Leisure Time Exercise Questionnaire (22). Participants were asked to indicate the average frequency and duration of any vigorous (heart beats rapidly, sweating), moderate (not exhausting, light perspiration) and light (minimal effort, no perspiration) intensity PA in which they engaged in a typical week over the past month. PA had to have been at least 10 minutes long and performed in free time. PA minutes was calculated based on the 2008 PA

Guidelines for Americans (23) which have also been recommended for cancer survivors by the American College of Sports Medicine (24) and the American Cancer Society (25). The guidelines state that cancer survivors should perform either 75 minutes of vigorous activity a week, 150 minutes of moderate activity a week, or a combination that double weights the vigorous minutes. 'PA minutes' per week were therefore calculated as moderate minutes plus two times vigorous minutes and this continuous measure was used in the structural equation modelling (SEM). For the analyses of the demographic and medical correlates, we transformed the continuous PA variable into two categories: 1) not meeting guidelines (≤149 minutes) or 2) meeting guidelines (≥150 PA minutes). This PA measure has been used successfully in previous cancer research (2, 11, 12, 26).

Theory of Planned Behaviour

The TPB was assessed using standard measures (27). The items were focused on engaging in future regular PA (28) as defined previously for moderate and vigorous activity. Attitude was assessed using six items on a 7-point bipolar Likert scale for both components; instrumental attitude (i.e., harmful-beneficial, useless-useful, bad-good) and affective attitude (i.e., unenjoyable-enjoyable, boring-fun, unpleasant-pleasant) using the preceding statement: "For me, engaging in PA regularly over the next 12 weeks will be...."

Subjective norm was measured with five items on a 7-point bipolar Likert scale. Three items assessed injunctive norm by asking "I think that if I participated in regular PA over the next month, most people who are important to me will be..." disapproving/ approving, discouraging/encouraging and unsupportive/supportive. The other two items measured descriptive norm by asking "I think that over the next month, most people who are

important to me will be...” inactive/active and “I think that over the next month, most people who are important to me will participate regularly in PA...” disagree/agree.

PBC was measured with six items on a 7-point bipolar Likert scale. An example item was “If you were really motivated, participating in PA over the next month would be...” extremely difficult/extremely easy. Intention was measured with two 7-point Likert scale items that asked “Do you intend...” and “How motivated are you... to do regular PA over the next month” respectively. Finally, planning was assessed with six items on a 7-point Likert scale with responses ranging from no plans to detailed plans (2). The first item asked “Do you have plans for when, where, and the type of PA you will do in the next month?” The following five items expanded on the first asking “I have made detailed plans concerning…” when, where, what, how and with whom they will engage in regular PA.

Statistical analyses

Chi-square tests were used to analyse the associations between categorical demographic, medical, and behavioural variables, and PA variables overall and separately for each cancer survivor group. Analyses of variance (ANOVAs) were conducted to determine any differences in TPB scores among the cancer survivor groups. Analyses of covariance (ANCOVAs) were also conducted to adjust for age, sex, marital status, disease stage, treatment types (surgery, chemotherapy, radiation, and hormone therapy), treatment status, and disease status when comparing cancer survivor groups. To test the primary hypotheses, path analyses were estimated with maximum likelihood procedures using the SEM software LISREL. For latent concept specification, the single item indicators’ factor loadings were fixed to 1 and the error variances were fixed to 0%. The comparative fit index (CFI) and incremental fit index (IFI) were used to determine the adequacy of model fit, which had a

model acceptability cut point of > 0.94 (29). Modification indices were examined and model adjustments were made accordingly. Finally, to determine whether the magnitude of the TPB coefficients were similar across cancer groups, an invariance approach was used. Specifically, given that the error variances and factor loadings were fixed to 0 and 1 respectively in the path analyses, we compared a model constraining the factor variances, covariances, and all the TPB coefficients (i.e., between two cancer groups) except the one coefficient we were interested in testing from a moderation perspective (e.g., all TPB coefficients would be constrained except the affective attitude → intention path to examine whether this coefficient was similar in magnitude between breast and prostate cancer survivors) to a model constraining the factor variances, covariances, and all the TPB coefficients (30). A significant change in the χ^2 is indicative of variance in the structural coefficient (i.e., the coefficient is significantly stronger in one cancer group compared to the other) (31). All structural coefficients presented in the figures are standardized and have p-values < .05. All analyses among cancer groups were well-powered at 90% to detect effect sizes (d) between 0.3 and 0.5 (32). Multivariate assumptions were checked and the PA continuous score had a kurtosis > 2. Therefore, we used the next highest value + 1 to replace the outliers prior to using SEM. Missing data was less than 5% for any variable and was replaced with the mean substitution.

Results

Flow of participants through the study is presented in Figure 2-1. The registry randomly generated a stratified sample of 2100 cancer survivors diagnosed between 2003 and 2011 (700 from each cancer site). The survey resulted in a 36% completion rate (741/2062) and a 38% response rate (741/1978) excluding the return to senders and deceased

persons. The response rate did not differ by cancer site (p=.946). Based on the limited medical and demographic data available in the registry, we compared responders (n=741) and non-responders (n=1321) on age, sex, cancer site, disease stage, and time since diagnosis. We found no significant differences between non-responders and responders for any variable. Table 2-1 describes the demographic, medical, and behavioural characteristics of the sample. The mean number of PA minutes was 193, which consisted of 123 moderate minutes and 35 vigorous minutes (doubled for PA minutes). Based on the PA categories, 313 (42.2%) were meeting PA guidelines.

Demographic and medical correlates of PA

Tables 2-2 and 2-3 describe the demographic, medical and behavioural correlates of meeting PA guidelines overall and among cancer survivor groups. Breast cancer survivors were more likely to be meeting guidelines if they were younger (p=.002), more educated (p=.002), wealthier (p=.008), and regular drinkers (p=.009). Prostate cancer survivors were more likely to be meeting guidelines if they were between the ages of 60-69 (p=.005) and at least a social drinker (p=.041). Colorectal cancer survivors were more likely to be meeting guidelines if they had at least some post-secondary education (p=.008) or were a non-smoker (p=.026). Breast cancer survivors who had better general health (p<.001), fewer comorbidities (p=.015), and a lower BMI (p<.001) were more likely to meet guidelines. Prostate cancer survivors were more likely to meet PA guidelines if they had surgery (p<.001) but not radiation (p=.044), chemotherapy (p=.048), or hormone therapy (p=.038), were not currently receiving treatment (p=.044), and were in better general health (p=.014). Colorectal cancer survivors were more likely to be meeting guidelines if they were in better general health (p=.011).

Theory of Planned Behaviour Differences among Cancer Survivor Groups

Tables 2-4 and 2-5 details differences in the TPB constructs and PA among the cancer survivor groups. Breast cancer survivors had a more favourable affective attitude (p=.042; *d*=0.25), instrumental attitude (p=.006; *d*=0.25), and descriptive norm (p=.007; *d*=0.23) compared to prostate cancer survivors. A significant difference was also found for PA minutes between prostate and colorectal cancer survivors (228 minutes vs. 166 minutes; p=.047). Significant differences did not remain, however, when results were adjusted for age, sex, marital status, disease stage, treatment types (surgery, chemotherapy, radiation, and hormone therapy), treatment status, and disease status.

Path analyses

All three path analyses showed that the model was a good fit to the data. The path analyses showed that for breast cancer survivors (see Figure 2-2a) intention was significantly predicted by instrumental attitude and affective attitude and PBC, whereas planning was predicted by intention and descriptive norm. PA was predicted solely by planning (CFI = .99, IFI = .99, $\chi 2$ (10) = 14.12, p = .17). Finally, instrumental attitude (β = .06), affective attitude (β = .07), descriptive norm (β = .04), PBC (β = .11), and intention (β = .28) had small to moderately large significant indirect effects on PA.

For prostate cancer survivors, results in Figure 2-2b show the model was a good fit to the data (CFI = .99, IFI = .99, $\chi 2$ (10) = 15.43, p = .12). Intention was significantly predicted by instrumental attitude, descriptive norm, and PBC, whereas planning was predicted by intention only. However, PA was predicted by planning and PBC. Finally, instrumental attitude (β = .05), descriptive norm (β = .04), PBC (β = .13), and intention (β = .27) had small to moderately large significant indirect effects on PA.

With respect to colorectal cancer survivors, Figure 2-2c shows intention was significantly predicted by instrumental and affective attitude, descriptive norm, and PBC. Planning was predicted by intention, whereas PA was only predicted by intention (CFI = .99, IFI = .99, $\chi 2$ (10) = 8.70, p = .56). Finally, instrumental attitude (β = .08), affective attitude (β = .15), descriptive norm (β = .06), and PBC (β = .20) had small to moderately large significant indirect effects on PA.

In terms of the invariance analyses, results showed that the intention to planning relationship was significantly stronger for breast cancer survivors compared to prostate cancer survivors $\chi^2(1)_{difference} = 4.00$, $p < .05$, whereas the affective attitude to intention relationship was significantly stronger for colorectal cancer survivors compared to prostate cancer survivors $\chi^2(1)_{difference} = 8.12$ $p < .01$. Finally, the planning to PA relationship was significantly stronger for prostate cancer survivors compared to colorectal cancer survivors $\chi^2(1)_{difference} = 4.20$, $p < .05$.

Discussion

As hypothesized, the majority of cancer survivors were not meeting the PA guidelines with activity rates of 42% overall and no significant differences among the cancer survivor groups. This rate is slightly higher than what has generally been found for cancer survivors (1, 2, 4, 18-21). Previous research has reported levels of activity sufficient to meet guidelines in breast cancer survivors as low as 16% (1), ranging from 24-70% in prostate (1, 21), and colorectal cancer survivors ranging from 17-33% (1, 2).

We found some small differences in the mean levels of TPB constructs across cancer survivor groups. Breast cancer survivors compared to prostate cancer survivors had slightly more positive affective attitude, instrumental attitude, and descriptive norm although these

differences did not remain after adjusted for standard demographic and medical variables. We are not aware of any minimally important differences for the TPB scales but the differences translate into small (d=0.20) standardized effect sizes. Though small, these differences may have an impact when developing materials to increase PA in the different cancer survivor groups.

Path analysis of the TPB revealed that the model explained 11%, 24% and 24% of the variance in PA for breast, prostate, and colorectal cancer survivors, respectively. These results are similar to previous studies in cancer survivors (2, 4, 33). Intention was found to have a significant unique association with PA among the colorectal cancer survivor group, which is consistent with previous research and the TPB (2, 4). Of note, planning had unique associations with PA among breast and prostate cancer survivors but not colorectal cancer survivors and these differences appear to be meaningful. The invariance analyses also showed the intention to planning relationship was stronger for breast compared to prostate cancer survivors and the planning to PA relationship was stronger for the prostate cancer survivors compared to colorectal cancer survivors. It is unclear why intention was more strongly associated with PA, and planning not at all, in colorectal cancer survivors. A recent study among colorectal cancer survivors in Alberta found that planning was the strongest correlate of PA (2). More research is needed to determine whether this is a consistent result.

The TPB explained 55%, 45% and 60% of the variance in PA intentions for breast, prostate, and colorectal cancer survivors, respectively. Moreover, PBC had significant unique direct associations with intention among all three cancer survivor groups, consistent with the body of literature for breast (4, 33), prostate (4, 33), and colorectal cancer survivors (2). Similarly, instrumental attitude had direct associations with intention in all three cancer

survivor groups. Based on the invariance analyses the affective attitude to intention relationship was significantly stronger for colorectal cancer survivors compared to prostate cancer survivors supporting its importance in this cancer survivor group. Current research concerning attitudes in cancer survivors is mixed. Hunt-Shanks et al (4) found that only instrumental attitude had a significant contribution to intention in breast cancer survivors whereas neither instrumental attitude nor affective attitude were significant among prostate cancer survivors. Blanchard et al (33) found that attitude had a unique contribution to intention in breast and not prostate cancer survivors but this analysis did not use the two component model of the TPB. Among colorectal cancer survivors, Speed-Andrews and colleagues (2) found that both instrumental attitude and affective attitude made significant unique contributions to intention, consistent with the present study. Ensuring that PA is enjoyable and relevant to participants remains an important consideration for PA practitioners.

Eliciting the support of others who engage in PA may be an important step in increasing PA behaviour among cancer survivors. Descriptive norm made unique contributions to PA intention in colorectal cancer survivors and prostate cancer survivors. Among breast cancer survivors, the contribution was made to planning rather than intention. Conversely, injunctive norm did not have any significant contributions to intention. Again, previous research is mixed with regards to subjective norm and intention among cancer survivors. Hunt-Shanks and colleagues (4) found that subjective norm had unique contributions to intention in breast and prostate cancer survivors whereas Blanchard and colleagues (33) found it contributed only to breast cancer survivors. It is worthwhile to note that both of these studies analysed subjective norm as one component as opposed to

injunctive and descriptive norm separately. Speed-Andrews and colleagues (2) found that neither injunctive nor descriptive norm were associated with intentions in their Alberta sample of colorectal cancer survivors.

The secondary analyses of this study found several important differences among the medical and demographic correlates of PA for each cancer survivor group. For example, BMI was found to have a strong negative relationship with PA among breast cancer survivors but no relationship with PA among prostate and colorectal cancer survivors. Previous studies have found similar results for breast (1, 34, 35) and colorectal cancer survivors (2, 34) but not for prostate cancer survivors (34). One potential explanation for the differences among the cancer survivor groups may be the effects of treatments on weight gain. Treatment among breast cancer survivors often induces menopause which is associated with weight gain (36). It may also be that body weight differentially affects PA for men and women. Studies among breast cancer survivors show that weight gain can lead to low self-esteem, poor body image and depression (37, 38). There is little research focusing on BMI and PA in prostate cancer survivors, therefore future studies should continue to examine the role of body weight in affecting PA levels in cancer survivors.

Another interesting finding of this study is that treatment-related variables were strongly related to PA among prostate cancer survivors but not breast and colorectal cancer survivors. Research yields mixed results on the treatments effects on PA in prostate cancer survivors (4, 33, 39-41). There has been little research in this area, however we postulate that, one possible explanation is that prostate cancer treatments may be more physically taxing when compared to treatments among breast and colorectal cancer survivors. For example, common early side effects associated with prostate cancer treatment are

musculoskeletal loss, fatigue, osteoporosis, and incontinence (40, 41) and recent research indicated these side effects may not be temporary in some survivors (42, 43). Another possible explanation is that extensive treatments may be indicative of a poorer prognosis in prostate cancer survivors which may affect health and PA levels. Future research should continue to examine treatment-related correlates of PA in cancer survivors as this could have a major bearing on the types and delivery of PA programs offered to prostate cancer survivors.

Our study is the first to directly compare the correlates of PA among breast, prostate, and colorectal cancer survivors. Among the strengths of this study are the rigorous process of stratified sample selection from a population-based provincial registry, the similar response rate from each cancer survivor group, the sampling from an understudied geographic region within Canada, the adoption of a theoretical framework, the validated PA and TPB items, and the comparison of responders and non-responders on a limited data set of medical and demographic variables. Conversely, the limitations of this study include the inability to infer causation due to the cross-sectional design, the modest response rate, lack of correction for multiple comparisons, the use of self-report measures for PA and medical data, selection bias due to the transparent nature of the study, and not assessing the specific types of activity performed by each cancer survivor group. Future research should continue to compare the correlates of PA across cancer survivor groups to determine if targeted interventions based on cancer site are warranted such has been done for breast (10) and colorectal cancer survivors (44).

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Table 2- 1: Demographic and behavioural characteristics of cancer survivors in Nova Scotia, Canada, October 2011 - February 2012.

Demographic/ Behaviour Variables	Overall (n=741) N (%)	Breast (n=248) N (%)	Prostate (n=253) N (%)	Colorectal (n=240) N (%)	P value
Gender					<.001
Female	336 (45%)	245 (99%)	0 (0%)	91 (38%)	
Male	405 (55%)	3 (1%)	253 (100%)	149 (62%)	
Age [Mean (SD)]	65.6 (8.5)	62.7 (9.2)	67.6 (7.1)	66.6 (8.4)	<.001
≤ 59	176 (24%)	84 (34%)	42 (17%)	50 (21%)	
60-69	303 (41%)	95 (38%)	112 (44%)	96 (40%)	
≥ 70	262 (35%)	69 (28%)	99 (39%)	94 (39%)	
Ethnic origin					.788
White	718 (97%)	240 (97%)	244 (96%)	234 (97%)	
Other	23 (3%)	8 (3%)	9 (4%)	6 (3%)	
Marital status					.013
Married	595 (80%)	185 (75%)	215 (85%)	195 (81%)	
Not married	146 (20%)	63 (25%)	38 (15%)	45 (19%)	
Education					.250
≤High School	361 (49%)	112 (45%)	133 (53%)	116 (48%)	
Postsecondary	380 (51%)	136 (55%)	120 (47%)	124 (52%)	
Family Income[1]					.438
< 60,000	435 (67%)	146 (66%)	140 (65%)	149 (70%)	
≥ 60,000	215 (33%)	76 (34%)	76 (35%)	63 (30%)	
Employment					.078
Employed	219 (30%)	164 (66%)	76 (30%)	59 (25%)	
Not employed	522 (70%)	84 (34%)	177 (70%)	181 (75%)	
Smoking status					.241
Never	263 (35%)	100 (40%)	85 (34%)	78 (33%)	
Ex-smoker	400 (54%)	119 (48%)	143 (56%)	138 (57%)	
Current smoker	78 (11%)	29 (12%)	25 (10%)	24 (10%)	
Alcohol consumption					.233
Never drink	199 (27%)	70 (28%)	58 (23%)	71 (30%)	
Social	473 (64%)	161 (65%)	168 (66%)	144 (60%)	
Regular	69 (9%)	17 (7%)	27 (11%)	25 (10%)	

Note: [1] Overall sample size n=650 (breast n=222, prostate n=216, colorectal n=212).

Table 2- 2: Demographic, behavioural, and medical characteristics of cancer survivors in Nova Scotia, Canada, October 2011 - February 2012.

Medical Variables	Overall (n=741) N (%)	Breast (n=248) N (%)	Prostate (n=253) N (%)	Colorectal (n=240) N (%)	P value
Disease Stage					<.001
I	218 (29%)	147 (59%)	0 (0%)	71 (29%)	
II	369 (50%)	80 (32%)	213 (84%)	76 (32%)	
III/IV	154 (21%)	21 (9%)	40 (16%)	93 (39%)	
Surgery					<.001
Yes	666 (90%)	244 (98%)	186 (74%)	236 (98%)	
No	75 (10%)	4 (2%)	67 (26%)	4 (2%)	
Radiation therapy					<.001
Yes	289 (39%)	161 (65%)	75 (30%)	53 (22%)	
No	452 (61%)	87 (35%)	178 (70%)	187 (78%)	
Chemotherapy					<.001
Yes	261 (35%)	116 (47%)	12 (5%)	133 (55%)	
No	480 (65%)	132 (53%)	241 (95%)	107 (45%)	
Hormone Therapy					<.001
Yes	173 (23%)	126 (51%)	43 (17%)	4 (2%)	
No	568 (77%)	122 (49%)	210 (83%)	236 (98%)	
Current treatment status					<.001
No treatment	672 (91)	188 (76)	244 (96)	240 (100)	
Receiving treatment	69 (9)	60 (24)	9 (4)	0 (0)	
Recurrence					.332
Yes	23 (3)	11 (4)	6 (2)	6 (3)	
No	718 (97)	237 (96)	247 (98)	234 (97)	
Current disease status					<.001
Disease free	706 (95%)	245 (99%)	228 (90%)	233 (97%)	
Existing disease	35 (5%)	3 (1%)	25 (10%)	7 (3%)	
Time since diagnosis [Mean (SD)]	4.3 (1.5)	4.3 (1.5)	4.5 (1.5)	4.2 (1.5)	.175
< 5 years	474 (64%)	162 (65%)	155 (61%)	157 (65%)	
≥ 5 years	267 (36%)	86 (35%)	98 (39%)	83 (35%)	
General Health					.954
Poor/Fair	116 (16%)	36 (15%)	42 (17%)	38 (16%)	
Good	312 (42%)	103 (41%)	106 (42%)	103 (43%)	
Very good/Excellent	313 (42%)	109 (44%)	105 (41%)	99 (41%)	
Co-morbidity status					.919
No co-morbidities	116 (16%)	43 (17%)	40 (16%)	33 (14%)	
1 co-morbidity	117 (24%)	55 (22%)	66 (26%)	56 (23%)	
2 co-morbidities	173 (23%)	60 (24%)	53 (21%)	60 (25%)	
3 co-morbidities	128 (17%)	44 (18%)	43 (17%)	41 (17%)	
≥ 4 co-morbidities	147 (20%)	46 (19%)	51 (20%)	50 (21%)	
Body mass index [Mean (SD)]	27.8 (4.6)	28.0 (5.2)	27.5 (4.2)	28.0 (4.4)	.400
Normal weight	198 (27%)	78 (31%)	64 (25%)	56 (23%)	
Overweight	351 (47%)	94 (38%)	137 (54%)	120 (50%)	
Obese	192 (26%)	76 (31%)	52 (21%)	64 (27%)	

Table 2- 3: Associations between demographic and behavioural variables and meeting physical activity guidelines overall and by cancer site in Nova Scotia cancer survivors, Canada, October 2011 to February 2012.

	Overall (n=741) N (%)		**Breast (n=248) N (%)**		**Prostate (n=253) N (%)**		**Colorectal (n=240) N (%)**	
Demographic/ Behaviour Variables	% Meeting guidelines	P value	% Meeting guidelines	P value	% Meeting guidelines	P value	% Meeting guidelines	P value
Gender		.466		-		-		.328
Female	43%		-		-		35%	
Male	42%		-		-		39%	
Age		<.001		.002		.005		.069
≤ 59	52%		60%		45%		46%	
60-69	47%		43%		54%		42%	
≥ 70	34%		32%		31%		29%	
Ethnic origin		.365		.463		.341		.403
White	42%		46%		43%		37%	
Other	48%		38%		56%		50%	
Marital status		.277		.363		.501		.210
Married	43%		46%		43%		39%	
Not married	40%		43%		45%		31%	
Education		<.001		.002		.088		.008
≤High School	35%		35%		39%		29%	
Postsecondary	49%		54%		48%		45%	
Family Income[1]		.001		.008		.125		.097
< 60,000	40%		41%		42%		37%	
≥ 60,000	53%		59%		51%		48%	
Employment		.436		.370		.164		.549
Employed	42%		45%		38%		37%	
Not employed	43%		48%		46%		38%	
Smoking status		.039		.440		.268		.026
Never	48%		50%		51%		38%	
Ex-smoker	42%		44%		40%		41%	
Current smoker	44%		38%		40%		13%	
Alcohol consumption		.002		.009		.041		.256
Never drink	34%		33%		29%		38%	
Social	44%		48%		47%		35%	
Regular	57%		71%		52%		52%	

Note: [1] Overall sample size n=650 (breast n=222, prostate n=216, colorectal n=212).

Table 2- 4: Associations between medical variables and meeting physical activity guidelines overall and by cancer site in Nova Scotia cancer survivors, Canada, October 2011 to February 2012.

	Overall (n=741)		**Breast (n=248)**		**Prostate (n=253)**		**Colorectal (n=240)**	
Medical Variables	% Meeting guidelines	P value	% Meeting guidelines	P value	% Meeting guidelines	P value	% Meeting guidelines	P value
Disease Stage		.423		.735		.157		.981
I	44%		48%		0%		37%	
II	43%		43%		45%		38%	
III/IV	38%		43%		35%		38%	
Surgery		.011		.619		.003		.518
Yes	44%		45%		49%		38%	
No	29%		50%		28%		25%	
Radiation therapy		.243		.381		.044		.139
Yes	40%		47%		35%		30%	
No	43%		44%		47%		40%	
Chemotherapy		.147		.536		.048		.356
Yes	39%		46%		17%		36%	
No	44%		45%		45%		39%	
Hormone Therapy		.218		.149		.038		.150
Yes	45%		49%		30%		75%	
No	41%		42%		46%		37%	
Current treatment status		.538		.480		.044		-
No treatment	42%		45%		45%		100%	
Receiving treatment	42%		47%		11%		0%	
Recurrence		.032		.175		-		.597
Yes	22%		27%		0%		33%	
No	43%		46%		100%		38%	
Current disease status		.213		.567		.074		.240
Disease free	43%		46%		45%		37%	
Existing disease	34%		33%		28%		57%	
Time since diagnosis		.395		.162		.408		.110
< 5 years	42%		48%		43%		34%	
≥ 5 years	43%		41%		45%		43%	
General Health		<.001		<.001		.014		.011
Poor/Fair	27%		25%		29%		26%	
Good	37%		39%		40%		31%	
Very good/Excellent	54%		59%		53%		48%	
Co-morbidity status		.094		.015		.178		.919
No co-morbidities	47%		63%		38%		36%	
1 co-morbidity	49%		55%		53%		39%	
2 co-morbidities	40%		37%		45%		40%	
3 co-morbidities	39%		32%		47%		39%	
≥ 4 co-morbidities	35%		43%		31%		32%	
Body mass index		.001		<.001		.501		.639
Normal weight	53%		64%		47%		43%	
Overweight	41%		43%		45%		36%	
Obese	34%		30%		37%		36%	

Table 2- 5: Descriptive statistics for the theory of planned behaviour and physical activity by cancer site in a sample of cancer survivors in Nova Scotia, Canada, October 2011 to February 2012.

	Overall (n=741)	Breast (n=248)	Prostate (n=253)	Colorectal (n=240)	ANOVA p value	Post Hocs (p<0.05)
Affective attitude						
Unadjusted [M (SD)]	5.0 (1.2)	5.2 (1.2)	4.9 (1.2)	5.0 (1.2)	.042	BC > PC
Adjusted [M(SE)]	5.0 (.05)	5.1 (.14)	4.9 (.12)	5.1 (.09)	.482	
Instrumental attitude						
Unadjusted [M(SD)]	5.8 (1.2)	6.0 (1.2)	5.7 (1.3)	5.8 (1.1)	.006	BC > PC
Adjusted [M(SE)]	5.8 (.04)	5.9 (.13)	5.8 (.11)	5.9 (.08)	.823	
Injunctive norm						
Unadjusted [M(SD)]	6.0 (0.9)	6.0 (0.9)	5.9 (1.0)	6.0 (0.8)	.485	
Adjusted [M(SE)]	6.0 (.03)	5.9 (.10)	5.9 (.09)	6.1 (.07)	.227	
Descriptive norm						
Unadjusted [M(SD)]	5.1 (1.3)	5.3 (1.2)	5.0 (1.4)	5.2 (1.2)	.007	BC > PC
Adjusted [M(SE)]	5.1 (.05)	5.1 (.14)	5.1 (.13)	5.2 (.09)	.650	
PBC						
Unadjusted [M(SD)]	5.3 (1.4)	5.2 (1.4)	5.3 (1.4)	5.4 (1.4)	.522	
Adjusted [M(SE)]	5.3 (.05)	5.2 (.15)	5.2 (.14)	5.4 (.10)	.298	
Planning						
Unadjusted [M(SD)]	3.7 (2.2)	4.0 (2.2)	3.6 (2.2)	3.6 (2.2)	.102	
Adjusted [M(SE)]	3.7 (.08)	4.1 (.24)	3.5 (.22)	3.6 (.16)	.220	
Intention						
Unadjusted [M(SD)]	4.4 (2.0)	4.5 (1.9)	4.3 (2.0)	4.3 (2.0)	.407	
Adjusted [M(SE)]	4.4 (.07)	4.5 (.21)	4.3 (.20)	4.4 (.14)	.868	
Moderate PA minutes						
Unadjusted [M(SD)]	124 (219)	117 (194)	147 (266)	107 (185)	.108	
Adjusted [M(SE)]	124 (8.0)	162 (24.1)	106 (21.8)	102 (16.0)	.164	
Vigorous PA minutes						
Unadjusted [M(SD)]	34 (91)	34 (83)	41 (103)	30 (83)	.395	
Adjusted [M(SE)]	35 (3.3)	31 (9.9)	43 (9.0)	30 (6.6)	.470	
Total PA minutes						
Unadjusted [M(SD)]	194 (290)	185 (268)	228 (335)	166 (257)	.052	PC > CRC
Adjusted [M(SE)]	193 (10.5)	224 (31.6)	192 (28.7)	162 (21.0)	.468	
Meeting PA guidelines						
Unadjusted	42%	46%	43%	38%	.174	
Adjusted	42%	45%	43%	38%	.468	

Note: ANOVA = Analysis of Variance. BC = breast cancer; PC = prostate cancer; CRC = colorectal cancer; PBC = Perceived behavioural control; PA = Physical activity. Adjusted means (SE) were adjusted for age, sex, marital status, disease stage, treatment types (surgery, chemotherapy, radiation, hormone therapy), treatment status, and disease status.

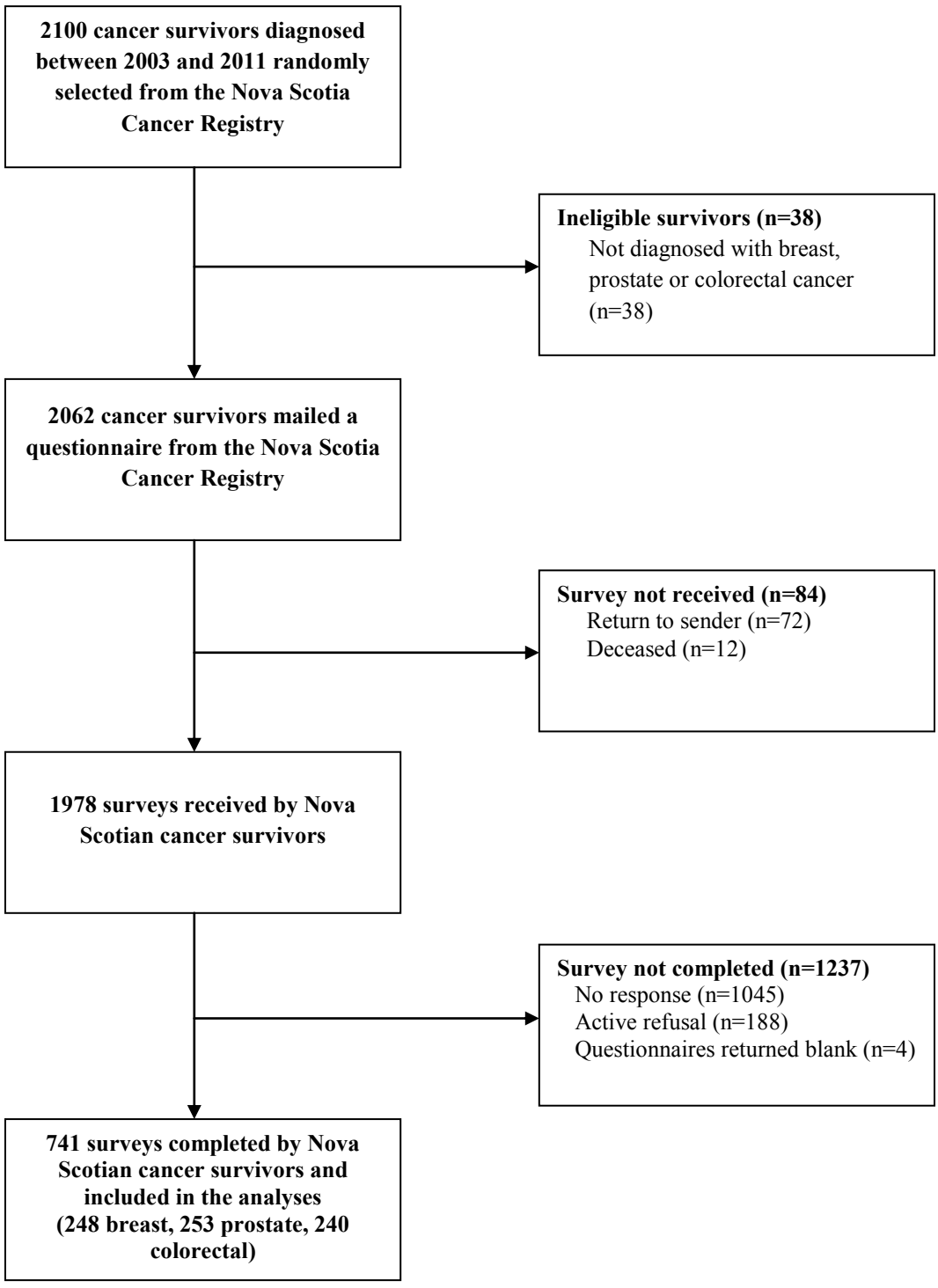

Figure 2- 1: **Flow of participants through a survey study of the correlates of physical activity in Nova Scotian Cancer survivors, 2011.**

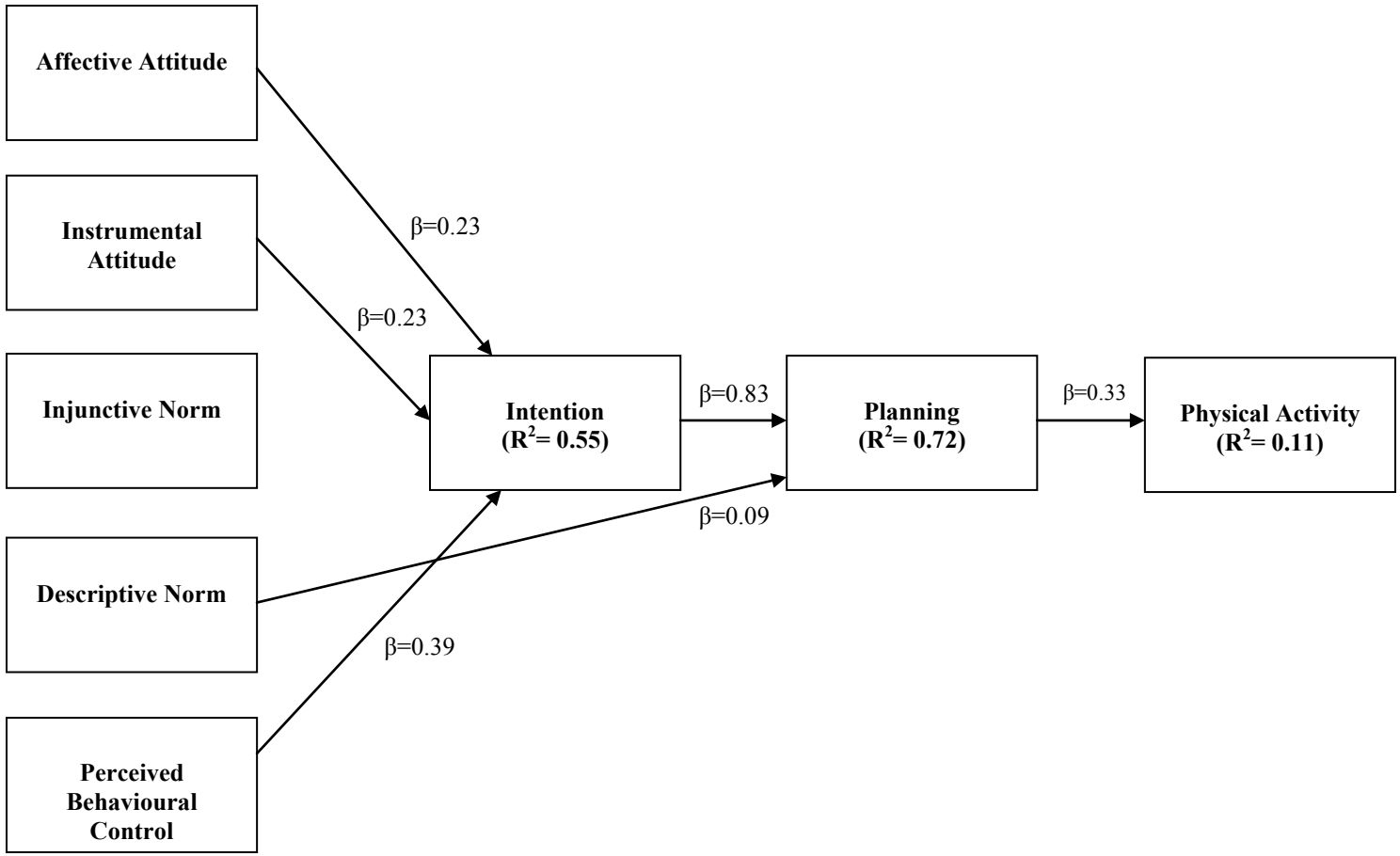

Figure 2-2 a: **Path analysis of the theory of planned behaviour and physical activity in 248 breast cancer survivors in Nova Scotia, Canada, October 2011 to February 2012**

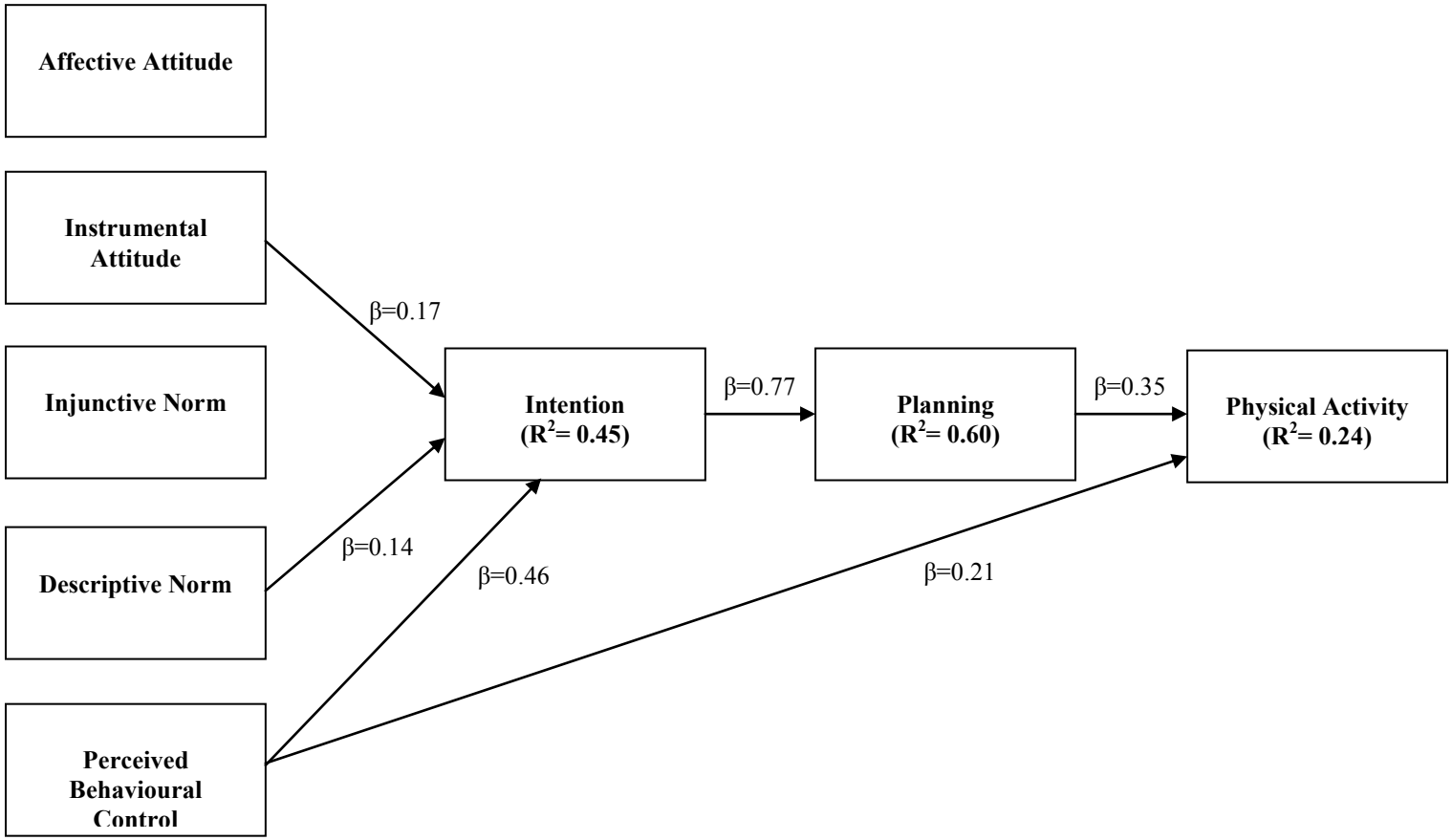

Figure 2-2 b: **Path analysis of the theory of planned behaviour and physical activity in 253 prostate cancer survivors in Nova Scotia, Canada, October 2011 to February 2012**

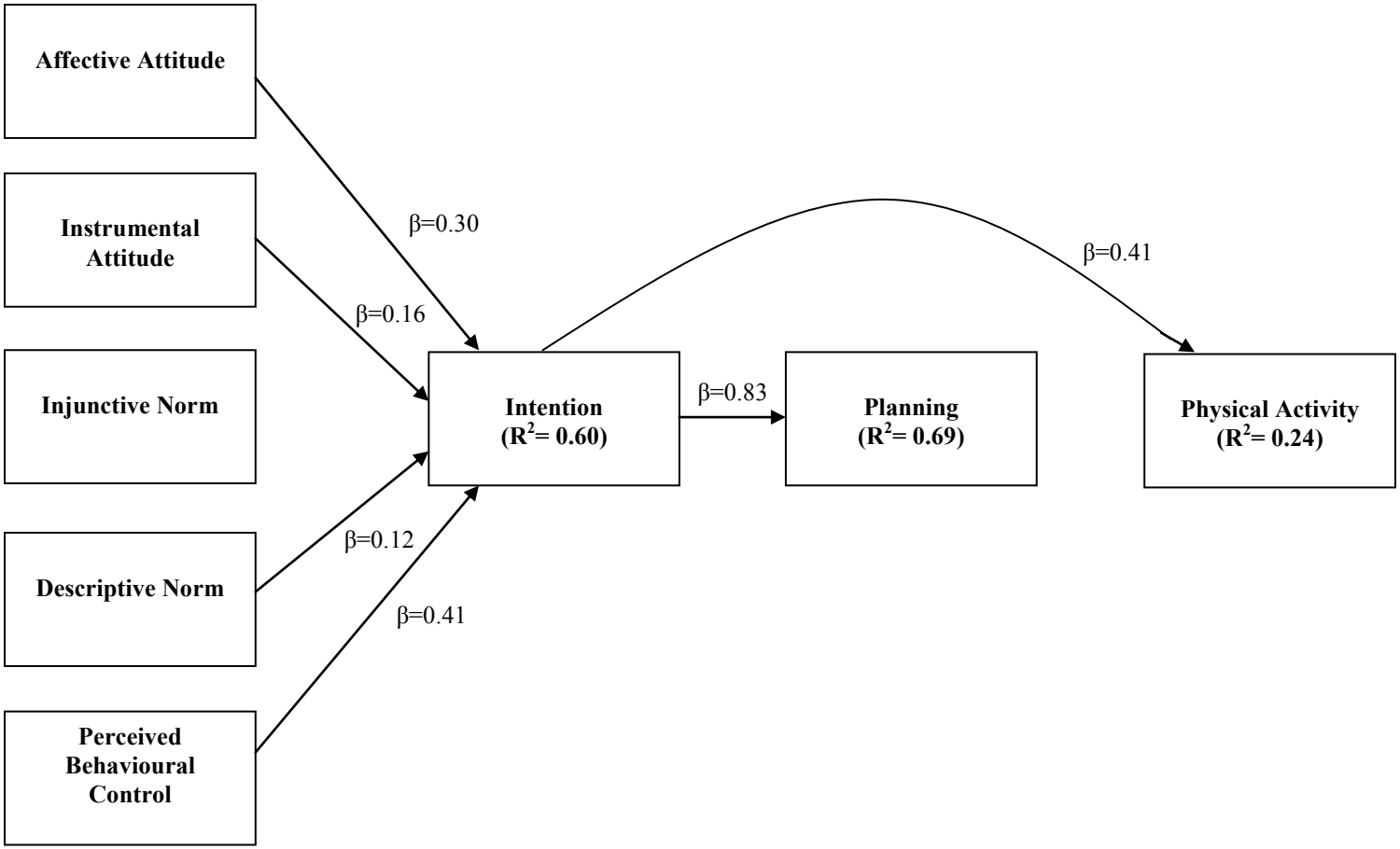

Figure 2-2 c: Path analysis of the theory of planned behaviour and physical activity in 240 colorectal cancer survivors in Nova Scotia, Canada, October 2011 to February 2012

Chapter 3 – STUDY I: Paper 2

Physical activity preferences of breast, prostate, and colorectal cancer survivors in Nova Scotia

Forbes CC, Blanchard CM, Mummery WK & Courneya KS. (in press). A comparison of physical activity preferences among breast, prostate, and colorectal cancer survivors in Nova Scotia, Canada. *Journal of Physical Activity and Health.*

Introduction

Physical activity (PA) improves quality of life (QoL) in cancer survivors and may even lower the risk of recurrence and premature death (1). Even small bouts of PA can improve outcomes such as aerobic fitness, muscular strength, fatigue, depression and daily functioning (2). Despite these potential benefits, much of the research suggests that the majority of cancer survivors do not get the required amount of activity (3-7).

Behavioural research using social cognitive models such as the Theory of Planned Behaviour (TPB) suggests that the underlying beliefs and motivations of PA will influence behaviour (8). Developing interventions based on cancer survivors PA preferences may optimize the motivational foundation of PA behaviour by allowing them to select activities they perceive to be most beneficial, enjoyable, and controllable. PA interventions should, therefore, target the specific interests, beliefs, and preferences of a particular group. Previous research in PA preferences among cancer survivors suggests there may be differences across different cancer survivor groups but no study has directly compared preferences (3-7). Moreover, no studies to date have assessed the PA preferences of prostate cancer survivors or cancer survivors living in Nova Scotia, Canada.

The Atlantic Provinces (Nova Scotia, New Brunswick, Newfoundland and Labrador and Prince Edward Island) have some of the highest cancer rates in Canada. Nova Scotia, along with the other Atlantic provinces, may have unique PA preferences when compared to other regions of Canada because of the higher rate of rural residents (9). The Atlantic provinces also have lower socioeconomic status, which in turn means less access to fitness facilities and services (10). A study among rural breast cancer survivors in Alberta showed

the majority of participants indicated that travel was their main barrier to engaging in PA (11).

The primary purpose of this study was to compare the PA preferences of breast, prostate and colorectal cancer survivors in Nova Scotia, Canada. A secondary purpose was to examine the associations of demographic and medical characteristics with PA preferences within each cancer survivor group. Based on the most recent preference research among cancer survivors, we hypothesized that the majority of cancer survivors in Nova Scotia would prefer to engage in moderate intensity PA, at home, begin sometime after treatment and would prefer walking as the primary type of activity (3-7). Comparisons among the cancer survivor groups were considered exploratory.

Materials and Methods

Study Procedures and Population

The design and methods of this survey have been described in detail elsewhere (12). Briefly, the study included a mailed, self-administered survey using a population-based, cross-sectional design. A stratified sample of 700 from each breast, prostate, and colorectal cancer survivors (2100 total) was compiled by Nova Scotia Cancer Registry (NSCR) in September 2011. Participants were eligible for the study if they were: a) aged between 18 and 80 years, b) current residents of Nova Scotia, and c) had a diagnosis of breast, prostate or colorectal cancer between 2003 and 2011. The Halifax District Health Authority and the University of Alberta provided ethical approval. The mailed survey package contained: a) an invitation letter from the registry explaining its role in the study and how their name was chosen, b) an invitation letter from the researchers explaining the purpose of the study, c) a questionnaire, and d) a postage-paid return envelope. If they were willing to participate,

individuals completed the questionnaire and mailed it in the included return envelope. Participants were mailed the initial package and a postcard reminder approximately three weeks later to those who had not responded in that time period.

Measures

Demographic and medical information

Self-report data including age, sex, education level, marital status, income, employment status, ethnicity and height and weight in order to calculate body mass index (BMI) was collected to measure demographic variables. Medical variables were assessed using self-report data as well and included type of cancer, time since diagnosis, lymph node involvement, treatment type, current treatment status, previous recurrences, and current disease status. Current behaviours (e.g., smoking and drinking status) were measured by individual items. We also examined co-morbidities by asking participants to select from a list which conditions they were told they had (e.g., high cholesterol, diabetes, high blood pressure).

Physical activity

The PA measures have been previously described (12). Briefly, we used the modified version of the Leisure Score Index (LSI) from Godin's Leisure Time Exercise Questionnaire (LTEQ) (13). Participants were asked to record the average weekly frequency and duration of the activity they performed a minimum of 10 minutes in the last month. The guidelines recommend that a cancer survivor should obtain 150 minutes per week of moderate intensity, 75 minutes per week of vigorous activity, or an equivalent combination (14-16). For this study, we categorized PA as meeting guidelines (150 PA minutes or greater) or not meeting guidelines (149 PA minutes or less).

PA preferences

PA preferences were measured using previously tested items in cancer studies (4, 5, 17-19). PA counselling preferences were measured using three close ended items, the first asking if the participant would be interested in receiving information about a PA program at some point after diagnosis. Participants were then asked to continue with the following questions which asked from whom and the method they would prefer to receive the PA program information.

PA program preferences were assessed using a mixture of open and close ended items. Firstly, participants were asked to indicate whether they were interested and able to participate in a PA program designed to increase PA levels in cancer survivors. Subsequent questions were to determine the preferred time to start a PA program, preferred company, location, time of day, intensity, structure, and PA type. Two additional questions asked participants about home equipment and current fitness centre memberships. The final two items were open-ended questions soliciting the top three preferred activities to engage in during the summer and winter. Participants were able to choose more than one option for the preferred information source and method as well as preferred company and preferred location. Participants were encouraged to choose only one option for all other preference questions.

Statistical analyses

All statistical analyses were done using PASW Statistics 20.0 (PASW Inc, Chicago IL, USA). PA program and counselling preference items were analysed using frequencies and percentages. Chi-square analyses were used to determine the associations between cancer site (breast, prostate, and colorectal) and PA preferences. Chi-square analyses were also used

to examine the associations between demographic and medical variables with PA preferences within each cancer site. All demographic and medical variables were grouped based on relevant cut points or balanced statistical splits to ensure each cell had adequate numbers for analysis. The demographic variables include age (≤59, 60-69, ≥70), sex, marital status, annual income, BMI (healthy weight 18.5-24.9; overweight 25-29.9; obese ≥ 30), and general health status (poor/fair; good; very/excellent). Medical variables included disease stage (localized; metastasized), time since diagnosis (<5 years; ≥5 years), treatments received (surgery, radiation, chemotherapy, hormone therapy), current cancer status (disease-free or existing disease), recurrence status (yes or no), and current treatment status (not receiving treatment; receiving treatment). These demographic and medical variables were chosen based on specific subgroups that may be important when determining a PA program for cancer survivors. Preference variables were grouped based on relevant cut points including combining the "yes" and "maybe/unsure" for the following questions: 1) would the participant be interested in receiving information about a PA program, 2) would the participant be interested in participating in a PA program designed to increase PA levels in cancer survivors, and 3) would the participants be able to participate in a PA program designed to increase PA levels in cancer survivors. Additional variable groupings were performed for preferred time to start a PA program (before treatment versus after treatment) and preferred intensity (light versus moderate/vigorous). Due to the large number of analyses, we chose a p value of $<.01$ for statistical significance and a between group absolute difference of 10% as clinically meaningful.

Results

Flow of participants through the study has been reported elsewhere (12). Briefly, the registry randomly generated a stratified sample of 2100 cancer survivors (700 from each cancer site) of which 2062 were mailed an invitation package. The survey resulted in a 36% completion rate (741/2062) and a 38% response rate (741/1978) excluding the return to senders and deceased persons. The response rate did not differ by cancer site (p=.94). Note that response rates differed slightly among preference items because some items were left blank by some respondents.

Demographic, medical and behavioural characteristics of the sample have been described elsewhere (12). In brief, the majority of the study population were male (55%), and had a mean age of 65.6 years. The sample was evenly distributed between breast (33.5%), prostate (34.1%) and colorectal (32.4%) cancers. Overall, 313 (42.2%) were meeting PA guidelines.

Physical activity preferences overall

Descriptive statistics for the overall sample and by cancer site are presented in Table 3-1. Briefly, about 77% of the overall sample would have liked or maybe liked to receive PA information at some point after diagnosis. The majority of participants indicated they would prefer to receive PA information from a fitness expert associated with a cancer centre (51%) or from Cancer Care Nova Scotia (CCNS) or the Canadian Cancer Society (CCS) (44%) via print materials (61%), face to face (34%), or email (33%). The majority of participants indicated they would or might be able (78%) and interested (68%) in a PA program for cancer survivors that would increase their PA level. The most common preferences were to start a PA program three to six months after treatment (34%), to engage in PA with friends

(53%) or their spouse (50%), outside around their neighbourhood (67%), and in the morning (55%). Overall, the sample preferred PA to be moderate intensity (65%), different each session (64%), unsupervised (53%), scheduled (60%), and individual activities (61%). The top two preferred summer activities listed were walking and swimming among all three groups. The two most preferred winter activities were walking and outdoor winter activities (e.g., skiing, snowshoeing etc.) among all three groups.

Differences in physical activity preferences by cancer site

Numerous differences emerged among the cancer sites (Table 3-1). Some of the larger differences (>20% difference) among breast, prostate, and colorectal cancer survivors, respectively, were identified for engaging in PA with other cancer survivors (42% vs. 22% vs. 30%; $p<.001$) and with their friends (65% vs. 40% vs. 64%; $p<.001$); engaging in PA at a community fitness centre (59% vs. 39% vs. 45%; $p<.001$); and preferring supervised (60% vs. 34% vs. 45%; $p<.001$) and group (53% vs. 24% vs. 41%; $p<.001$) sessions. The third most preferred activity was biking for breast and colorectal cancer survivors and golf for prostate cancer survivors. The third most preferred winter activity was indoor aerobic activities (e.g., going to a gym, treadmill etc.) for breast and prostate cancer survivors and swimming for colorectal cancer survivors.

Associations between demographic, medical and PA preferences within each cancer site

Significant associations ($p<.01$) between demographic, medical, and PA preferences within each cancer survivor group are summarized in Tables 3-2 (breast), 3-3 (prostate) and 3-4 (colorectal). Associations common to all three cancer survivor groups were: 1) those meeting PA guidelines were more likely to prefer moderate or vigorous intensity activity and were more likely to have a fitness centre membership; 2) those age ≥70 were less likely to

prefer to receive information via email or through the internet and less likely to prefer engaging in PA in the evening; and 3) those who indicated their health was poor or fair were less likely to prefer moderate or vigorous intensity activity. In general, age and employment status were most commonly associated with PA preferences within the cancer sites.

Among breast cancer survivors, there were 43 associations found at the $p<.01$ level. The majority of associations were with meeting PA guidelines, age, education level and employment status. The strongest associations (>30% difference) were that those meeting PA guidelines were more likely to prefer moderate or vigorous intensity activity (36% difference; $p<.001$). Moreover, those ≥70 years of age compared to ≤59 were less likely to be interested in doing a PA program for breast cancer survivors (31% difference; <.001), less likely to prefer to receive info via email (34% difference; $p<.001$), less likely to prefer to engage in PA in the evening (35% difference; $p<.001$), less likely to prefer moderate or vigorous intensity activity (35% difference; $p<.001$), and less likely to prefer different activities each session (31% difference; $p<.001$). Finally, those with poor or fair health compared to very good or excellent health were less likely to prefer engaging in PA outside around their neighbourhood (37% difference; $p=.001$) and less likely to prefer moderate or vigorous intensity activity (31% difference; $p<.001$).

Among prostate cancer survivors, there were 14 significant associations at the $p<.01$ level with meeting PA guidelines and age accounting for half of the associations. The strongest associations were that those meeting PA guidelines were more likely to prefer moderate or vigorous intensity activity (31% difference; $p<.001$); and those in poor or fair health were less likely than those in very good or excellent health to prefer moderate or vigorous intensity activity (36% difference; $p<.001$).

Among colorectal cancer survivors, there were 23 significant associations at the p<.01 level. Meeting PA guidelines, age, sex, and employment status accounted for the majority of the associations. Those who were ≥60 years of age compared to those <60 years of age were less likely to prefer to receive PA information from a fitness expert associated with a community fitness centre (36% difference; p<.001), those ≥70 years of age were less likely than those age ≤59 to prefer to receive PA information from a cancer fitness centre (37% difference, p<.001), those ≥60 years of age were less likely than those age ≤59 to prefer to receive info via email (32% difference; p<.001), those who were ≥60 years of age were less likely than those age ≤59 to prefer to engage in PA in the evening (39% difference; p<.001), those ≥70 years of age were less likely than those age ≤59 to prefer moderate or vigorous intensity activity (38% difference; p<.001); and those who indicated their health was poor/fair were less likely than those indicating good (43% difference) or very good/excellent health (53% difference; p<.001) to prefer moderate or vigorous intensity activity.

Discussion

This study is the first to compare PA preferences among breast, prostate and colorectal cancer survivors in Nova Scotia, Canada. Overall, the majority of breast, prostate and colorectal cancer survivors were interested or maybe interested in receiving PA information at some point after their diagnosis; preferred PA information via print materials; and preferred to receive that information from a fitness expert associated with a cancer centre. The majority of breast, prostate and colorectal survivors also indicated they would be interested and able to do a PA program for cancer survivors, starting three to six months after treatment, outside around their neighbourhood, in the morning, scheduled, at moderate

intensity, and doing different types of PA each session. Among the three survivor groups, walking and swimming were the most preferred summer activities whereas walking and outdoor winter activities (skating, skiing, snowshoeing etc.) were the most preferred winter activities.

Our study also indicates that breast, prostate, and colorectal cancer survivors have a number of important differences in PA preferences that may inform targeted PA interventions for these groups. One key finding was that prostate cancer survivors were less likely to prefer PA with other cancer survivors, with their friends, engaging in PA at a community fitness centre, and having supervised and group sessions. Previous research among cancer survivors has shown that younger and female cancer survivors are more likely to prefer PA with others (3). Prostate cancer survivors are older men; therefore, these results are not unexpected. We found no previous research examining PA counselling and program preferences among prostate cancer survivors, therefore, more research needs to be conducted to test the consistency of these findings.

Breast cancer survivors are more likely to prefer receiving PA information from a fitness expert associated with either the community or a cancer centre than prostate and colorectal cancer survivors. This finding among breast cancer survivors is consistent with preference research in this group (11, 20, 21). There is only one study that focused on PA preferences of colorectal cancer survivors which found approximately 47% of participants preferred to receive information from a fitness expert at a cancer centre. This is similar to the numbers found among our colorectal (48%) and prostate (42%) cancer survivors (3). More research is needed to investigate PA preferences among these understudied survivors groups to determine whether these findings are consistent.

Approximately 60% of breast cancer survivors preferred supervised or instructed activities compared to 45% of colorectal and 34% prostate cancer survivors. A similar trend was found for preferring group activities with 53% of breast cancer survivors preferring group sessions compared to 41% of colorectal and 24% of prostate cancer survivors. Again, studies on PA preferences among colorectal and prostate cancer survivors are few; therefore, there is very little data for comparison. The average age was significantly different among the survivor groups with breast, prostate and colorectal survivors having average ages of 63, 68 and 67 years of age respectively. As noted above, older participants tend to prefer solitary, home-based PA. Another potential explanation may be the sex differences among the groups. Our evidence showed that females were more likely to prefer supervised exercise and group sessions than males. This is consistent with other research investigating sex differences in PA preferences among cancer survivors (3, 4, 22).

Walking was the most preferred summer and winter activity among all three survivor groups. This is consistent with previous research among cancer survivors (3-7, 17). Swimming and outdoor winter activity activities were the second most popular activities in all three groups for summer and winter respectively. The third most popular activities differed among the cancer survivor groups. The third most preferred summer activity being biking for breast and colorectal cancer and golf for prostate cancer; and the third most popular winter activity being indoor aerobic activities (e.g., going to a gym, treadmill etc.) among breast and prostate cancer survivors and swimming for colorectal cancer survivors. These differences illustrate that there may be a need for targeted programs that cater to the unique preferences of various cancer survivor groups.

Further analyses within the cancer groups also identified significant associations among many other demographic and medical characteristics. The demographic and medical characteristics most consistently associated with PA preferences among all three cancer survivor groups were age, current PA levels and perceived general health. Older cancer survivors were less likely to be interested in receiving PA information delivered via email or the internet. These results are consistent with research that indicates that older adults are less likely to have access to technology and are less likely to use technology regularly and as proficiently as younger people (5, 23, 24). This provides some evidence that using internet-delivered methods to increase PA levels may be more feasible among specific demographic groups. More research on how to make technology more usable and easy to understand may be helpful in increasing the interest and use among older adults.

Participants meeting the PA guidelines were more likely to prefer moderate or vigorous activity and more likely to have a current fitness centre membership. This is consistent with research among cancer survivors (4, 17, 18, 21). Inactive individuals may have more barriers to engaging in PA due to physical limitations or associated health problems (3, 17, 25). This may indicate why these participants would prefer light intensity activity and is consistent with the standard exercise principle of progression.

Among all three cancer survivor groups, participants indicating their perceived general health was fair or poor were less likely to prefer engaging in moderate or vigorous activity. This finding is consistent with the literature among comorbidities and quality of life (4). Those with lower perceived general health are more likely to have comorbidities that act as barriers to engaging in PA. Targeted programs to address increasing PA among those with poor health and multiple comorbidities may be needed.

Breast cancer survivors had approximately two to three times as many associations with ≥10% differences (43 total) among the medical and demographic characteristics than prostate (14 total) and colorectal (24 total) cancer survivors suggesting that targeting PA interventions to breast cancer survivors may be more difficult because of population heterogeneity, or that additional targeting based on important characteristics may be needed for breast cancer survivors. Some interesting common associations among breast cancer survivors were those who were meeting PA guidelines, age ≤69 years, were employed, had a normal BMI and perceived themselves to be of very good or excellent health were more likely to prefer moderate or vigorous intensity activity. Another common association was that those age ≤59 years, with at least some post-secondary education, ≥60,000 annual income and employed were more likely to prefer to receive PA information via the internet or email.

Conversely, targeting PA interventions for prostate cancer survivors may be more feasible because there were few other associations with medical or demographic variables. Among colorectal cancer survivors, those who were meeting PA guidelines, age ≤69 years, employed and had a perceived general health score of 'good' or better were more likely to prefer moderate or vigorous intensity activity. As there are both males and females in the colorectal cancer survivor group, some significant sex differences emerged. We found that men were less likely than women to prefer engaging in PA with friends, more likely to prefer unsupervised or self-paced activities, and more likely to prefer individual activities. This finding is consistent with the differences between the breast and prostate cancer survivor groups suggesting that these differences in preferred company may be more related to sex than cancer site.

To our knowledge, this is the first study to directly compare the PA preferences among breast, prostate and colorectal cancer survivors. We believe it is also the first to examine PA preferences among prostate cancer survivors and in Nova Scotian cancer survivors; and the second study among colorectal cancer survivors. The strengths of this study include the rigorous selection of a stratified sample of cancer survivors from a population-based provincial registry, the comparable response rate from each cancer survivor group, and use of previously tested PA preference measures. Limitations include the use of self-report data for the PA and medical data, the transparent nature of the study which may have led to an inherent selection bias, and the moderate response rate overall.

In conclusion, the majority of breast, prostate and colorectal cancer survivors living in Nova Scotia indicated they would be interested or maybe interested in receiving PA information at some point after their diagnosis. Overall, they preferred moderate intensity activity that could be done outside around their neighbourhood with their friends or spouse. There were important differences in PA preferences among the cancer survivor groups that may justify targeting PA interventions based on cancer site as has been done for breast and colon cancer survivors (26, 27). Nevertheless, other important medical and demographic variables may also be useful for targeting PA intervention to cancer survivors. Future studies should determine whether cancer site is the optimal variable for targeting PA interventions in cancer survivors.

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Table 3- 1: Descriptive statistics for physical activity preferences overall and by cancer site, Nova Scotia, Canada, October 2011 to February 2012.

Preference variable	Overall N (%)	Breast N (%)	Prostate N (%)	Colorectal N (%)	Chi-Square P value
Like to receive information about PA at some point after diagnosis? (n=713)					
Yes	352 (50%)	138 (58%)	102 (42%)	112 (48%)	.001
No	166 (23%)	41 (17%)	59 (24%)	66(29%)	
Maybe/Unsure	195 (27%)	60 (25%)	82 (34%)	53 (23%)	
Who to receive PA information from? (n=699)[a]					
Oncologist	185 (27%)	61 (26%)	59 (25%)	65 (29%)	.561
Fitness expert from cancer centre	355 (51%)	148 (62%)	99 (42%)	108 (48%)	<.001
Cancer support group	186 (27%)	70 (30%)	52 (22%)	64 (29%)	.120
Community fitness expert	273 (39%)	114 (48%)	76 (32%)	83 (37%)	.001
Nurse	87 (12%)	35 (15%)	25 (11%)	27 (12%)	.363
CCNS/CCS	306 (44%)	107 (45%)	100 (42%)	99 (44%)	.780
How to receive information about PA? (n=699)[a]					
Brochures/print material	425 (61%)	157 (66%)	133 (56%)	135 (60%)	.068
Self-help video	151 (22%)	60 (25%)	38 (16%)	53 (24%)	.031
On the internet	163 (23%)	54 (23%)	57 (24%)	52 (23%)	.955
Telephone	84 (12%)	38 (16%)	11 (5%)	35 (16%)	<.001
Face to face	235 (34%)	79 (33%)	75 (32%)	81 (36%)	.568
Email	233 (33%)	91 (38%)	78 (33%)	64 (29%)	.080
Able to do a PA program for cancer survivors? (n=695)					
Yes	330 (47%)	121 (50%)	108 (47%)	101 (45%)	.789
No	151 (22%)	47 (20%)	52 (22%)	52 (23%)	
Maybe	214 (31%)	71 (30%)	72 (31%)	71 (32%)	

Interested in doing a PA program for cancer survivors? (n=696)					
Yes	225 (32%)	88 (37%)	69 (29%)	68 (30%)	.416
No	222 (32%)	68 (28%)	81 (35%)	73 (33%)	
Maybe	249 (36%)	83 (35%)	84 (36%)	82 (37%)	
When to start a PA program? (n=634)					
At the time of diagnosis	123 (19%)	45 (20%)	48 (23%)	30 (15%)	.062
During treatment	47 (7%)	20 (9%)	9 (4%)	18 (9%)	
Right after treatment	151 (24%)	55 (25%)	50 (24%)	46 (23%)	
3-6 months after treatment	214 (34%)	82 (36%)	66 (31%)	66 (34%)	
At least 1 year after treatment	99 (16%)	23 (10%)	38 (18%)	38 (19%)	
Who to do PA with? (n=700)[a]					
Alone	315 (45%)	104 (44%)	117 (49%)	94 (42%)	.264
Other cancer survivors	219 (31%)	99 (42%)	52 (22%)	68 (30%)	<.001
Family	192 (27%)	79 (33%)	54 (23%)	59 (26%)	.033
Friends	370 (53%)	154 (65%)	96 (40%)	120 (64%)	<.001
Spouse	352 (50%)	99 (42%)	126 (53%)	127 (57%)	.003
Where to do a PA program? (n=700)[a]					
Outside around neighbourhood	467 (67%)	147 (62%)	157 (66%)	163 (73%)	.046
At home	388 (55%)	142 (60%)	119 (50%)	127 (57%)	.076
At a community fitness centre	335 (48%)	140 (59%)	94 (39%)	101 (45%)	<.001
At a cancer centre	74 (11%)	32 (14%)	15 (6%)	27 (12%)	.026
When to do PA program? (n=667)					
Morning	364 (55%)	132 (57%)	116 (53%)	116 (54%)	.847
Afternoon	130 (19%)	38 (16%)	48 (22%)	44 (20%)	

Evening	127 (19%)	47 (20%)	40 (18%)	40 (19%)	
More than one time	46 (7%)	15 (7%)	15 (9%)	16 (7%)	
Interested in a program that would increase PA level? (n=695)					
Yes	323 (47%)	121 (51%)	96 (41%)	106 (47%)	.085
No	135 (19%)	35 (15%)	51 (22%)	49 (22%)	
Maybe/Unsure	237 (34%)	80 (34%)	88 (37%)	69 (31%)	
What PA intensity? (n=669)					
Light	190 (28%)	64 (28%)	65 (29%)	61 (28%)	.611
Moderate	433 (65%)	155 (67%)	141 (63%)	137 (64%)	
Vigorous	46 (7%)	11 (5%)	18 (8%)	17 (8%)	
Prefer the same or different activities each time? (n=635)					
Different each PA session	407 (64%)	161 (72%)	126 (61%)	120 (59%)	.033
Same each PA session	227 (36%)	64 (28%)	81 (39%)	83 (41%)	
Prefer supervised/instructed or unsupervised/self-paced PA? (n=646)					
Supervised/instructed	302 (47%)	136 (60%)	72 (34%)	94 (45%)	<.001
Unsupervised/self-paced	343 (53%)	89 (40%)	141 (66%)	113 (55%)	
Prefer spontaneous/flexible or scheduled PA sessions? (n=635)					
Spontaneous/flexible	253 (40%)	79 (36%)	98 (46%)	75 (38%)	.186
Scheduled	382 (60%)	142 (64%)	116 (54%)	125 (62%)	
Prefer group or individual activities? (n=638)					
Group	250 (39%)	117 (53%)	50 (24%)	84 (41%)	<.001
Individual	383 (61%)	104 (47%)	163 (76%)	120 (59%)	
Favourite types of PA in summer (listed as top 3)?					

	Walking	Walking	Walking	Walking	
	Swimming	Swimming	Swimming	Swimming	
	Biking	Biking	Golf	Biking	
Favourite types of PA in winter (listed as top 3)?					
	Walking	Walking	Walking	Walking	
	Outdoor winter activities (Skiing, skating, snowshoeing)	Outdoor winter activities (Skiing, skating, snowshoeing)	Outdoor winter activities (Skiing, skating, snowshoeing)	Outdoor winter activities (Skiing, skating, snowshoeing)	
	Indoor aerobic activity (Treadmill, Gym etc)	Indoor aerobic activity (Treadmill, Gym etc)	Indoor aerobic activity (Treadmill, Gym etc)	Swimming	
PA equipment in your home? (n=705)					
Yes	383 (54%)	126 (53%)	126 (53%)	131 (58%)	.462
No	322 (46%)	113 (47%)	113 (47%)	96 (42%)	
Type of PA equipment (listed as top 3)?					
	Treadmill	Treadmill	Treadmill	Treadmill	
	Resistance equipment	Resistance equipment	Resistance equipment	Resistance equipment	
	Bike (stationary or other)	Bike (stationary or other)	Bike (stationary or other)	Bike (stationary or other)	
Current member of a fitness centre? (n=707)					
Yes	94 (13%)	44 (18%)	32 (13%)	18 (8%)	.004
No	613 (87%)	196 (82%)	208 (87%)	209 (92%)	
Do you have access to the internet?					
Yes	545 (76)	188 (78%)	186 (77%)	171 (74%)	.591
No	170 (24)	53 (22%)	57 (23%)	60 (26%)	

Would you be interested in receiving PA information through the internet?					
Yes	337 (48)	126 (53%)	114 (47%)	97 (43%)	.106
No	372 (52)	114 (47%)	128 (53%)	130 (57%)	
Would you have been able and willing to complete this survey on-line?					
Yes	373 (52)	128 (53%)	129 (53%)	116 (51%)	.780
No	337 (48)	113 (47%)	113 (47%)	111 (49%)	

Note: PA=physical activity; CCNS=Cancer Care Nova Scotia; CCS=Canadian Cancer Society [a] Could check more than one response

Table 3- 2: Associations between demographic and medical variables and PA preferences in breast cancer survivors in Nova Scotia, Canada.

Group	Preference	Association	X^2	p*
Meeting PA guidelines *versus* not meeting PA guidelines	More likely to prefer receiving information from a community fitness centre	60% versus 38%	10.0	.002
	Less likely to prefer receiving information from a cancer support group	21% versus 37%	7.0	.008
	More likely to prefer exercising outside in the neighbourhood	71% versus 54%	6.7	.010
	More likely to prefer moderate or vigorous intensity activities	91% versus 55%	35.1	<.001
	More likely to have a current fitness centre membership	34% versus 5%	32.9	<.001
Received chemotherapy *versus* did not receive chemotherapy	More likely to prefer to engage in PA in the evening	31% versus 15%	9.6	.008
Received hormone therapy *versus* did not receive hormone therapy	More likely to prefer receiving information via face to face	42% versus 25%	6.9	.009
Age 70 and older *versus* age 60-69 *versus* 59 and younger	Less likely to be able to do a PA program for cancer survivors	66% versus 82% versus 89%	12.6	.002
	Less likely to be interested in doing a PA program for cancer survivors	55% versus 70% versus 86%	16.4	<.001
	Less likely to prefer exercising with their spouse	31% versus 34% versus 58%	15.1	.001
	Less likely to prefer receiving information from a cancer centre fitness centre	52% versus 57% versus 76%	11.0	.004
	Less likely to prefer to receive info via email	21% versus 35% versus 55%	17.9	<.001
	Less likely to prefer exercising at community fitness centre	44% versus 57% versus 73%	12.7	.002
	Less likely to prefer to engage in PA in the evening	7% versus 14% versus 42%	31.2	<.001
	Less likely to be interested in a program to increase PA levels	69% versus 90% versus 92%	16.7	<.001
	Less likely to prefer moderate or vigorous intensity activity	48% versus 77% versus 83%	22.8	<.001
	Less likely to prefer different activities each session	51% versus 74% versus 82%	15.7	<.001

Married *versus* not married	More likely to prefer exercising with their spouse	52% versus 10%	31.3	<.001
	More likely to prefer exercising at home	65% versus 45%	6.6	.010
	More likely to prefer exercising at a community fitness centre	64% versus 43%	7.4	.007
	More likely to have PA equipment at home	60% versus 33%	12.0	.001
Completed high school or less *versus* some post-secondary education	Less likely to prefer to receive information from a community fitness expert	39% versus 62%	10.7	.001
	Less likely to prefer receiving information via internet	16% versus 33%	9.2	.002
	Less likely to prefer to exercise outside in the neighbourhood	52% versus 77%	14.5	<.001
	Less likely to have a current fitness centre membership	11% versus 29%	10.9	.001
Annual income $59,999 or less *versus* $60,000 or more	Less likely to prefer to receive information from a community fitness expert	40% versus 66%	11.8	.001
	Less likely to prefer to receive info via email	39% versus 54%	7.4	.006
	Less likely to prefer to exercise outside in the neighbourhood	54% versus 79%	12.1	.001
	Less likely to have PA equipment at home	44% versus 71%	13.5	<.001
	Less likely to have a current fitness centre membership	11% versus 34%	15.1	<.001
Employed *versus* not employed	More likely to be able to do a PA program for cancer survivors	90% versus 75%	7.1	.008
	More likely to be interested in doing a PA program for cancer survivors	84% versus 67%	9.3	.002
	More likely to prefer to exercise with friends	76% versus 58%	6.7	.009
	More likely to prefer to receive information via internet	34% versus 17%	7.8	.005
	More likely to prefer to receive information via email	58% versus 30%	19.2	<.001
	More likely to prefer to exercise outside in the neighbourhood	75% versus 55%	7.9	.005
	More likely to prefer to exercise at a community fitness centre	71% versus 53%	6.9	.009

	More likely to prefer to engage in PA in the evening	48% versus 8%	49.5	<.001
	More likely to prefer moderate or vigorous intensity activity	85% versus 65%	10.5	.002
Normal (<25) versus overweight (25-30) *versus* obese (>30)	Overweight group more likely to prefer receiving information from a cancer support group	21% versus 43% versus 21%	13.3	.001
	More likely to prefer moderate or vigorous intensity activity	85% versus 71% versus 61%	10.4	.005
General health poor/fair *versus* good *versus* very good/excellent	Less likely to prefer to exercise outside in the neighbourhood	34% versus 63% versus 71%	14.9	.001
	Less likely to prefer moderate or vigorous intensity activity	55% versus 64% versus 86%	18.5	<.001

* p<.01

Table 3- 3: Associations between demographic and medical variables and PA preferences in prostate cancer survivors in Nova Scotia, Canada.

Group	Preference	Association	X^2	p*
Meeting PA guidelines *versus* not meeting PA guidelines	More likely to prefer to exercise outside in the neighbourhood	77% versus 56%	10.6	.001
	More likely to prefer to engage in PA in the morning	66% versus 46%	11.0	.004
	More likely to prefer moderate or vigorous intensity activity	88% versus 57%	24.7	<.001
	More likely to have a current fitness centre membership	25% versus 4%	21.8	<.001
Age 70 and older *versus* age 60-69 *versus* 59 and younger	Less likely to prefer to receive information via internet	15% versus 25% versus 43%	11.4	.003
	Less likely to prefer to engage in PA in the evening	11% versus 23% versus 38%	16.1	.003
	Less likely to have a current fitness centre membership	3% versus 17% versus 28%	16.3	<.001
Married *versus* not married	More likely to prefer exercising with their spouse	60% versus 14%	24.2	<.001
	Less likely to prefer to engage in PA in the afternoon	42% versus 21%	9.5	.008
Completed high school or less *versus* some post-secondary education	Less likely to prefer to receive information from a community fitness expert	25% versus 45%	9.4	.004
Annual income $59,999 or less *versus* $60,000 or more	Less likely to have a current fitness centre membership	7% versus 24%	10.4	.001
Employed *versus* not employed	More likely to prefer to engage in PA in the evening	46% versus 10%	36.3	<.001
General health poor/fair *versus* good *versus* very good/excellent	Less likely to prefer to exercise outside in the neighbourhood	52% versus 59% versus 78%	12.0	.002
	Less likely to prefer moderate or vigorous intensity activity	45% versus 71% versus 81%	17.9	<.001

* p<.01

Table 3-4: Associations between demographic and medical variables and PA preferences in colorectal cancer survivors in Nova Scotia, Canada.

Group	Preference	Association	X^2	p*
Meeting PA guidelines *versus* not meeting PA guidelines	Less likely to prefer receiving information from a cancer support group	18% versus 36%	7.3	.007
	Less likely to prefer to exercise at a cancer centre	5% versus 17%	6.8	.009
	More likely to prefer moderate or vigorous intensity activity	88% versus 61%	18.4	<.001
	More likely to have PA equipment at home	69% versus 50%	6.9	.009
	More likely to have a current fitness centre membership	14% versus 4%	7.3	.007
Received chemotherapy *versus* did not receive chemotherapy	More likely to have PA equipment at home	68% versus 45%	11.9	.001
Age 70 and older *versus* age 60-69 *versus* 59 and younger	Less likely to prefer receiving information from a community fitness centre	29% versus 30% versus 65%	19.9	<.001
	Less likely to prefer receiving information from a cancer centre fitness centre	36% versus 46% versus 73%	16.7	<.001
	Less likely to prefer to receive info via email	22% versus 22% versus 54%	19.6	<.001
	Less likely to prefer to engage in PA in the evening	11% versus 13% versus 50%	35.3	<.001
	Less likely to be interested in a program to increase PA levels	68% versus 82% versus 90%	9.9	.007
	Less likely to prefer moderate or vigorous intensity activity	52% versus 78% versus 90%	23.8	<.001
Men *versus* women	Less likely to prefer to exercise with friends	45% versus 68%	10.4	.001
	More likely to prefer unsupervised/self-paced PA sessions	63% versus 40%	10.1	.001
	More likely to prefer individual activities	68% versus 39%	15.2	<.001
Married *versus* not married	Less likely to prefer to exercise with other cancer survivors	26% versus 50%	7.8	.005
	More likely to prefer to exercise with their spouse	64% versus 25%	18.4	<.001
Employed *versus* not employed	More likely to prefer receiving information from a community fitness centre	53% versus 31%	8.1	.004
	More likely to prefer receiving information from a cancer centre fitness centre	66% versus 42%	8.5	.004
	More likely to prefer to engage in PA in the evening	57% versus 7%	65.4	<.001

	More likely to prefer moderate or vigorous intensity activity	88% versus 67%	9.3	.002
Normal (<25) *versus* overweight (25-30) *versus* obese (>30)	Overweight group less likely to prefer receiving information from a cancer centre fitness centre	55% versus 38% versus 62%	9.7	.008
General health poor/fair *versus* good *versus* very good/excellent	Less likely to prefer moderate or vigorous intensity activity	30% versus 73% versus 83%	29.2	<.001

* p<.01

Chapter 4 – STUDY I: Paper 3

Prevalence and correlates of strength exercise among breast, prostate, and colorectal cancer survivors in Nova Scotia, Canada.

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Introduction

Strength exercise, or resistance training, is any type of activity that involves the repetitive use of muscular force against an external resistance or body weight such as weight lifting, push-ups, sit-ups, yoga, and pilates (1). Systematic reviews have documented that strength exercise improves many health outcomes in cancer survivors including muscular strength and endurance, lean body mass, fatigue and quality of life (2-5). One trial even reported that strength exercise improved chemotherapy completion rate in breast cancer patients (6). Moreover, some studies have suggested that strength exercise may result in larger improvements in quality of life than aerobic exercise in prostate cancer survivors (7). Strength exercise has even been found to be safe and feasible for cancer survivors with advanced disease (8-10). These studies have led the American Cancer Society (11) and the American College of Sports Medicine (12) to recommend at least two days per week of strength exercise for cancer survivors.

Despite this recommendation, few studies have examined the prevalence and correlates of strength exercise among cancer survivors. Speed-Andrews and colleagues (13) examined strength exercise among 600 colorectal cancer survivors and found that only about 25% reported meeting the strength exercise guidelines. Moreover, the study found that colorectal cancer survivors were more likely to meet the guidelines if they were male, married, in better health and not obese. More recently, Short and colleagues (14) reported on the strength exercise behaviour of 330 breast cancer survivors and found less than 25% were meeting the strength exercise guidelines. Breast cancer survivors who had higher outcome expectancies, task self-efficacy, barrier self-efficacy, behavioural capability, social support and goal setting were more likely to be meeting the strength exercise guidelines. Among

cancer survivors, the theory of planned behaviour (TPB) (15) has been used extensively to explain aerobic exercise (16-18) but no study to date has used the TPB to explain strength exercise.

The TPB states that intention (or motivation) is the immediate determinant of behaviour. Intention is influenced by instrumental and affective attitude (expected benefits and enjoyment from performing a behaviour), injunctive and descriptive norm (expected support from others and extent to which important others perform a behaviour) and perceived behavioural control (PBC) (the perceived controllability of performing a behaviour). Planning is an addition to the model as a mediator between behaviour and intention in an attempt to explain the "intention–behaviour gap" (19, 20). Several recent studies among various cancer survivor groups have found the TPB to be highly effective when predicting general physical activity (17, 18, 21). A recent meta-analysis showed that intention and PBC had strong correlations with adhering to physical activity among cancer survivors (22).

The primary purpose of this study was to examine the prevalence and correlates of strength exercise among breast, prostate, and colorectal cancer survivors in Nova Scotia, Canada. To our knowledge, our study is the first to examine the prevalence and correlates of strength exercise in prostate cancer survivors; arguably the survivor group with the most evidence of benefit from strength exercise (2, 23). Moreover, our study is only the second to examine the prevalence and correlates of strength exercise in breast and colorectal cancer survivors; and the first to test the TPB as a model to explain strength exercise in these survivors (15). Finally, our study is the first to directly compare the prevalence and correlates of strength exercise across cancer survivor groups to determine if interventions to promote strength exercise may need to be targeted based on cancer site.

Based on the studies by Speed-Andrews et al. (13) and Short et al. (14), we hypothesized that the majority of Nova Scotian cancer survivors would not be meeting the strength exercise guidelines. Moreover, based on the evidence of benefit, we hypothesized that prostate cancer survivors would have the highest rate of strength exercise participation followed by breast and colorectal cancer survivors. In terms of correlates, we hypothesized that the theory of planned behaviour would provide the strongest correlates of strength exercise across all three survivor groups. Finally, we hypothesized that survivors who are men (colorectal only), more educated, in better general health, and less obese would be more likely to meet the strength exercise guidelines. Our comparison of the correlates across the three cancer survivor groups was considered exploratory.

Materials and Methods

Study Procedures and Population

The design of this survey has been previously described (16).The study package included a mailed, self-administered survey using a population-based, cross-sectional design. The Nova Scotia Cancer Registry (NSCR) generated a stratified sample of 700 from each breast, prostate, and colorectal cancer survivors (2100 total) in September 2011. Participants were deemed eligible if the following criteria were met: a) aged between 18 and 80 years, b) current residents of Nova Scotia, and c) had a diagnosis of breast, prostate or colorectal cancer between 2003 and 2011. The Halifax District Health Authority and the University of Alberta provided ethical approval. Those identified received a package containing: a) an invitation letter from the registry explaining its role in the study and how they were identified, b) an invitation letter from the researchers explaining the purpose of the study, c) a questionnaire, and d) a postage-paid return envelope. If individuals were interested in

participating they were asked to complete the questionnaire and mail it in the return envelope. Participants were mailed the initial package and then a postcard reminder approximately three weeks later to those who had not responded in that time period.

Measures

Demographic and medical information

Self-report demographic data included age, sex, education level, marital status, income, employment status, ethnicity and height and weight in order to calculate body mass index (BMI). Also collected using self-report were medical variables consisting of type of cancer, time since diagnosis, lymph node involvement, treatment type, current treatment status, previous recurrences, current disease status, and perceived general health status. Comorbidities were examined by asking participants to select from a list which conditions they were told they had (e.g., high cholesterol, diabetes, high blood pressure).

Strength Exercise

To measure strength exercise behaviour, we used a scale previously used by Speed-Andrews and colleagues (13). The questionnaire asked "Have you done any strength exercises in the past month?" with a yes or no response. Examples of strength exercise were provided for respondents such as weight lifting, sit-ups, or push-ups. If they answered yes, they were instructed to complete three more questions asking what type of strength exercise they did (open-ended), how often (days per week) and the duration of each session (minutes per day). We used the current recommended guidelines (1, 11, 12) to determine the percentage of participants meeting the strength exercise guidelines. These guidelines state that individuals should engage in strength exercises for all major muscle groups on two or more days per week with eight to twelve repetitions per exercise. Our primary estimate of

prevalence was participating in strength activities at least twice per week. Given that we did not ask about all major muscle groups or the number of repetitions, we estimated that it would take approximately 30 minutes to complete 8 to 12 repetitions for each major muscle group. Therefore, our second estimate of strength exercise prevalence was two or more days per week for at least 30 minutes per session. This secondary estimate was only used for descriptive purposes. All correlates analyses used the primary estimate of strength exercise prevalence based on frequency alone.

Theory of Planned Behaviour

The TPB is generally assessed using Likert scales from 1 to 7 (negative to positive) that quantify a person's attitude, subjective norm, perceived behavioural control, intention, and plan to engage in a behaviour. The TPB was assessed using these standardized measures as recommended by Ajzen (24) and reported previously (16). The items were focused on regular PA as defined for moderate and vigorous activity but did not specifically refer to aerobic or strength exercise. Attitude was assessed using six items on a 7-point bipolar Likert scale for both components; instrumental (i.e., harmful-beneficial, useless-useful, bad-good) and affective attitude (i.e., unenjoyable-enjoyable, boring-fun, unpleasant-pleasant) using the preceding statement: "For me, engaging in PA regularly over the next 12 weeks will be...." The internal consistencies (α) of the attitude subscales were 0.88 and 0.83 respectively.

Subjective norm was measured with five items on a 7-point bipolar Likert scale. Three items assessed injunctive norm by asking "I think that if I participated in regular PA over the next month, most people who are important to me will be..." disapproving/approving, discouraging/encouraging and unsupportive/supportive. The other two items measured descriptive norm by asking "I think that over the next month, most

people who are important to me will be...” inactive/active and “I think that over the next month, most people who are important to me will participate regularly in PA...” disagree/agree. Internal consistencies (α) of the subjective norm subscales were 0.93 and 0.84 respectively.

PBC was measured with six items on a 7-point bipolar Likert scale. The items were “If you were really motivated, participating in PA over the next month would be...” extremely difficult/extremely easy; “If I wanted to, I could easily engage in regular activity over the next month” strongly agree/strongly disagree; “How confident are you that you could engage in PA regularly over the month” not at all confident/extremely confident; “If you were really motivated, how much control do you feel you would have in engaging in PA regularly over the next month” very little control/complete control; “Whether or not I engage in PA regularly over the next month is completely up to me” strongly disagree/strongly agree and; “How much do you feel that engaging in PA over the next month is beyond your control” not at all/very much. Internal consistency (α) was 0.89 for these items.

Intention was measured with two 7-point Likert scale items that asked “Do you intend...” and “How motivated are you... to do regular PA over the next month” respectively. Internal consistency (α) was 0.95 for these two items. Finally, planning was assessed with six items on a 7-point Likert scale with responses ranging from no plans to detailed plans. The first item asked “Do you have plans for when, where, and the type of PA you will do in the next month?” The following five items expanded on the first asking “I have made detailed plans concerning…” when, where, what, how and who they will engage in regular PA. Internal consistency (α) was 0.97 for these items.

Statistical analyses

All statistical analyses were done using PASW Statistics 21.0 (PASW Inc, Chicago IL, USA). Descriptive statistics were used to determine the prevalence of strength exercise including the frequency, duration and type. To determine any associations between cancer site (breast, prostate and colorectal) and meeting the strength exercise guidelines, Chi-square analyses were completed. Chi-square analyses were also used to determine any differences between demographic and medical characteristics with strength exercise behaviour between and within cancer sites including exploratory tests of interactions. All demographic and medical variables were grouped based on relevant cut points or balanced statistical splits to ensure each cell had adequate numbers for analysis. The demographic variables include age (≤59, 60-69, ≥70), sex, marital status, annual income, BMI (healthy weight 18.5-24.9; overweight 25-29.9; obese ≥ 30), and general health status (poor/fair; good; very/excellent).Medical variables included disease stage (localized; metastasized), time since diagnosis (<5 years; ≥5 years), treatments received (surgery, radiation, chemotherapy, hormone therapy), current cancer status (disease-free or existing disease), recurrence status (yes or no), and current treatment status (not receiving treatment; receiving treatment).

TPB correlates were examined using Analyses of Variance (ANOVAs). We also explored interactions between cancer site and the correlates using ANOVAs. We chose a p value of <.05 for statistical significance for the main correlates and describe any interactions that were p<.10. Multivariate logistic regression analyses were performed using all variables that were statistically significant (p<.05) or borderline significant (p<.10) to predict the probability that a respondent would meet guidelines for strength exercises (≥two days/week). We used mean substitution to replace any missing data, which was less than 5% for all variables.

Results

The flow of participants through the study has been reported elsewhere (16). Briefly, NSCR randomly generated a stratified sample of 2100 cancer survivors (700 from each cancer site) of which 2062 were mailed an invitation package. The survey resulted in a 36% completion rate (741/2062) and a 38% response rate (741/1978) which excludes the return to senders and deceased persons. The response rate did not differ by cancer site (p=.94).

Demographic, medical and behavioural characteristics of the sample have also been reported elsewhere (16). The study population were mostly male (55%), white (97%), married (80%), not working (70%) and had an average age of 65.6 years. The sample was evenly distributed between breast (33.5%), prostate (34.1%) and colorectal (32.4%) cancers. Medically, 50% had stage II disease, the mean years since diagnosis was 4.3, 90% had surgery, 47% were overweight, and 26% were obese.

Prevalence of strength exercise

Overall, 23% of the sample was meeting the strength exercise guidelines of ≥2 days/week (Table 4-1). Of those meeting the guidelines, the majority were lifting weights (68%) followed by doing core exercises (28%) (e.g., sit-ups, pilates, yoga etc.) and free bodyweight exercises (24%) (e.g., push-ups, squats, chin-ups etc.). The average session duration was 28 (SD=20) minutes. About 10% were meeting the criteria of ≥2 days/week for ≥30 minutes each session.

Differences in strength exercise behaviour by cancer site

Differences in strength exercise behaviour by cancer site are presented in Table 4-1. The only significant difference was in duration per session with colorectal cancer survivors

reporting significantly shorter duration than breast or prostate cancer survivors (31% <30 minutes/session versus 55% and 45% respectively; p=.027).

Associations between demographic variables and strength exercise behaviour

Table 4-2 shows detailed information regarding the associations between demographic variables and strength exercise behaviour overall and within cancer site. Overall, survivors were more likely to meet strength exercise guidelines if they were younger (p=.001), more educated (p<.001) or had a higher income (p<.001). The only interaction involving cancer site was a borderline significant interaction with marital status (p for interaction=.055) (Figure 4-1). Unmarried colorectal cancer survivors were more likely to meet guidelines whereas there was no difference for breast and prostate cancer survivors based on marital status.

Associations between medical variables and strength exercise behaviour

Table 4-3 shows detailed information regarding the associations between medical variables and strength exercise behaviour overall and within cancer site. Overall, participants were more likely to meet the strength exercise guidelines if they had better perceived general health (p<.001), fewer than two co-morbidities (p=.010) and a normal body mass index (p=.001). The only interaction involving cancer site was a borderline significant interaction with time since diagnosis (p for interaction=.058) (Figure 4-2). Breast cancer survivors were more likely to meet guidelines if their diagnosis was less than five years ago whereas colorectal cancer survivors were more likely to meet guidelines if their diagnosis was more than five years ago.

Associations between TPB variables and strength exercise behaviour

Table 4-4 describes differences in the TPB constructs based on meeting the strength exercise guidelines. Overall, those meeting strength guidelines had significantly higher scores for affective attitude ($p<.001$), instrumental attitude ($p<.001$), injunctive norm ($p=.003$), perceived behavioural control ($p<.001$), planning ($p<.001$), and intention ($p<.001$). Significant differences remained when results were adjusted for age, sex, marital status, disease stage, treatment types (surgery, chemotherapy, radiation, and hormone therapy), treatment status, and disease status. There were no significant interactions based on cancer site.

Multivariate stepwise logistic regression analysis was conducted with all TPB constructs and age (<60 vs. ≥60), education level (≤ high school vs. postsecondary or greater), BMI (<25 vs. ≥25), general health (poor/fair, good, very good/excellent) and comorbidities (<2, 2-3, ≥4). Four variables entered the model and explained 15% of the variance in meeting strength exercise guidelines ($p<.001$). Survivors were more likely to be meeting strength exercise guidelines if they had stronger intentions (OR=1.61; $p<.001$) and higher education (OR=2.08; $p<.001$); and less likely to be meeting guidelines if they were older age (OR=0.61; $p=.019$), and overweight/obese (OR=0.57; $p=.006$).

Discussion

To our knowledge, this study is the first to examine the prevalence and correlates of strength exercise in prostate cancer survivors; the first to examine the TPB constructs as correlates of strength exercise in cancer survivors; and the first to compare the prevalence and correlates across breast, prostate and colorectal cancer survivors. Approximately 23% of our sample was meeting the guidelines for strength exercise at least two days per week with no differences across the cancer sites. There are only two studies that we know of that have

assessed the prevalence of strength exercise among cancer survivors. Speed-Andrews and colleagues (13) found that 26% of colorectal cancer survivors in Alberta were meeting strength exercise guidelines whereas Short et al. (14) found that 24% of breast cancer survivors in Australia were meeting guidelines. These data suggest a remarkable consistency of about 25% of cancer survivors meeting the strength exercise guidelines with very little variation across cancer sites or geographic region.

Overall, participants were more likely to be meeting the strength exercise guidelines if they were younger, more educated, and had a higher income. This is consistent with results among colorectal cancer survivors (13). There was one borderline significant interaction between cancer site and marital status. We found that colorectal cancer survivors were more likely to be meeting guidelines if they were unmarried whereas breast and prostate cancer survivors showed no differences based on marital status. This is in contrast to the only other study among colorectal cancer survivors which found being married was positively correlated to strength exercise behaviour. Moreover, Short et al. (14) did not find any differences among demographic characteristics. Given the unexpected and inconsistent association between marital status and strength exercise participation, further research is needed before definitive conclusions can be made.

When examining medical characteristics, we found that having a greater perceived general health, fewer comorbidities and a healthy BMI were associated with meeting strength guidelines. Speed-Andrews et al. (13) also found that general health and BMI were significant correlates of meeting strength guidelines among colorectal cancer survivors. As with the demographics, Short et al. (14) found no differences based on medical characteristics for breast cancer survivors. In our study, a borderline significant interaction

was found among cancer site and time since diagnosis for meeting strength guidelines. Breast cancer survivors were more likely to meet the guidelines if they were less than 5 years from diagnosis whereas colorectal cancer survivors were more likely to meet guidelines if they were ≥ 5 years since diagnosis. It is possible that breast cancer survivors are highly motivated to improve their health soon after diagnosis or treatment whereas colorectal cancer survivors are less motivated initially. It is also possible that the treatments for colorectal cancer are more difficult initially which may have an impact on early strength exercise participation. Speed-Andrews et al. (13) found a borderline significant association among colorectal cancer survivors who had an ostomy bag versus those who did not, with those without an ostomy being more likely to meet the strength guidelines.

As hypothesized, the TPB constructs were the strongest correlates of strength exercise in cancer survivors with no differences by cancer site. Those meeting guidelines had consistently higher scores for each construct when compared to those not meeting guidelines. That the differences remained after being adjusted for demographic and medical variables signifies the importance of addressing the motivational aspects of strength exercise. Our logistic regression analysis indicated that those with higher intentions were 60% more likely to be engaging in strength exercise. As with aerobic exercise, strength exercise intentions should be the primary target in interventions designed to increase strength exercise behaviour. Assessing a patient's intention to engage in strength exercise and addressing concerns that may arise is an important step in recommending strength exercise to cancer survivors.

Other significant correlates in the multivariate logistic regression analysis were age, education level and BMI classification. Cancer survivors who were younger, more educated

and had a healthy BMI were more likely to be meeting the strength exercise guidelines. Speed-Andrews et al. (13) also found that colorectal cancer survivors who were obese and in poorer health were less likely to meet guidelines. Short et al. (14) did not find any significant predictors among demographic or medical characteristics after controlling for constructs from social cognitive theory. The discrepancy in results may be due to differences in the survivor group, the theoretical model, or country of residence.

Research in non-cancer populations has shown that age, sex and education level are common predictors of strength exercise behaviour (25-28). Similar to the current study, Humphries, Duncan and Mummery (25) conducted a study among the general population in Australia and found that younger, healthier participants were more likely to meet strength guidelines. Our results indicate that interventions to promote strength exercise should target older, less educated, and obese cancer survivors. Strength exercise may be especially beneficial for cancer survivors who are older and/or obese because of their additional comorbidities and functional decline. Moreover, it may be more feasible for older and obese cancer to survivors to engage in strength exercises than aerobic exercises because of comorbidities such as musculoskeletal pain and reduced stamina.

As stated previously, this is the first study to examine strength exercise behaviour among prostate cancer survivors and only the second to exam strength exercise in breast and colorectal cancer survivors. We believe it is also the first study to directly compare strength exercise behaviour among breast, prostate and colorectal cancer survivors. The strengths of this study include the rigorous selection of a stratified sample of cancer survivors from a population-based provincial registry, the largest sample size to date, the comparable response rate from each cancer survivor group, and the use of previously tested strength exercise

measures. Limitations include the cross-sectional design which restricts inferences of causality; the use of self-report data for the strength, demographic and medical data; the transparent nature of the study which may have led to selection biases; the modest response rate; and our failure to assess the TPB constructs specifically for strength exercise.

Neglecting to assess the TPB constructs specifically for strength exercise means that participants are probably thinking of both aerobic and strength exercise when answering the social cognitive questions. The TPB explicitly notes that every behaviour is unique in terms of target, action, context, and time. Attitudes towards strength exercise may be very different than attitudes toward aerobic exercise. Given this principle, we likely underestimated the association between the TPB and strength exercise. Future studies of strength exercise should explicitly measure the TPB constructs for performing strength exercise.

In conclusion, we found that the prevalence of strength exercise among Nova Scotian cancer survivors was low and did not vary among prostate, breast, and colorectal cancer survivors. Moreover, we found that stronger intentions, higher education, younger age, and healthy body weight were independent correlates of meeting the strength exercise in guidelines with very little evidence of variation by cancer site. These data suggest that interventions to increase strength exercise in breast, prostate, and colorectal cancer survivors should focus on maximizing motivation for strength exercise with special attention to less educated, older, and overweight/obese survivors, but with minimal concern for cancer site. As there is still very little research on the prevalence and correlates of strength exercise in cancer survivors, more studies are needed to determine the reliability of these results.

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Table 4- 1: Self-reported participation in strength exercise of cancer survivors in Nova Scotia, Canada, October 2011 - February 2012.

	Overall N (%)	**Breast N (%)**	**Prostate N (%)**	**Colorectal N (%)**	**χ^2 P value**
Participated in any strength exercise over the past month					
Yes	189 (25.5)	69 (27.8)	65 (25.7)	55 (22.9)	.46
No	552 (74.5)	179 (72.2)	188 (74.3)	185 (78.1)	
If yes, what type? (n=187)					
Weights (e.g., free weights, machine weights)	123 (65.8)	45 (65.2)	41 (65.1)	37 (67.3)	.96
Core exercises (e.g., crunches, sit-ups, pilates, yoga, back exercises)	52 (27.8)	21 (30.4)	19 (30.2)	12 (21.8)	.50
Free bodyweight exercises (e.g., pushups, chin ups, squats etc)	44 (23.5)	10 (14.5)	19 (30.2)	15 (27.3)	.08
Other	24 (12.8)	12 (17.4)	6 (9.5)	6 (10.9)	.35
If yes, how often? (n=189)					
1 day per week	21 (11.1)	11 (15.9)	7 (10.8)	3 (5.5)	.06
2 days per week	34 (18.0)	18 (26.1)	7 (10.8)	9 (16.4)	
3 days per week	58 (30.7)	20 (29.0)	23 (35.4)	15 (27.3)	
4+ days per week	76 (40.2)	20 (29.0)	28 (43.1)	28 (50.9)	
If yes, how long? (n=189)					
Average duration, M (SD)	28 (20)	31 (19)	31 (24)	22 (16)	.031
<30 minutes	105 (55.6)	31 (44.9)	36 (55.4)	38 (69.1)	.027
≥30 minutes	84 (44.4)	38 (55.1)	29 (44.6)	17 (30.9)	
% meeting strength exercise guidelines for frequency					
≥ 2 days per week	168 (22.7)	58 (23.4)	58 (22.9)	52 (21.7)	.90
< 2 days per week	573 (77.3)	190 (76.6)	195 (77.1)	188 (78.3)	
% meeting strength exercise guidelines for frequency and time					
≥ 2 days per week and ≥30 minutes per session	72 (9.7)	28 (11.3)	27 (10.7)	17 (7.1)	.24
< 2 days per week and/or < 30 minutes per session	669 (90.3)	220 (88.7)	38 (89.3)	38 (92.9)	

Table 4- 2: Associations between demographic variables and meeting strength exercise guidelines for frequency overall and by cancer site in Nova Scotia cancer survivors, Canada, October 2011 to February 2012.

	Overall (n=741)		**Breast (n=248)**		**Prostate (n=253)**		**Colorectal (n=240)**	
Demographic/ Variables	Meeting guidelines	P value	Meeting guidelines	P value	Meeting guidelines	P value	Meeting guidelines	P value
Sex		.68		-		-		.80
Female	24%		-		-		23%	
Male	22%		-		-		21%	
Age		.001		.012		.21		.049
≤ 59	33%		35%		29%		34%	
60-69	21%		18%		26%		17%	
≥ 70	18%		17%		17%		20%	
Ethnic origin		.89		.75		1.00		.29
White	23%		24%		23%		21%	
Other	26%		13%		22%		50%	
Marital status		.45		.67		.93		.021
Married	22%		24%		23%		19%	
Not married	25%		21%		21%		36%	
Education		<.001		<.001		.07		.007
≤High School	14%		11%		18%		14%	
Postsecondary	31%		34%		28%		29%	
Family Income		<.001		.010		.06		.045
< 60,000	18%		20%		17%		18%	
≥ 60,000	33%		37%		29%		32%	
Employment		.19		.12		.76		.32
Employed	26%		30%		21%		27%	
Not employed	21%		20%		24%		20%	

Table 4- 3: Associations between medical variables and meeting strength exercise guidelines for frequency overall and by cancer site in Nova Scotia cancer survivors, Canada, October 2011 to February 2012.

	Overall (n=741)		**Breast (n=248)**		**Prostate (n=253)**		**Colorectal (n=240)**	
Medical Variables	Meeting guidelines	p value	Meeting guidelines	p value	Meeting guidelines	p value	Meeting guidelines	p value
Disease Stage		.81		.71		.89		.82
I	24%		25%		-		21%	
II	22%		21%		23%		20%	
III/IV	23%		19%		25%		24%	
Surgery		.47		.50		.33		.65
Yes	23%		23%		25%		22%	
No	19%		50%		18%		0%	
Radiation therapy		.47		.23		.92		.71
Yes	24%		26%		24%		19%	
No	22%		18%		23%		23%	
Chemotherapy		.81		1.00		.38		.25
Yes	23%		23%		8%		25%	
No	22%		24%		24%		18%	
Hormone Therapy		.50		.36		.35		.046
Yes	25%		26%		16%		75%	
No	22%		21%		24%		21%	
Current treatment status		.39		.22		.65		-
No treatment	22%		21%		23%		-	
Receiving treatment	28%		30%		11%		-	
Recurrence		.72		.43		1.00		.84
Yes	17%		9%		18%		33%	
No	23%		24%		23%		22%	
Current disease status		1.00		1.00		.91		1.00
Disease free	23%		23%		23%		22%	
Existing disease	23%		33%		20%		29%	
Time since diagnosis		1.00		.08		.75		.25
< 5 years	23%		27%		22%		19%	
≥ 5 years	23%		16%		25%		27%	
General Health		<.001		.002		.046		.017
Poor/Fair	11%		14%		10%		11%	
Good	19%		16%		23%		18%	
Very good/ Excellent	31%		34%		29%		30%	
Comorbidities		.010		.12		.36		.12
<2	28%		29%		27%		27%	
2-3	22%		23%		20%		22%	
≥ 4	15%		13%		20%		12%	
Body mass index		.001		.002		.35		.09
Healthy weight	32%		37%		25%		32%	
Overweight	21%		19%		25%		18%	
Obese	16%		15%		15%		19%	

Table 4- 4: Associations between meeting the strength exercise guidelines for frequency and the theory of planned behaviour in cancer survivors in Nova Scotia, Canada, October 2011 to February 2012.

	Overall (n=741)	Meeting guidelines (n=168)	Not meeting guidelines (n=573)	P value
Affective attitude				
Unadjusted [M (SD)]	5.0 (1.2)	5.4 (1.1)	4.9 (1.3)	<.001
Adjusted [M (SE)]	5.0 (.05)	5.4 (.09)	4.9 (.05)	<.001
Instrumental attitude				
Unadjusted [M (SD)]	5.8 (1.2)	6.3 (0.9)	5.7 (1.2)	<.001
Adjusted [M (SE)]	5.8 (.04)	6.2 (.09)	5.7 (.05)	<.001
Injunctive norm				
Unadjusted [M (SD)]	6.0 (0.9)	6.2 (0.9)	5.9 (1.0)	.003
Adjusted [M (SE)]	6.0 (.03)	6.1 (.07)	5.9 (.04)	.008
Descriptive norm				
Unadjusted [M (SD)]	5.1 (1.3)	5.3 (1.2)	5.1 (1.3)	.167
Adjusted [M (SE)]	5.1 (.05)	5.3 (.10)	5.1 (.05)	.137
PBC				
Unadjusted [M (SD)]	5.3 (1.4)	5.8 (1.2)	5.1 (1.4)	<.001
Adjusted [M (SE)]	5.3 (.05)	5.8 (.11)	5.2 (.06)	<.001
Planning				
Unadjusted [M (SD)]	3.7 (2.2)	5.0 (1.9)	3.4 (2.1)	<.001
Adjusted [M (SE)]	3.7 (.08)	5.0 (.16)	3.4 (.09)	<.001
Intention				
Unadjusted [M (SD)]	4.4 (2.0)	5.6 (1.5)	4.1 (1.9)	<.001
Adjusted [M (SE)]	4.4 (.07)	5.6 (.14)	4.1 (.08)	<.001

Note: PBC = Perceived behavioural control. Adjusted means (SE) were adjusted for age, sex, marital status, cancer type, disease stage, treatment type (surgery, chemotherapy, radiation, hormone therapy), treatment status, and disease status.

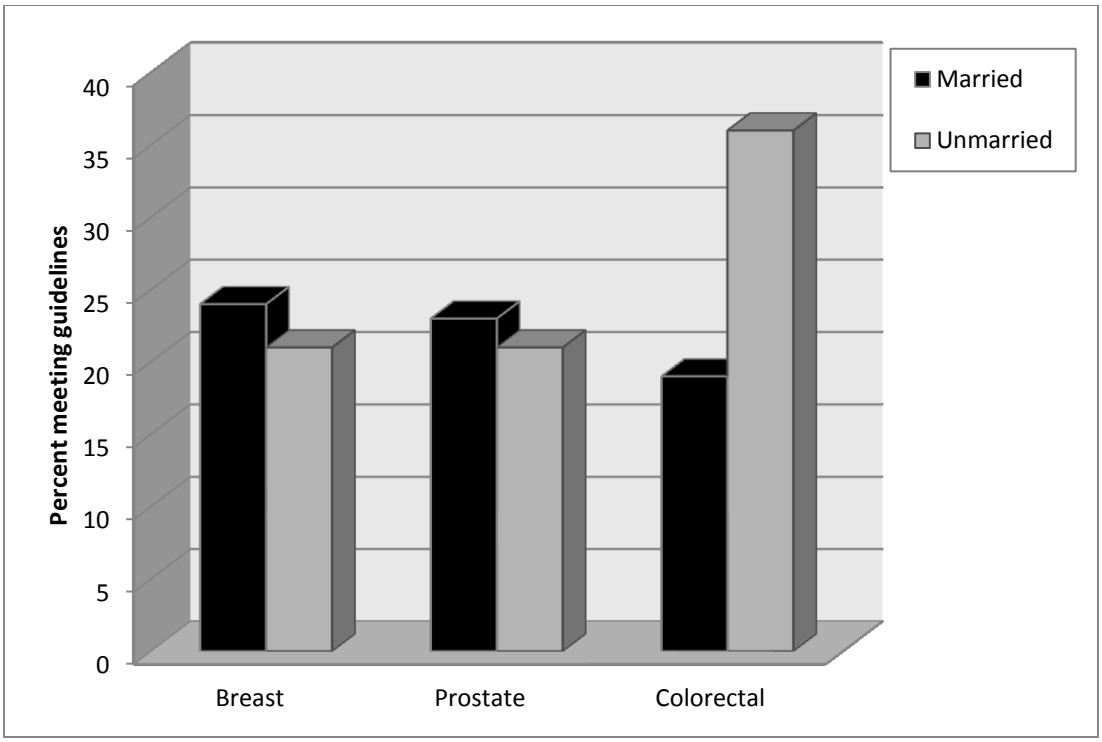

Figure 4- 1: Interaction between marital status and cancer site.

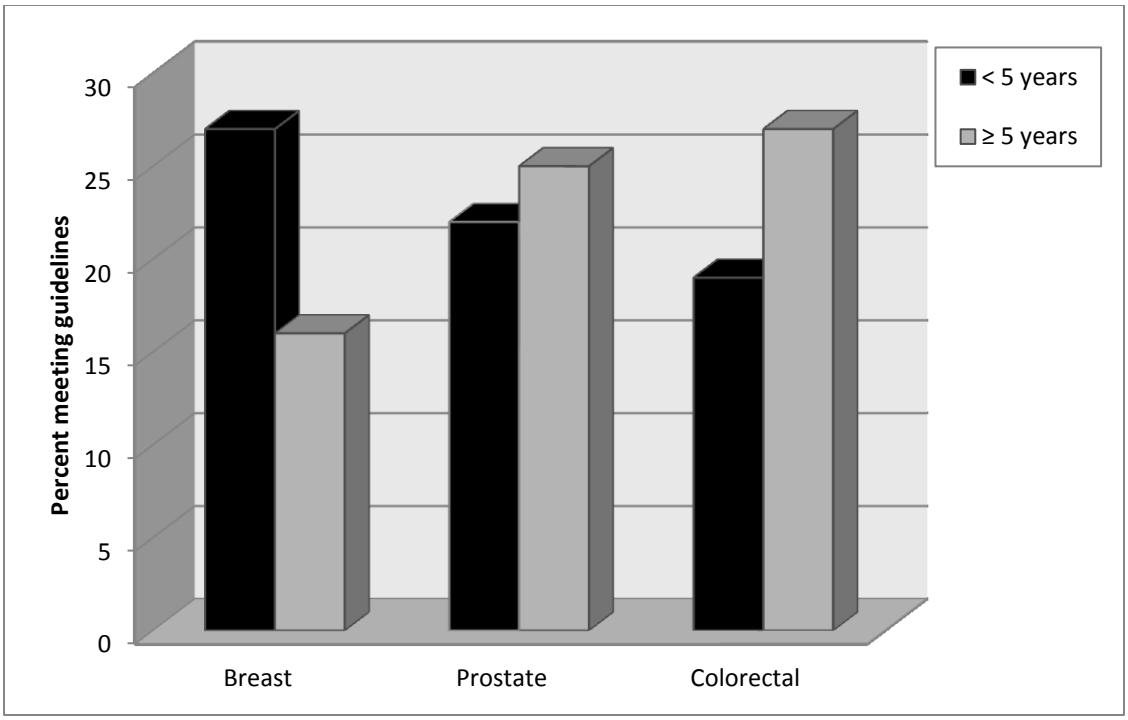

Figure 4- 2: Interaction between time since diagnosis and cancer site.

Chapter 5 – STUDY II: Paper 4

Feasibility and preliminary efficacy of an online intervention to increase physical activity in Nova Scotian cancer survivors.

Forbes CC, Blanchard CM, Mummery WK & Courneya KS. Feasibility and preliminary efficacy of an online intervention to increase physical activity in Nova Scotian cancer survivors. (in preparation).

Introduction

Physical activity (PA) improves quality of life, symptom control, and possibly even survival in cancer survivors (1-8). Despite these benefits, many cancer survivors do not accumulate the recommended 150 minutes of moderate intensity PA/week (2, 9, 10). A recent survey among breast, prostate and colorectal cancer survivors living in Nova Scotia showed less than half of survivors were meeting PA guidelines (11). Therefore, interventions focusing on behaviour change are necessary to help increase PA levels among these cancer survivors.

Numerous studies examining the correlates of PA among cancer survivors have used the Theory of Planned Behaviour (TPB) (12). Recent reviews and studies have found that 23 to 69% of variance in PA intentions among various cancer survivors groups was explained using TPB constructs (9, 11, 13-19). An essential step in promoting behaviour change is the use of targeted messages to increase motivation for the specific behaviour. Investigating the PA correlates and preferences of cancer survivors is important when developing these targeted messages. To date, theory-based behaviour change interventions designed to increase PA levels among cancer survivors have employed face-to-face, telephone counselling, email, and print-based methods (9, 13, 20-24). Encouraging results suggest a positive influence of these interventions on PA among cancer survivors. Nevertheless, these methods can be costly and time consuming; therefore, identifying alternate methods capable of broad reach with little cost would be beneficial.

Recent attention has been given to computer-tailored, internet-delivered programs to achieve behaviour change among various diseased and non-diseased populations. This research has indicated that this method of delivery is a viable option when disseminating PA

interventions. Recent meta-analyses and reviews (25-32) have summarized the effectiveness of technology when delivering interventions among the general population as well as various chronic disease populations. Overall, the research has found various forms of technology to be effective in facilitating PA behaviour.

Davies et al (2012) reviewed computer-tailored or website-delivered behaviour change interventions across various groups and found effect sizes for change in PA were small but significant in the healthy population (d=0.11), in those with chronic disease (d=0.19) and in those who were overweight (d=0.28). One study reviewed examined the effectiveness of an internet-support system on symptom distress in cancer patients (33). While their hypotheses were only partially supported, the study showed the website was a promising tool to help cancer survivors reduce their symptom distress.

Previous research into the PA counselling and programming preferences of cancer survivors in Nova Scotia (34) revealed 76% of the sample had access to the internet. Approximately 50% of the sample indicated they would be willing to receive PA information online and would be able to complete the questionnaires online as well. The benefits of using an internet-delivered program is the efficiency and reach that it can provide. Face-to-face counselling is time consuming, resource intensive and requires participants to live near a physical location (25, 28, 30, 31). This is particularly important in regions with a large rural population such as Nova Scotia which is approximately 43% rural (35). Internet provides people who may not be able to access standard education sessions with an alternative. Having components of the educational content given in oncologist consultations delivered via internet could relieve some of the burden on oncologists to deliver the message and for patients to retain information.

Currently, there is only one study to examine PA behaviour change among cancer survivors using an online delivery (36). Lee and colleagues (36) randomized 59 women in Seoul, South Korea who completed breast cancer treatment into either a web-based self-management PA and diet intervention group or the control group, which received an educational booklet on PA and diet developed using the Transtheoretical Model (TTM). They found that the web-based intervention group increased the proportion of people meeting moderate-intensity activity guidelines of ≥150 minutes more so than the control group (from 33% to 66% versus 35% to 36% respectively). However, the small sample of non-representative (younger, more educated sample) breast cancer survivors makes generalizing results difficult. In addition, similar to many studies using the TTM as a template, this study did not fully operationalize the multidimensional model which is a limitation when determining effectiveness (37).

The primary purpose of this study was to test the feasibility of an internet-delivered PA behaviour change intervention among breast, prostate and colorectal cancer survivors living in Nova Scotia. A secondary purpose was to examine the preliminary efficacy of the intervention for improving PA and quality of life. We hypothesized that it would feasible to use an internet-delivered program to deliver a behaviour change program to breast, prostate and colorectal cancer survivors living in Nova Scotia. In addition, we hypothesized that the website program would result in an increase in self-reported PA and QoL; however, as this was a pilot study we did not anticipate significant effects.

Materials and Methods

Study Procedures and Population

Participants were recruited from a sample (N=415) of breast, prostate and colorectal cancer survivors living in Nova Scotia who had previously taken part in a survey study and had indicated an interest in future studies (11). The sample was contacted via email, mail or telephone with an invitation to participate that included an information sheet from the investigators explaining the purpose of the study and instructions on how to proceed if interested, a consent form, and a copy of the primary publication from the previous survey. Eligibility criteria were: a) being able to speak and read English, b) have access to the internet, and c) be able and interested in an internet-delivered program designed to increase weekly PA levels.

Design

This study was a pilot two-group randomized controlled trial to compare a usual care group (no intervention) with an internet-delivered behaviour change group. The focus of the behaviour change program specifically was to increase PA in the form of steps or minutes. Eligible participants provided informed consent and completed a baseline questionnaire to gather demographic, behavioural and PA information prior to randomization.

Randomization

A rolling blocked randomization was completed after baseline measures were collected. Participants were allocated to one of two groups randomly using a computer generated random numbers list. Group assignments were generated by a research assistant and assigned after blocks of baseline measures were received to eliminate bias in group allocation. Participants were then notified of their group assignment via email. The groups were either usual care (UC) or the intervention group which was a private online community

called *Active Nova Scotia* hosted on the PA tracking website UWALK.ca and modified for cancer survivors (UCAN).

Intervention

Those randomized into the UCAN group were given access to a nine-module behaviour change program which was developed using previous print materials as a template (20, 38). The nine modules were published sequentially on the site as the intervention progressed to increase retention. Information module topics were developed from survey results of the same group (11, 34) that assessed through open- and closed-ended questions their TPB-related attitudes, subjective norm and perceived behavioural control toward meeting PA guidelines. Information modules were as follows: 1) welcome – general information about the site, types of exercise and how to gauge intensity, 2) exercise myths – dispelling common exercise myths, 3) exercise safety – tips on how to exercise smart and safe, 4) goals and planning – how to plan and make SMART goals, 5) exercise benefits – specific benefits of exercise for cancer survivors, 6) make it fun – tips on how to keep exercise fun, 7) exercise barrier – tips on how to overcome the most common barriers identified, 8) support network – how others can help you exercise, and 9) relapse – strategies on how to avoid and deal with relapse. Each module remained available to review after the week was concluded. Also, each module included a video relevant to the current topic featuring the first author to foster a connection and simulate face-to-face interactions.

Aside from the behaviour change program, the UCAN group were able to use UWALK.ca to track their PA in steps, moderate or vigorous minutes, and flights of stairs. Participants were able to see the progress of other group members as well as their own progress over time. Participants in the UCAN group also received individually tailored

weekly email updates informing them of new information posts as well as a brief summary of their previous weeks PA levels. Emails were developed to offer general encouragement to those who were not meeting the guidelines and congratulate those who were sufficiently active. The emails also served as a prompt to view the upcoming new module. Direct links were provided within the email to both the PA log page and the new module. Upon being informed of their group assignment, the UC group was asked to keep their regular exercise routine over the intervention period and they would receive access to the website and the behaviour change program once the follow up questionnaire was completed.

Measures

Demographic and medical information

All questionnaires were completed online using FluidSurveys software. Information on demographic and medical data was collected through self-report measures and included age, sex, marital status, education level, income, employment status, ethnicity and height and weight to compute body mass index (BMI). Medical variables included date of diagnosis, cancer site, disease stage, previous treatments, current treatment status, cancer recurrence and current disease status. Measures for the primary and secondary endpoints were examined at baseline (pre-intervention) and at 10 weeks (post-intervention).

Website engagement and usage

Mixpanel analytics were used to track web usage statistics. This tracking program provides information on the number of logins (when an individual signs in to the site using their email id and password), page-views (when an individual views a page on the site), and activity logged (when an individual enters a bout of PA). Mixpanel analytics is a measurement tool that shows the effectiveness of a web page in achieving a goal. It is an easy

way to see how visitors use the site and identify which pages are performing well and which are performing poorly.

Program evaluation and adherence

In order to assess program satisfaction, participants randomized to UCAN were asked to complete a section examining overall website satisfaction and usefulness of the different program features. The questions were adapted from recent web-based PA intervention for people with type 2 diabetes (29) which was in turn developed from the Health-*e*Steps (39) and Diabetes NetPLAY programs (40). The items used a 4-point Likert type scale ranging from "*strongly disagree*" to "*strongly agree*" for the following statements: "I enjoyed the Active Nova Scotia program", "If I had any concerns I knew who to contact", "I would continue to participate in the Active Nova Scotia program", "I increased my PA because I was in this study", "This study made me more aware of the amount of PA I get each day", "The topics for each information post were useful and relevant", "I liked the videos for the information posts", "The videos in the information posts were not burdensome on my computer", I was able to easily find my way around the website", "I was able to easily record my PA on the website", "I would recommend this website to other people" and "I will continue to use the website now that the Active Nova Scotia program has finished." These twelve items were supplemented by four open-ended questions to indicate likes, dislikes and recommendations for future development.

Physical activity behaviour

PA was measured using a modified version of the validated Leisure Score Index (LSI) from Godin's Leisure Time Exercise Questionnaire (LTEQ) (41). Participants were asked to recall the average frequency and duration of any vigorous (heart beats rapidly,

sweating), moderate (not exhausting, light perspiration), and light (minimal effort, no perspiration) intensity aerobic PA, as well as resistance exercise (lifting weights, situps, pushups, therabands), in a typical week over the past month. PA sessions had to be at least 10 minutes long and performed during their free time and not occupational. The percentage of participants meeting PA guidelines was calculated using the 2008 PA Guidelines for Americans (42) which have been recommended for cancer survivors by the American College of Sports Medicine (43) and the American Cancer Society (3). The guidelines indicate that cancer survivors should perform either 75 minutes of vigorous activity a week, 150 minutes of moderate activity a week, or a combination that double weights the vigorous minutes. 'PA minutes' was calculated as moderate minutes plus two times vigorous minutes and then transformed into two categories: 1) not meeting guidelines (≤149 minutes) or 2) meeting guidelines (≥150 PA minutes). The percentage of participants meeting strength guidelines was defined as those engaging in two or more sessions of strength exercise per week. 'Strength minutes' were calculated by multiplying average minutes per session by strength frequency. 'Total exercise minutes' was calculated by adding 'PA minutes' and 'Strength minutes'.

Quality of Life

Quality of life (QoL) was assessed by the validated Functional Assessment of Cancer Therapy-Fatigue (FACT-F) scale which includes the 27 items from the FACT-General (FACT-G) scale plus the 13 item fatigue subscale (44, 45). The FACT-G consists of physical well-being, functional well-being, emotional well-being, and social well-being. On all scales, higher scores indicate better QoL. QoL was also assessed using the Medical Outcomes Study 36-Item Short Form (SF-36) (46), which contains 36 items that produce eight health domains

with multi-item scales. *Physical functioning* evaluates limitations in physical activities, such as walking and climbing stairs. *Role limitations* as a result of *physical* or *emotional* health conditions measure problems with work or other daily activities. *Bodily pain* assesses limitations caused by pain, and *vitality* measures levels of energy and tiredness. *Social functioning* examines the effect of physical or emotional health on normal social activities, and *mental health* evaluates happiness, nervousness and depression. The *general health perceptions* questions examine personal health and the expectation of changes in health. A single item assesses *change in perceived health* during the last year. All items used a Likert-type scale of varying points.

Statistical Analysis

All analyses were performed using PASW Statistics 22 (PASW Inc., Chicago, IL). Chi-square and Analyses of variance (ANOVAs) were performed to determine the differences between the intervention groups for PA behaviour and QoL items. Analyses of covariance (ANCOVAs) were also conducted to adjust for baseline value when comparing intervention groups. Feasibility was assessed using recruitment rate, website satisfaction and usage statistics gathered from UWALK.ca and Mixpanel. Efficacy was determined based on potential PA differences between intervention groups. Results were interpreted for statistical trends as well as potential clinical significance. Using a two-tailed alpha of $p \leq .05$, the study had 80% power to detect medium standardized effects (d=0.50) after adjustment for covariates with 45 participants per condition. Trends were defined as $p < .10$ and potential clinical significance a standardized effect size of $d \geq 0.33$. Intention-to-treat protocol was adhered to for all analyses. Based on the higher than expected number of participants

meeting PA guidelines at baseline, subgroup analyses were conducted for those with <150 minutes versus ≥150 minutes of total exercise.

Results

The detailed flow of participants through the study can be found in Figure 5-1. Of the 415 cancer survivors contacted, 197 (47.5%) did not respond and 98 (23.6%) were excluded for various reasons. Of the 120 (28.9%) survivors who expressed interest, we excluded 25 for not meeting inclusion criteria or contacting us after recruitment had closed. We randomized 95 cancer survivors (UCAN=48; UC=47) resulting in a 22.9% recruitment rate. During the study we had one person withdraw due to personal issues. At the post-intervention evaluation, 84 (88%) had completed 100% of the post-study survey. Among those that did not fully complete the survey, five were non-responders, four had incomplete data, and one had non-cancer related health issues. At baseline, the majority of the sample were female (56%), married (86%), more educated (77%), had higher income (50%), breast cancer (51%), more than 5 years since diagnosis (85%), currently disease free (96%) and indicated a perceived general health of good or better (95%). Average age and body mass index were 65.1 years and 27.6 kg/m^2 respectively. The majority of participants were not meeting minimum PA guidelines (54%). Detailed demographic and medical information can be found in Tables 5-1 and 5-2.

Based on data from our original survey, we were able to compare study participants (n=95) to the non-participants (n=320). We found that study participants were more likely to be meeting PA guidelines (p=.005), have breast cancer (p=.002), previous hormone therapy (p=.013), be married (p=.024), more educated (p=.014), have higher income (p<.001), be employed (p=.044), have a stronger preference for receiving PA information via the internet

(p=.002) or email (p<.001), and a weaker preference for receiving information face-to-face (p=.019). The groups were balanced on all baseline demographic and medical variables except those in UCAN were less likely to have higher degrees (p=.033) and more likely to have had a recurrence (p=.037).

Website Usage

Detailed weekly web statistics can be found in Table 5-3. The overall average number of logins was 10.3 for the nine week duration of the intervention. There were 2,293 individual PA events logged over 1,085 days (average 23 days per participant) and 4,319 page views recorded. The most frequently visited page was the log page where participants entered their PA data. The modules were visited 213 times over the length of the study with an overall read rate of 26%. Moreover, 94% of participants logged in at least once, 85% recorded PA at least once and 67% viewed the modules at least once.

Associations between website usage and PA behaviour change

We used Pearson correlations to examine the associations between all changes in PA outcomes and the web usage parametrics to assess any possible correlation between usage and PA levels. There were significant negative correlations between meeting the strength exercise guidelines and total PA entries (r= -.35, p=.023), days PA entered (r= -.36, p=.018), total vigorous minute entries (r= -.36, p=.019), days vigorous minutes entered (r= -.37, p=.016), and stair entries (r= -.35, p=.023).

Intervention Satisfaction

With regards to the intervention program, 73% said they enjoyed the Active Nova Scotia program, 63% would be willing to continue participating, 46% indicated they increased their PA because of this program, 71% said they were more aware of the amount of

PA they get each day, 73% thought the information in the weekly modules were useful and relevant. About half of participants liked the videos posts and felt they were not too burdensome on their computer. When evaluating the website, 68% were able to easily navigate and enter PA information on the site. When asked if they would recommend the site to others, 64% indicated yes and 39% said they would continue using the site after the study had finished.

Effect on Physical Activity behaviour

Table 5-4 describes the differences in physical activity behaviour between the UC and UCAN groups at baseline and post-intervention. Overall, the adjusted between-group mean change scores favoured the UCAN group; however, there were no significant differences between the groups in any PA measure. The adjusted between group difference for total exercise minutes was +42 (95% CI= -65 to +150; p=.44, d=0.17). The adjusted between group difference for strength training frequency achieved a meaningful difference of +0.5 (95% CI= -0.2 to +1.1; p=.14, d=0.34). Figure 5-2 illustrates the subgroup analysis of the changes in total exercise minutes by baseline PA levels. Among those not meeting guidelines at baseline, the UCAN group increased their PA levels by 52 minutes while the UC group decreased by 15 minutes (+67 minutes); whereas among those meeting guidelines, the UCAN and UC group increased PA by 88 and 65 minutes respectively (+23 minutes).

Quality of Life

Tables 5-5 and 5-6 summarize the general and cancer-specific QoL measures respectively, at baseline and post-intervention. Change in the SF-36 measure of mental health favoured the UC group with a mean change score of -2.9 (95% CI= -5.1 to -0.6; p=.014, d=0.37). All other measures were non-significant.

Discussion

Our pilot study is one of the first studies to use an online platform to deliver a theory-based physical activity behaviour change program to cancer survivors, and the first to target Nova Scotian cancer survivors. It is difficult to compare our expression of interest rate (29%) and recruitment rate (23%) to other studies as recruitment methods vary greatly. The previous study among cancer survivors used community and clinical based recruitment methods that were unable to track the initial reach of the invitation (36). Lee et al (36) randomized 59 women out of 343 whom expressed interest resulting in a recruitment rate of 17%. Jennings et al (29) had a recruitment strategy most similar to ours with an email invitation going out from the Queensland branch of Diabetes Australia to 12,923 individuals. Of the 568 who expressed interest 397 (3.1%; 397/12,923) were randomized for the study. Similarly, our initial survey invitation was sent to 2,063 survivors of which 741 completed it, 415 indicated interest in future studies, and 95 were randomized to this intervention (4.6%; 95/2,063).

It is common in non-blinded studies to have self-selection bias among participants. Our original study (11) openly invited people to participate in a physical activity survey, leading to a selection bias for those motivated to engage in PA. Despite this, we were still surprised at the number of participants in the intervention meeting guidelines (46%). It may be that the most motivated and active of the previous highly motivated and active survey sample were the ones to come forward for this intervention. In addition, our participants were more likely to prefer receiving information via the internet which may also bias results. When being asked to participate in an online study, those who prefer this method are more likely to come forward. However, if we were to exclude those already active, our sample size

would have been reduced by almost half. Previous preference research found that those who preferred web-based interventions were more likely to have higher internet use and higher PA participation (47). More research into preferences for internet delivery PA interventions should be explored.

Our post-intervention retention (88%) was higher than the majority of previous studies using the internet as a delivery method (26, 36). Among cancer survivors, Lee et al (36) had a retention rate of 97%. Among those with type 2 diabetes, Jennings et al (29) had a 66% retention at post-intervention, while Duncan et al (48) had 50% of their sample of Australian men complete the post-intervention survey. Large attrition is common among internet-based interventions (25, 27-29, 48) and like previous research, we had slightly higher attrition in the intervention group (15% vs. 9%) despite the high satisfaction ratings (29). It is difficult to pinpoint the reason for such high dropout rates but previous research indicates it is easier for participants to disengage from web-based interventions (49). Using strategies to increase the contact between user-to-user and user-to-researcher may help increase the connection and make the intervention meaningful to the participant (30).

Engagement in our study was fairly low compared to other internet based studies (29, 36). The modules had a completion rate of 26% (111/432 potential completions). As with logins, the number of completed modules dropped after the first few weeks. This is similar to a study by Duncan et al (48) among male Australians. Retaining and engaging participants remains an issue among internet-delivered behaviour change programs. Our average number of logins was 10.3 per person. This equals about once per week per person. Jennings et al (29) had an overall login average of 12 for both groups over 12 weeks. When looking at the intervention group alone, the number of logins increased to 21. A meta-analysis by Davies et

al (26) found the average number of logins per-person-per-week was 3.08 across 11 studies. Number of logins is the most commonly used measure of website engagement and is important to report (50). One potential reason for our lower login average is that the website was able to automatically pull data from devices such as the FitBit without the participants having to login. One recent suggestion for increasing user engagement is to allow user-generated content (e.g., creating a post to add to the newsfeed) (51) which may increase user "buy-in". This method, however, would need close monitoring as information would need to be vetted to endure accuracy and relevance.

Overall, the ANS program was very well received among participants in the UCAN group despite the low usage numbers. This is similar to other internet-based PA programs (29, 36, 48, 52). Most participants felt that the information provided was useful and relevant and they indicated that they were more aware of their level of daily activity. They also indicated they liked the weekly posts and videos and would be interested in continuing with the ANS program. Participants evaluated the website favourably and said they would recommend it to a friend but the majority indicated they would not continue using the site with the program finished. Very few participants contacted the study coordinator with issues related to using the website.

Engagement seems to be the biggest hurdle among internet delivered interventions. Vandelanotte et al. (30) evaluated freely accessible websites that promote physical activity and found that many did not use tools such as self-monitoring, goal setting and targeted feedback despite the supporting evidence (28, 31, 32, 53). An aspect found to be useful that our study lacked is a method of users generating their own content. Despite having a "news feed", our users were not able to directly message other participants which has been shown to

increase effectiveness of web-based interventions (32). Standardizing the components of behaviour change websites and thoroughly testing them will allow researchers to determine which are most effective among various populations.

As expected based on the small sample size of this pilot study, there were no significant between group differences in any PA measure. Nevertheless, after adjusting for baseline measures, the UCAN group increased total exercise by 42 minutes more than UC (29 aerobic minutes plus 12 strength minutes) which translated into a small standardized effect size of d=0.17 which is slightly higher than the overall effect size of d=0.12 found by Davies and colleagues (26). Moreover, the largest effect of the intervention was for strength training frequency where the UCAN group added a half day per week compared to the UC group (d=0.34). The previous research among cancer survivors (36) and the meta-analysis by Davies and colleagues (26) found that computer tailored PA programs had positive effects on PA. Previous reviews also indicate that internet-delivered interventions have positive effects on PA levels (54-56). One possible explanation for the modest effect of our intervention is the relatively high percentage of participants meeting PA guidelines at baseline (46%). Our invitation was to any who wanted to increase their PA with the assumption that only less active people would volunteer for such a study. Moreover, we included those meeting the guidelines because research has shown that even more health benefits can be gained by increasing activity levels to 300 or more minutes per week. (57, 58).

After performing an exploratory subgroup analysis we found a suggestion that the program may be more effective for those who were not meeting guidelines at baseline. Among those not meeting guidelines at baseline, the UCAN group increased their PA levels by 52 minutes while the UC group decreased by 15 minutes (see Figure 2). Among those

meeting guidelines, the UCAN and UC group increased PA by 88 and 65 minutes respectively. The suggestion that PA behaviour change programs are most beneficial to those least active is similar to previous research (26). Targeting specific populations that have lower than average PA levels (i.e., cancer survivors, inactive population) may have an even larger effect on clinical and public health outcomes (26).

Not surprisingly, our study did not find any beneficial changes in QoL measures. In fact, the only significant finding was a negative effect on mental health ($p=.014$, $d=0.37$). It is common to find no significant benefits to QoL among distance based PA interventions for cancer survivors even when PA increases are noted (22, 59). Similar to the PA measures, some studies have found significant improvements in aspects of QoL at post-intervention that were not sustained when assessed at follow-up (38, 60-66). Over the course of the study intervention, fourteen intervention participants contacted the study coordinator indicating they were having physical or personal issues, which may be a possible explanation for the negative trend in QoL evident in this study. Based on qualitative comments left by participants at the post-intervention survey, many felt that the QoL measures used did not apply to them as it had been so long since diagnosis. Approximately 85% of the study sample were more than 5 years since diagnosis. It may be that the measures used to assess QoL are more applicable to patients on treatments. Despite our inclusion of the generic SF-36, it may be beneficial to include long-term cancer-specific QoL measures for studies among long-term cancer survivors to see if they would be more applicable.

This is the first study to deliver a targeted, web-delivered PA behaviour change intervention to Nova Scotian cancer survivors, and one of the first among any cancer survivor group. This study showed that some cancer survivors are interested and willing to

receive PA information through the internet; however, modifications to the web site are necessary to optimize the effectiveness. Limitations of this study are the use of self-report data, the low usage rate overall, the decline in usage over the intervention period, and the lack of prior focus group testing. It may have been beneficial to include a pilot study to conduct evaluation among survivors, behavioural theory experts, and health professionals as part of the development phase. This may have had an impact on the development of the modules and website design. Despite the user-friendly web site we used to pilot this program, there were comments about confusion on how to use the site and find our information. In the future, we would recommend ensuring a separate site that would be able to house the information in a more prominent position.

In conclusion, using a web-based platform to deliver a PA behaviour change intervention to cancer survivors may be a feasible alternative to other methods of information delivery. There was a trend toward increased activity in the UCAN group when compared to the UC group, especially among inactive cancer survivors, although no significant differences were found. User engagement remains a challenge. Future research should incorporate as many of the tools previously found to be effective among web-based interventions to increase engagement and maintain PA behaviour.

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Table 5- 1: Demographic and behavioural characteristics of cancer survivors in Nova Scotia, Canada, September –October 2014.

Demographic/ Behaviour Variables	Overall (n=95) N (%)	Usual Care (n=47) N (%)	UCAN (n=48) N (%)	P value
Gender				1.00
Female	53 (56%)	26 (55%)	27 (56%)	
Male	42 (44%)	21 (48%)	21 (44%)	
Age [Mean (SD)]	65.1 (8.5)	65.7 (8.6)	64.5 (8.4)	.86
≤ 59	24 (25%)	11 (23%)	13 (27%)	
60-69	41 (43%)	20 (43%)	21 (44%)	
≥ 70	30 (32%)	16 (34%)	14 (29%)	
Ethnic origin				.99
White	94 (99%)	46 (98%)	48 (100%)	
Other	1 (1%)	1 (2%)	0 (0%)	
Marital status				1.00
Married	82 (86%)	41 (87%)	41 (85%)	
Not married	13 (14%)	6 (13%)	7 (15%)	
Education				.033
≤High School	22 (23%)	6 (13%)	16 (33%)	
Postsecondary	73 (77%)	41 (87%)	32 (67%)	
Family Income				.63
< 60,000	32 (34%)	18 (38%)	14 (30%)	
≥ 60,000	47 (50%)	22 (47%)	25 (52%)	
Prefer not to answer	16 (17%)	7 (15%)	9 (19%)	
Employment				.71
Employed	29 (31%)	13 (28%)	16 (33%)	
Not employed	66 (69%)	34 (72%)	32 (67%)	
Smoking status				.07
Never	43 (45%)	23 (49%)	20 (42%)	
Ex-smoker	47 (50%)	19 (40%)	28 (58%)	
Current smoker	5 (5%)	5 (11%)	0 (0%)	
Alcohol consumption				.31
Never drink	21 (22%)	8 (17%)	13 (27%)	
Social	60 (63%)	30 (64%)	30 (63%)	
Regular	14 (15%)	9 (19%)	5 (10%)	
Meeting PA guidelines				.35
Inactive	32 (34%)	13 (28%)	19 (39%)	
Insufficiently active	19 (20%)	12 (25.5%)	7 (15%)	
Meeting guidelines	17 (18%)	10 (21%)	7 (15%)	
Above guidelines	27 (28%)	12 (25.5%)	15 (31%)	
Dog Owner				.96
Yes	21 (22%)	11 (23%)	10 (21%)	
No	74 (78%)	36 (77%)	38 (79%)	

Table 5- 2: Medical characteristics of cancer survivors in Nova Scotia, Canada, September – October 2014.

Medical Variables	Overall (n=95) N (%)	Usual Care (n=47) N (%)	UCAN (n=48) N (%)	P value
Cancer Type				.95
Breast	48 (51%)	23 (49%)	25 (52%)	
Prostate	27 (28%)	14 (30%)	13 (27%)	
Colorectal	20 (21%)	10 (21%)	10 (21%)	
Disease Stage				.72
Localized	83 (88%)	42 (90%)	41 (86%)	
Metastasized	6 (6%)	2 (4%)	4 (8%)	
Don't know	6 (6%)	3 (6%)	3 (6%)	
Surgery				.37
Yes	90 (95%)	46 (98%)	44 (92%)	
No	5 (5%)	1 (2%)	4 (8%)	
Radiation therapy				.93
Yes	43 (45%)	22 (47%)	21 (44%)	
No	52 (55%)	25 (53%)	27 (56%)	
Chemotherapy				.12
Yes	41 (43%)	16 (34%)	25 (52%)	
No	54 (57%)	31 (66%)	23 (48%)	
Hormone Therapy				.54
Yes	25 (26%)	10 (21%)	15 (31%)	
No	70 (74%)	37 (79%)	33 (69%)	
Current treatment status				.23
No treatment	75 (79%)	40 (85%)	35 (73%)	
Receiving treatment	20 (21%)	7 (15%)	13 (27%)	
Recurrence				.037
Yes	6 (6%)	0 (0%)	6 (12%)	
No	89 (94%)	47 (100%)	42 (88%)	
Current disease status				.13
Disease free	91 (96%)	47 (100%)	44 (92%)	
Existing disease	4 (4%)	0 (0%)	4 (8%)	
Time since diagnosis [Mean (SD)]	6.6 (2.6)	6.4 (2.9)	6.8 (2.4)	1.00
< 5 years	14 (15%)	7 (15%)	7 (15%)	
≥ 5 years	81 (85%)	40 (85%)	41 (85%)	
General Health				.14
Very good/Excellent	48 (51%)	28 (60%)	42 (42%)	
Good	42 (44%)	18 (38%)	24 (50%)	
Poor/Fair	5 (5%)	1 (2%)	4 (8%)	
Co-morbidity status				.16
No co-morbidities	15 (16%)	5 (11%)	10 (21%)	
1 co-morbidity	29 (30%)	14 (30%)	15 (31%)	
2 co-morbidities	23 (24%)	11 (23%)	12 (25%)	
3 co-morbidities	14 (15%)	11 (23%)	3 (6%)	
≥ 4 co-morbidities	14 (15%)	6 (13%)	8 (17%)	
Body mass index [Mean (SD)]	27.6 (4.4)	27.1 (3.9)	28.1 (4.9)	.17
Healthy weight	32 (34%)	16 (34%)	16 (33%)	
Overweight	33 (35%)	20 (43%)	13 (27%)	
Obese	30 (31%)	11 (23%)	19 (40%)	

Table 5- 3: Summary of website usage during 10-week study period, September- December 2014.

	Total	Total Avg per person	Weekly Averages								
			Week 1: Welcome session	**Week 2:** Exercise myths	**Week 3:** Exercise safety	**Week 4:** Goals/ Planning	**Week 5:** Exercise Benefits	**Week 6:** Keeping PA fun	**Week 7:** Exercise barriers	**Week 8:** Support network	**Week 9:** Deal with relapse
Logins	493	10.3	2.0	1.2	1.3	1.4	1.1	0.9	0.8	0.8	0.8
Page views	4319	90.0	2.6	7.3	10.8	10.6	12.6	14.0	11.3	10.6	10.1
Physical activity entries[a]	2293	47.8	5.5	7.1	6.5	5.2	5.3	4.3	4.6	4.7	4.6
Moderate minute entries	538	11.2	1.5	2.1	1.8	1.2	1.1	0.8	1.0	0.9	0.8
Vigorous minute entries	258	5.4	0.7	0.9	0.8	0.6	0.5	0.5	0.4	0.4	0.5
Step entries	768	16.0	1.5	2.0	1.9	1.8	2.0	1.7	1.7	1.7	1.7
Flights of stairs entries	729	15.2	1.8	2.1	1.9	1.6	1.7	1.3	1.5	1.6	1.7
% entering any PA	54%	--	56%	58%	67%	54%	60%	44%	48%	54%	44%
% entering moderate minutes	37%	--	42%	46%	54%	38%	38%	25%	31%	35%	25%
% entering vigorous minutes	23%	--	31%	31%	29%	23%	23%	17%	17%	17%	19%
% entering steps	38%	--	38%	38%	44%	40%	40%	35%	35%	35%	33%
% entering stairs	35%	--	38%	40%	48%	35%	33%	27%	27%	31%	35%
Moderate minutes recorded	52,035	1084	191	204	188	117	93	78	78	72	62
Step equivalent activity	9,755,666	203,243	27,412	31,332	29,427	22,605	22,452	17,903	17,311	17,933	16,868
Days PA entries made	1,085	22.6	2.4	3.2	3.0	2.6	2.7	2.0	2.2	2.3	2.1
Visits to modules[b]	213	4.4	61	37	31	31	21	6	9	12	5
Completed modules[c]	111	2.3	24	22	16	15	12	5	5	7	5
% completed modules	26%	--	50%	46%	33%	31%	25%	10%	10%	15%	10%

Note: [a]Could enter more than once per day; [b]Could visit the module more than once; [c]Considered complete if visited at least once

Table 5- 4: Effects of internet-delivered behaviour change PA program on PA in NS cancer survivors, September-December 2014.

Outcome (N=87)	Baseline Mean (SD)	Post study Mean (SD)	Mean Change Mean (95% CI)	Unadjusted between group difference in Mean Change Mean (95% CI); p, Standardized effect size *d*	Adjusted between group difference in Mean Change[a] Mean (95% CI); p, Standardized effect size *d*
Total exercise minutes[b]					
UC	212 (216)	241 (197)	+30 (-18 to +77)	+34 (-82 to +150); p=.56, d=0.13	+42 (-65 to +150); p=.44, d=0.17
UCAN	231 (269)	294 (354)	+64 (-45 to +172)		
Total aerobic minutes[c]					
UC	194 (207)	222 (183)	+29 (-19 to +76)	+22 (-83 to +126); p=.68, d=0.09	+29 (-65 to +123); p=.55, d=0.04
UCAN	208 (253)	258 (302)	+50 (-47 to +147)		
Moderate aerobic minutes[d]					
UC	117 (140)	128 (110)	+11 (-32 to +53)	+17 (-47 to +80); p=.60, d=0.11	+14 (-36 to +63); p=.58, d=0.12
UCAN	112 (132)	140 (132)	+27 (-22 to +77)		
Vigorous aerobic minutes[d]					
UC	39 (66)	47 (71)	+9 (-7 to +25)	+3 (-31 to +36); p=.88, d=0.03	+6 (-27 to +38); p=.73, d=-0.03
UCAN	48 (91)	59(109)	+11 (-20 to +42)		
Meeting aerobic guidelines					
UC	50% (51%)	68% (47%)	+19% (+3% to +34%)	-6% (-29% to +16%); p=.56, d=-0.13	-9% (-27% to +10%); p=.36, d=-0.23
UCAN	47% (51%)	58% (49%)	+12% (-5% to +28%)		
Strength Frequency					
UC	0.7 (1.2)	0.8 (1.3)	+0.1 (-0.2 to +0.4)	+0.4 (-0.2 to +1.0); p=.17, d=0.30	+0.5 (-0.2 to +1.1); p=.14, d=0.34
UCAN	0.9 (1.5)	1.4 (2.2)	+0.5 (-0.02 to +1.0)		
Strength minutes					
UC	18 (35)	19 (36)	+2 (-6 to +9)	+12 (-11 to +35); p=.29, d=0.25	+12 (-10 to +35); p=.28, d=0.04
UCAN	23 (45)	36 (84)	+14 (-8 to +36)		
Meeting strength guidelines[e]					
UC	25% (44%)	27% (45%)	+2% (-12% to +17%)	+5% (-14% to +23%) p=.61, d=0.11	+6% (-11% to +23%) p=.48, d=0.18
UCAN	28% (45%)	35% (48%)	+7% (-5% to +19%)		

Abbreviations: CI, confidence interval; PA, physical activity; UC, usual care; UCAN, UWALK Cancer group. [a]Difference in mean change adjusted for baseline value. [b]Total exercise minutes was computed by adding total aerobic minutes to total strength minutes [c]Total aerobic minutes was computed using moderate minutes plus 2 times the vigorous minutes. [d]Capped at 420 minutes per week. [e]Strength guidelines is engaging in strength exercise 2 or more times per week.

Table 5- 5: Effects of internet-delivered PA program on generic QoL in NS cancer survivors, September-December 2014.

Outcome (N=86)	Baseline Mean (SD)	Post study Mean (SD)	Mean Change Mean (95% CI)	Unadjusted between group difference in Mean Change Mean (95% CI); p, Standardized effect size *d*	Adjusted between group difference in Mean Change[a] Mean (95% CI); p, Standardized effect size *d*
Physical Functioning					
UC	49.1 (9.7)	50.1 (7.0)	+1.0 (-1.5 to +3.5)	+0.1 (-3.3 to +3.5); p=.96, d=0.01	-0.6 (-3.3 to +2.2); p=.68, d=0.18
UCAN	47.8 (7.9)	49.0 (8.0)	+1.1 (-1.3 to +3.5)		
Role-physical					
UC	50.4 (7.5)	49.4 (8.3)	-0.9 (-3.4 to +1.6)	-0.6 (-3.9 to +2.7); p=.71, d=-0.08	-1.0 (-4.3 to +2.2); p=.53, d=-0.06
UCAN	48.5 (8.6)	47.0 (11.0)	-1.5 (-3.8 to +0.7)		
Bodily pain					
UC	51.0 (8.4)	51.5 (9.1)	+0.5 (-1.9 to +2.9)	-1.0 (-4.3 to +2.3); p=.55, d=-0.13	-1.6 (-4.8 to +1.5); p=.30, d=-0.23
UCAN	49.0 (7.6)	48.6 (9.0)	-0.5 (-2.8 to +1.9)		
General health					
UC	46.0 (5.9)	47.4 (6.2)	+1.4 (-0.4 to +3.2)	-2.1 (-4.5 to +0.4); p=.10, d=-0.36	-1.8 (-4.2 to +0.5); p=.12, d=-0.27
UCAN	46.7 (6.4)	46.1 (7.6)	-0.6 (-2.3 to +1.1)		
Vitality					
UC	44.9 (7.9)	45.2 (8.3)	+0.3 (-1.2 to +1.8)	-1.5 (-3.9 to +0.9); p=.22, d=-0.27	-1.4 (-3.9 to +1.0); p=.25, d=-0.09
UCAN	45.7 (7.2)	44.5 (9.3)	-1.2 (-3.2 to +0.7)		
Social Functioning					
UC	51.6 (8.7)	51.0 (8.8)	-0.6 (-2.9 to +1.7)	-1.3 (-4.6 to +2.1); p=.46, d=-0.16	-1.7 (-4.9 to +1.5); p=.30, d=-0.00
UCAN	50.3 (8.4)	48.4 (10.3)	-1.9 (-4.4 to +0.6)		
Role-emotional					
UC	51.8 (7.1)	51.1 (8.3)	-0.7 (-3.8 to +2.4)	-0.8 (-5.1 to +3.4); p=.70, d=-0.08	+1.5 (-5.3 to +2.4); p=.44, d=0.00
UCAN	50.6 (8.0)	49.1 (10.5)	-1.5 (-4.5 to +1.5)		
Mental health					
UC	44.7 (4.8)	44.9 (5.8)	+0.3 (-0.9 to +1.4)	-2.9 (-5.1 to -0.6); p=.013, d=-0.57	-2.9 (-5.1 to -0.6); p=.014, d=-0.37
UCAN	45.0 (5.6)	42.3 (8.5)	-2.6 (-4.6 to -0.6)		
Physical health component					
UC	49.7 (7.8)	50.4 (7.5)	+0.7 (-1.3 to +2.8)	-0.3 (-3.0 to +2.5); p=.86, d=-0.04	-0.8 (-3.3 to +1.8); p=.55, d=-0.09
UCAN	48.3 (8.0)	48.8 (7.9)	+0.5 (-1.4 to +2.4)		
Mental health component					
UC	47.6 (6.0)	47.1 (7.3)	-0.5 (-2.4 to +1.3)	-2.3 (-5.3 to +0.8); p=.14, d=-0.32	-2.2 (-5.2 to +0.8); p=.14, d=-0.10
UCAN	47.7 (7.6)	45.0 (10.2)	-2.7 (-5.3 to -0.2)		

Abbreviations: CI, confidence interval; UC, usual care; UCAN, UWALK Cancer group. [a]Difference in mean change adjusted for baseline value.

Table 5- 6: Effects of internet-delivered PA program on cancer specific QoL in NS cancer survivors, September-December 2014.

Outcome (N=86)	Baseline Mean (SD)	Post study Mean (SD)	Mean Change Mean (95% CI)	Unadjusted between group difference in Mean Change Mean (95% CI); p, Standardized effect size *d*	Adjusted between group difference in Mean Change[a] Mean (95% CI); p, Standardized effect size *d*
Physical well-being					
UC	24.4 (4.0)	24.4 (3.7)	-0.1 (-0.9 to +0.8)	-0.8 (-2.0 to +0.4); p=.19, d=-0.28	-0.6 (-1.8 to +0.5); p=.28, d=-0.06
UCAN	25.1 (2.5)	24.2 (3.7)	-0.8 (-1.7 to +0.04)		
Social well-being					
UC	19.8 (5.9)	19.3 (5.9)	-0.6 (-1.8 to +0.7)	+0.1 (-1.6 to +1.9); p=.89, d=0.03	+0.5 (-1.2 to +2.1); p=.57, d=0.20
UCAN	21.2 (5.5)	20.8 (5.6)	-0.4 (-1.7 to +0.8)		
Emotional well-being					
UC	20.6 (3.6)	20.3 (4.5)	-0.3 (-1.8 to +1.1)	-0.05 (-2.0 to +1.9); p=.96, d=-0.01	+0.3 (-2.0 to +1.3); p=.69, d=0.22
UCAN	20.2 (3.6)	19.8 (3.7)	-0.4 (-1.7 to +0.9)		
Functional well-being					
UC	23.3 (4.0)	22.8 (5.5)	-0.5 (-2.0 to +1.0)	-0.4 (-2.2 to +1.5); p=.69, d=-0.09	-0.4 (-2.3 to +1.4); p=.64, d=-0.11
UCAN	23.1 (4.3)	22.2 (5.1)	-0.9 (-2.0 to +0.2)		
Fatigue symptoms					
UC	41.1 (11.9)	38.2 (8.2)	-2.9 (-5.1 to -0.7)	-0.5 (-3.3 to +2.3); p=.74, d=-0.07	+0.2 (-2.2 to +1.8); p=85, d=0.06
UCAN	41.7 (8.5)	38.4 (6.4)	-3.4 (-5.2 to -1.6)		
FACT-G					
UC	88.2 (14.1)	86.8 (14.3)	-1.5 (-4.8 to +1.8)	-1.1 (-5.5 to +3.3); p=.62, d=-0.11	+0.9 (-5.2 to +3.5); p=.69, d=0.06
UCAN	89.6 (11.7)	87.0 (15.0)	-2.6 (-5.6 to +0.5)		
FACT-F					
UC	129.4 (23.7)	125.0 (19.8)	-4.4 (-9.0 to +0.2)	-1.6 (-7.5 to +4.3); p=.60, d=-0.11	-1.1 (-6.5 to +4.4); p=.70, d=0.04
UCAN	131.3 (17.6)	125.4 (20.0)	-5.9 (-9.8 to -2.1)		
TOI-F					
UC	88.9 (18.7)	85.5 (15.0)	-3.5 (-7.1 to +0.1)	-1.7 (-6.2 to +2.9); p=.47, d=-0.16	-1.3 (-5.3 to +2.7); p=.51, d=-0.08
UCAN	89.9 (13.2)	84.8 (13.5)	-5.1 (-8.0 to -2.2)		

Abbreviations: CI, confidence interval; UC, usual care; UCAN, UWALK Cancer group; FACT-G, Functional Assessment of Cancer Therapy-General; FACT-F, Functional Assessment of Cancer Therapy-Fatigue; TOI-F, Trial Outcome Index-Fatigue. [a]Difference in mean change adjusted for baseline value.

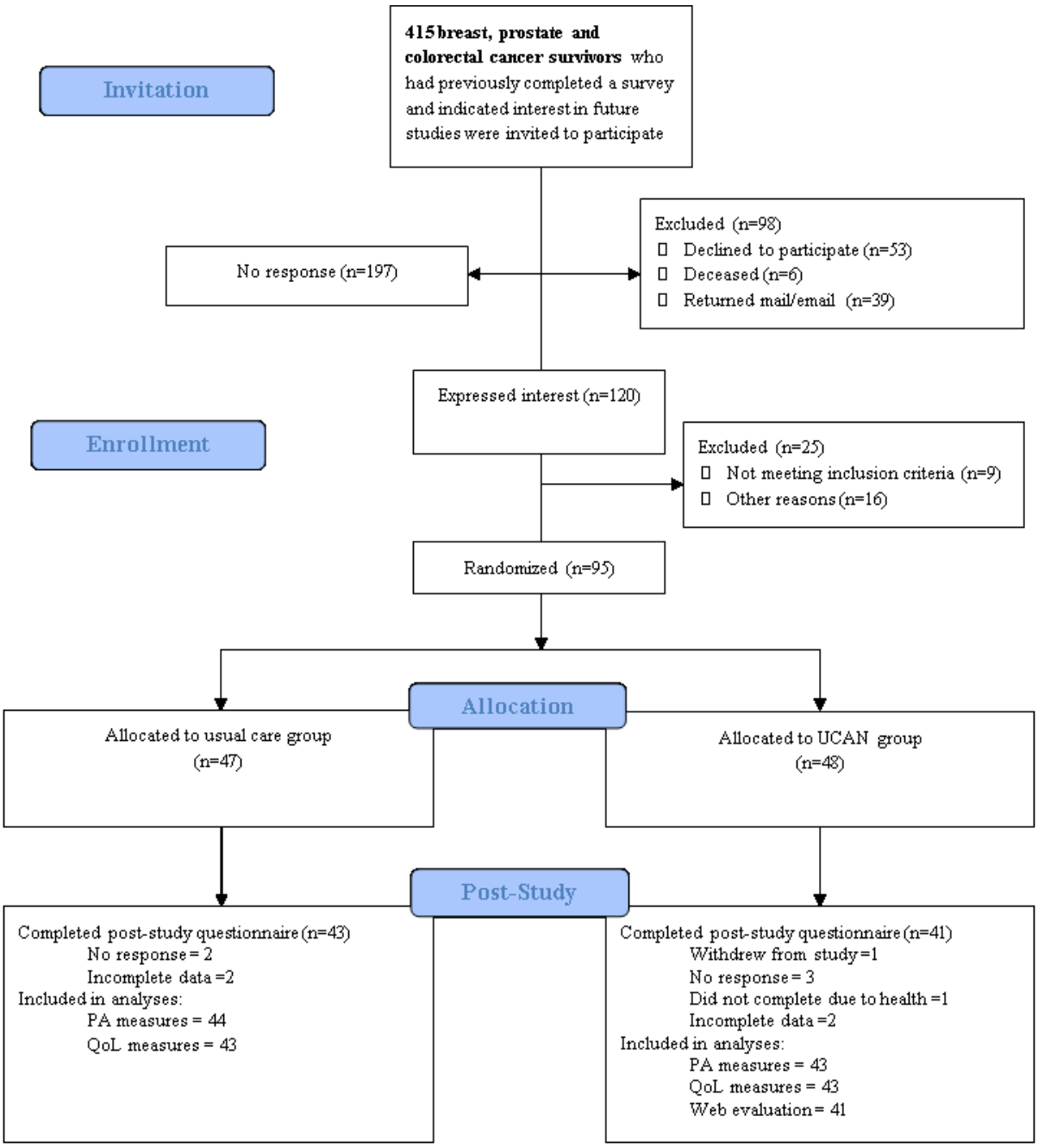

Figure 5- 1: Flow of participants through post intervention.

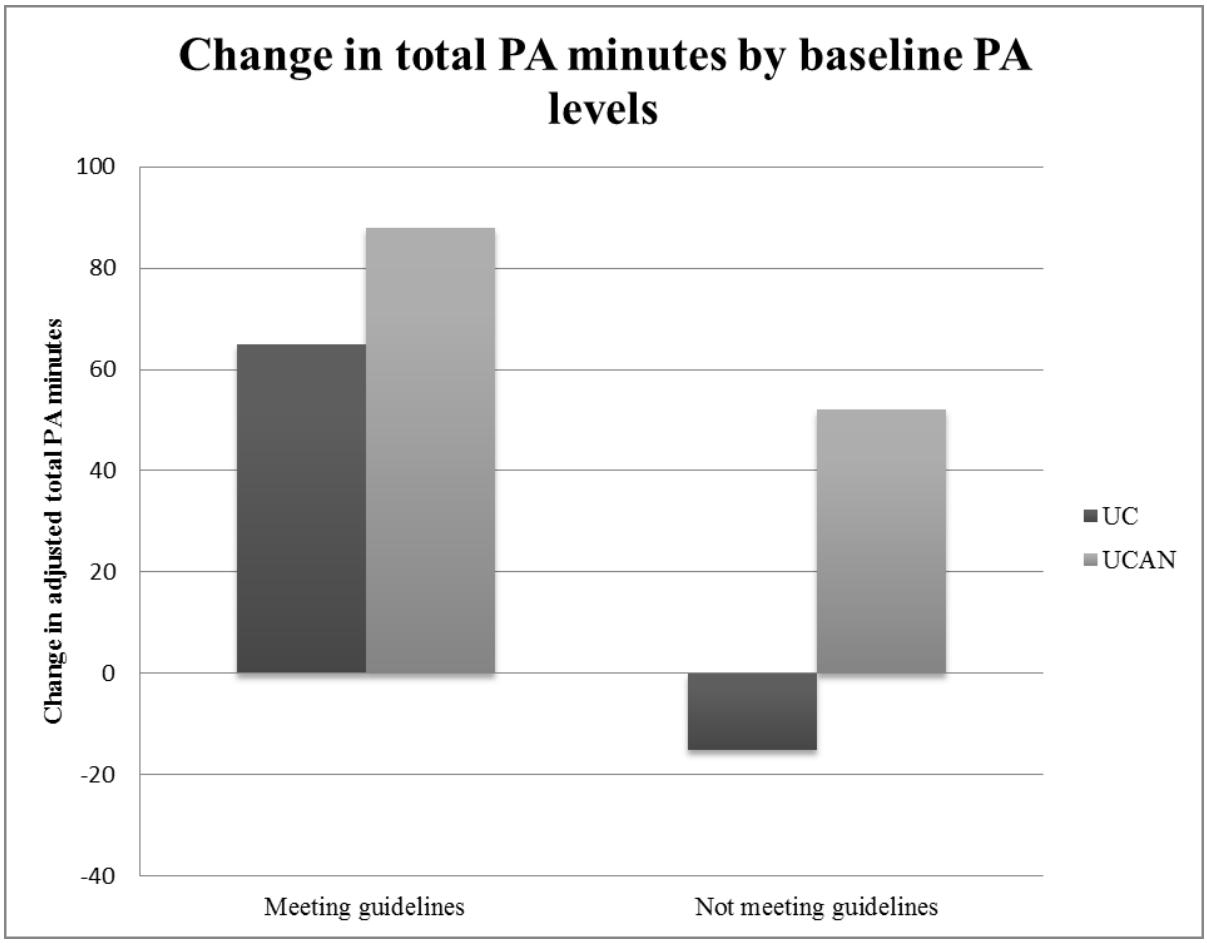

Figure 5- 2: Change in adjusted total PA by meeting guidelines at baseline.

Chapter 6 – STUDY II: Paper 5

Change in motivational outcomes of an internet-delivered home-based PA pilot intervention among Nova Scotian breast, prostate and colorectal cancer survivors.

Forbes CC, Blanchard CM, Mummery WK & Courneya KS. Change in motivational outcomes of an internet-delivered home-based PA pilot intervention among Nova Scotian breast, prostate and colorectal cancer survivors (in preparation).

Introduction

Despite the benefits of physical activity (PA) among cancer survivors, including improvements in aerobic endurance, muscular strength, fatigue, depression, anxiety, self-esteem, functional ability, and overall quality of life (1-7), the majority of cancer survivors do not meet the recommended PA public health guidelines of 150 minutes/week or more of moderate intensity activity (2, 8, 9). For example, less than 50% of Nova Scotian breast, prostate, and colorectal cancer survivors were meeting these PA guidelines (10).

Theoretical-based interventions targeting behaviour change may be most useful to increase PA levels among cancer survivors. In recent years, studies have focused on the correlates of PA behaviour, most of which used the Theory of Planned Behaviour (TPB) (11) as a framework. Multiple reviews and studies have found that among cancer survivors the TPB explains 23 to 69% of variance in PA intentions (9, 10, 12-17). Using targeted messages to help increase motivation is important when promoting behaviour change, as is determining significant correlates and preferences of PA among cancer survivors. This information is useful when developing PA education materials and programs. Traditional methods of PA theory based behaviour change, such as face-to-face counselling, telephone counselling and print-based material interventions have been used among cancer survivors to increase PA levels (18-23). These studies have found encouraging results that suggest these types of behaviour change interventions can positively influence PA behaviour change among cancer survivors yet, these interventions can be time consuming and costly.

In recent years, research has begun to focus on using internet-delivered programs to encourage behaviour change among the general and chronic disease populations and has found it a viable option when disseminating PA information (24-29). Two recent studies have

investigated motivation for a PA behaviour change program delivered via the internet among cancer survivors (30, 31). Valle and colleagues (30) used Social Cognitive Theory (SCT) to develop a Facebook delivered PA program for American young adult cancer survivors, while Lee et al (31) used the Transtheoretical Model (TTM) to deliver a web-based PA program among South Korean breast cancer survivors. Conflicting results for the effectiveness of these programs on motivational outcomes were found with one study finding negative results (30) and one finding positive results (31). Further research needs to be conducted to determine the effectiveness of the internet as a delivery method for PA behaviour change programs for cancer survivors.

Previously we investigated the feasibility and efficacy of an internet-delivered, home-based program designed to increase PA among breast, prostate, colorectal cancer survivors living in Nova Scotia (32). Participants were assigned to either the Active Nova Scotia (ANS) group housed on the UWALK.ca website (UCAN) or the usual care group (UC). We reported potentially meaningful changes in total PA between the groups, especially among those not meeting public health guidelines at baseline. There were no significant between group changes for any of the quality of life outcomes.

The purpose of this study was to examine the effect of an internet-delivered, home-based PA behaviour change program on motivational outcomes based on the TPB in a sample of breast, prostate and colorectal cancer survivors living in Nova Scotia. We hypothesized that those in the intervention group would have significantly greater positive changes in the TPB constructs and the related underlying beliefs than the usual care group.

Materials and Methods

Study Procedures and Population

Detailed methods have been described elsewhere (32). Briefly, a sample (N=415) of previously surveyed breast, prostate and colorectal cancer survivors currently living in Nova Scotia that identified an interest in future studies (10) were invited to participate in an PA behaviour change intervention. Study invitations, including an information sheet from the investigators explaining the purpose of the study and instructions on how to proceed if interested, a consent form and a copy of the first publication from the previous survey, were conveyed via email, mail or phone. Participants were eligible if they were: a) able to speak and read English, b) had access to the internet, and c) able and interested in an internet-delivered program that aimed to increase PA levels.

Design and Randomization

This two-group randomized, controlled pilot study compared a usual care group with an internet-delivered behaviour change group. The behaviour change program focused on increasing PA in the form of steps or minutes. After providing informed consent and completing a questionnaire to gather demographic, behavioural and PA information, eligible participants were randomized. Once baseline measures were completed, a rolling blocked randomization was undertaken. Using a computer generated randomization program, participants were assigned to one of two groups randomly. Group allocation was completed by a research assistant and blocking was based on when baseline measures were received to eliminate bias. The two groups were the usual care (UC) or the intervention group which was a private community called *Active Nova Scotia* (ANS) embedded on the PA tracking website UWALK.ca (UCAN). All participants were notified of their randomly assigned group via email.

Intervention

The UCAN group were able to access a nine-module behaviour change program which was based on previously developed printed booklets (20, 33). As previous research has shown (27), to increase retention the nine modules were published sequentially on the site as the intervention progressed. Topics of the information posts were developed from previous studies and from our survey results (10, 20, 33, 34). Module topics were: 1) welcome – general information about exercise, intensity, and the website, 2) exercise myths – identifying and debunking common exercise myths, 3) exercise safety – tips on how to be a smart and safe exerciser, 4) goals and planning – planning and making SMART goals, 5) exercise benefits –health benefits specific to cancer survivors, 6) make it fun – ideas to keep exercise fun, 7) exercise barriers – most common barriers and how to overcome them, 8) support network – friends and family can help you exercise, and 9) relapse – tips and hints on how to manage relapse. All modules remained on the website after each week was concluded for participants to review. In order to foster a connection and simulate face-to-face interactions, each module had a video featuring the lead researcher and a brief introduction relevant to the current topic.

Other features of the UWALK.ca website available for the UCANS group were activity tracking PA in steps, moderate or vigorous minutes and flights of stairs, ability to see the progress of other group members as well as their own progress over time, weekly email updates with a link to the current week's information post a overview of their previous week's activity. Emails were worded to offer positive encouragement to those who were insufficiently active and congratulate those who were meeting guidelines. The UC group was instructed to maintain their normal routine over the next 9 weeks.

Measures

Demographic and medical information

Baseline and post-study surveys were completed online using FluidSurveys survey software. Self-report measures of baseline demographic and medical data were collected and included age, sex, marital status, education level, income, employment status, ethnicity and height and weight in order to calculate body mass index (BMI). Medical variables collected were date of diagnosis, cancer site, disease stage, previous treatments, current treatment status, cancer recurrence and current disease status.

Theory of Planned Behaviour

Social-cognitive constructs from the TPB used the following definition for regular PA: moderate intensity PA (e.g., brisk walking) done for at least 150 minutes per week (2.5 hours) or vigorous intensity PA (e.g., jogging) done for at least 75 minutes per week (1.25 hours), or any combination that results in 150 "PA minutes" per week that double weights the vigorous minutes. The questionnaires examined engaging in regular PA over the next 3 months.

Intention was measured with two 7-point Likert scale items that asked "Do you intend to do regular PA over the next 12 weeks" (*no, not really* to *strongly intend*) and "How motivated are you to do regular PA over the next 12 weeks" (*not at all motivated* to *extremely motivated*). Planning was assessed using six items on a 7-point Likert scale with responses ranging from *no plans* to *detailed plans*. The first item asked "Do you have plans for when, where, and the type of PA you will do in the next 12 weeks?" The following five items expanded on the first asking "I have made detailed plans concerning…" when, where, what, how and who they will engage in regular PA.

Attitude was measured by items using a bipolar adjective scale ranging from 1 to 7 that will assess both components; instrumental (i.e., *harmful-beneficial*, *useless-useful*, *bad-good*) and affective attitude (i.e., *unenjoyable-enjoyable*, *boring-fun*, *unpleasant-pleasant*).The preceding statement was "For me, engaging in PA regularly over the next 12 weeks will be...."

Subjective norm was evaluated using items with a 7-point Likert scale ranging from 1 to 7 (*strongly disagree* to *strongly agree*). The injunctive norm items included were "Most people who are important to me 1) think I should, 2) would encourage me to, and 3) would support me, engaging in PA regularly over the next 12 weeks." Descriptive norm was assessed using two items asking "I think that over the next month, most people who are important to me will be…" (*extremely inactive* to *extremely active*) and "I think that over the next 12 weeks, most people who are important to me will participate in regular PA" (*strongly disagree* to *strongly agree*).

Perceived Behavioural Control (PBC) was assessed with six items on a 7-point Likert scale. The items were 1) "if you were really motivated, 1) participating in PA over the next 12 weeks would be..." 1 to 7 (*extremely difficult* to *extremely easy*), 2) "if I wanted to, I could easily engage in regular activity over the next 12 weeks" 1 to 7 (*strongly agree* to *strongly disagree*) and, 3) "how confident are you that you could engage in PA regularly over the 12 weeks" 1 to 7 (*not at all confident* to *extremely confident*),4) "If you were really motivated, how much control do you feel you would have in engaging in PA regularly over the next 12 weeks" 1 to 7 (*very little control* to *complete control*), 5) "Whether or not I engage in PA regularly over the next 12 weeks is completely up to me" 1 to 7 (*strongly disagree* to

strongly agree), and, 6) "How much do you feel that engaging in PA over the next 12 weeks is beyond your control" 1 to 7 (*not at all* to *very much*).

Underlying beliefs were measured using a series of questions under three belief subheadings (i.e., normative, behavioural and control). All items were assessed using a 7-point Likert scale ranging from "*extremely un- to extremely ...*" depending on the specific item.

Statistical Analysis

Analyses were performed using PASW Statistics 22 (PASW Inc., Chicago, IL). Analyses of variance (ANOVAs) and Analyses of Covariance (ANCOVAs) were performed to determine the mean change differences from baseline to post-intervention between the UCAN and UC groups for the motivational TPB variables and underlying beliefs. With 48 and 47 participants per condition, the trial had power to detect medium standardized effects (d=0.60) at a p value of .05. A *trend* was defined as a p<.10 and potentially meaningful clinical significance a standardized effect size of $d \geq 0.20$. All analyses used intention-to-treat protocol. Intention to treat protocol was used for those who provided complete data for both baseline and post-intervention measures.

Results

A detailed description of the characteristics and flow of participants was previously published (32). Briefly, 415 breast, prostate and colorectal were contacted, 197 (47.5%) did not respond and 98 (23.6%) were excluded. One hundred-twenty survivors (28.9%) contacted us to express interest and of those, 95 were randomized (UCANS=48; UC=47) giving us a 22.9% recruitment rate. Measurement retention was 88% at the post-intervention survey. The sample was mostly female (56%), married (86%), more educated (77%), had higher income

(50%), breast cancer survivors (51%), more than 5 years since diagnosis (85%), currently disease free (96%), indicated a perceived general health of good or better (95%) and were not meeting minimum PA guidelines (54%). We calculated average age and body mass index as 65.1 years and 27.6 kg/m^2 respectively.

Changes in TPB constructs

Table 1 describes the changes in TPB variables between the study groups from baseline to post-study measures. At post-intervention, significant medium effects in favour of the UC group were found for self-efficacy (adjusted mean change -0.7; 95% CI= -1.2 to -0.1; d=-0.53, p=.019), affective attitude (adjusted mean change -0.4; 95% CI= -0.8 to -0.0; d=-0.45, p=.044), and instrumental attitude (adjusted mean change -0.5; 95% CI= -0.9 to -0.1; d=-0.43, p=.026). Potentially meaningful non-significant changes in favour of the UC group were also noted in intention (adjusted mean change -0.5; 95% CI= -1.0 to +0.1; d=-0.36, p=.11), planning (adjusted mean change -0.6; 95% CI= -1.3 to +0.0; d=-0.42, p=.06), PBC (adjusted mean change -0.4; 95% CI= -0.8 to +0.1; d=-0.35, p=.12), and injunctive norm (adjusted mean change -0.2; 95% CI= -0.6 to +0.1; d=-0.33, p=.14).

Changes in Salient Beliefs

Tables 2-4 describe the changes in behavioural, control and normative beliefs. At post-intervention, there were no significant changes among behavioural beliefs between the UCAN and UC group. Potentially meaningful effect sizes favouring the UC group were observed for feeling better (adjusted mean change -0.3; 95% CI= -0.7 to +0.1; d=-0.28, p=.19) and relieving stress (adjusted mean change -0.3; 95% CI= -0.8 to +0.2; d=-0.29, p=.19). There were no significant changes between the UCAN and UC group for normative

beliefs. One potentially meaningful effect favouring the UCAN group was noted for oncologist support (adjusted mean change +0.4; 95% CI= -0.1 to +1.0; d=0.33, p=.13).

Significant moderate to large effects at post intervention favouring the UC group for control beliefs were found for engaging in PA in bad weather (adjusted mean change -0.8; 95% CI= -1.6 to -0.1; d=-0.49, p=.030), having medical or health issues (adjusted mean change -0.7; 95% CI= -1.3 to -0.1; d=-0.48, p=.031), pain or soreness (adjusted mean change -0.7; 95% CI= -1.4 to -0.1; d=-0.52, p=.020), family responsibilities (adjusted mean change -1.0; 95% CI= -1.7 to -0.3; d=-0.62, p=.005), and feeling that PA is boring (adjusted mean change -0.8; 95% CI= -1.4 to -0.1; d=-0.54, p=.016). Potentially meaningful, though non-significant differences also favouring the UC group were found for being tired or fatigued (adjusted mean change -0.8; 95% CI= -1.4 to -0.1; d=-0.54, p=.016), being busy (adjusted mean change -0.8; 95% CI= -1.4 to -0.1; d=-0.54, p=.016), and having a cancer recurrence (adjusted mean change -0.8; 95% CI= -1.4 to -0.1; d=-0.54, p=.016).

Discussion

We previously reported a small positive effect of the UCAN internet-based intervention on PA in cancer survivors (32). The main purpose of this study was to examine the effects of the intervention on motivation. Our results did not support the hypothesis that the UCAN group would have greater positive changes in motivational outcomes than the UC group. As expected, the UC group changed very little from baseline to post-intervention. Contrary to expectations, however, the UCAN experienced significant and large declines in motivation after the intervention. Significant negative effects were discovered for self-efficacy, affective and instrumental attitude among the UCAN group. This means that at the end of the study, those in the UCAN group felt PA was less beneficial, less enjoyable, and

they were less confident about their ability to do PA than the UC group. Potentially meaningful, non-significant negative effects were also found for the other core TPB measures. Overall, motivation to engage in PA decreased among the UCAN group more than the UC group. In addition to the main TPB outcomes, underlying beliefs generally trended toward negative effects.

Although our results for motivation were unexpected and contradictory with the PA behaviour outcomes, similar results have been reported among distance based studies using print or telephone delivery to promote PA (22, 35). Valle and colleagues (30) examined psychosocial mediators of PA using a Facebook delivered behaviour change program. Participants were randomized to one of two Facebook-based groups (intervention or self-help comparison). The intervention group (FITNET) were able to use a PA tracking website and received weekly messages designed to illicit social support and skill building. The comparison group received weekly messages with general PA information. Both groups received a pedometer to use over 12 weeks. In their main paper, they report no significant effect of the intervention on moderate-to-vigorous PA (36). In a secondary paper, Valle et al. report significantly lower self-efficacy and social support from social network friends (online friends) in the intervention group when compared to the self-care group from baseline to post-intervention (30). In another study, Rabin and colleagues (35) examined whether a brief TTM-based intervention delivered over the phone would affect the adoption of PA among breast cancer survivors and found small non-significant changes among TTM constructs in favour of the telephone group. A study testing a TPB-based PA behaviour change booklet among breast cancer survivors also found very small changes in the TPB components

concluding that it may be unrealistic for a minimal-contact intervention to expect large changes in social cognitive variables (22).

There are several possible explanations for our paradoxical findings of a small positive effect of the UCAN program on PA and a moderate negative effect on motivation. One possible explanation is a *response shift* (37) at baseline. Prior to starting a PA program, expectations of how enjoyable, beneficial or easy it may be to perform PA may be artificially inflated due to lack of recent experience. After attempting the program, the reality of beginning a PA program may be drastically different resulting in a more realistic evaluation of the benefits, difficulty, and enjoyment of performing a PA program in the intervention group. Previous research subscribes to this explanation for small or negative changes in motivational outcomes (22, 30).

Another possible explanation could be the low engagement rate for the behaviour change program (32). We previously reported only 26% of the modules were "completed" or read meaning the program may not have been effectively delivered to many of the participants. The behaviour change program offered advice on how to overcome barriers and had encouraging messages from oncologists as well as other cancer survivors designed to increase self-efficacy and control beliefs, yet, approximately 75% of the intervention sample did not access these messages. Valle and colleagues also indicate that low adherence to their study website, supplementing the Facebook group, may have been an explanation for their negative results (30, 36).

A recent review and meta-analysis examined the effectiveness of various techniques used change self-efficacy to increase PA (38). Self-efficacy is a main component in most prominent behaviour change theories, yet can be operationalized in various ways. They found

a significant small effect (d=0.16, p>.001) of the 27 unique interventions on self-efficacy. Among the techniques, those using vicarious experience (seeing others similar to themselves performing PA), and feedback on past or others' performance (personal comparison or comparison to like others) had significantly higher PA self-efficacy. On the other hand, interventions that used persuasion (a third party expressing faith in abilities), graded mastery (increasingly more difficult goals), and barrier identification (listing barriers to PA) techniques had significantly lower PA self-efficacy overall with individual studies reporting negative effects (39-43). The current study used forms of verbal persuasion and barrier identification which may have contributed to the negative effects. We also gave feedback on past behaviour; however, this may be viewed as negative if the participant feels they are not reaching their goals and are being reminded of their "failure."

Despite our negative results, other studies have found increases in motivational outcomes using internet delivery (31) and other delivery methods (9, 22, 23, 44, 45). Therefore, future research should pay attention to the methods of operationalizing motivational messaging that will be most effective. Focusing on vicarious experience by showcasing similar others' ability to perform PA or using testimonials; and carefully worded feedback based on past and other's comparison may be more effective in changing motivation than persuasion messages and identifying methods of overcoming barriers (38).

Several strengths and limitations should be considered with respect to our data and planning future research. Among the strengths are being the first TPB-based internet-delivered intervention to assess motivational outcomes among cancer survivors, using validated measures to assess TPB components, and achieving a high completion rate with little attrition. Limitations include using self-report measures for PA and the potential

selection bias of the sample meaning those highly motivated to engage in an internet-based study were more likely to participate.

This pilot study reports preliminary evidence of a TPB-based behaviour change program on motivational changes among breast, prostate, and colorectal cancer survivors living in Nova Scotia. Our results suggest that the program had a negative effect on the main motivation outcomes as represented by the TPB, especially the PBC-related constructs (i.e., self-efficacy and control beliefs). This study contributes to the limited literature about internet-delivered, theory-based PA behaviour change programs among cancer survivors. Future research in this area should focus on determining the most effective method of eliciting changes in motivation, especially self-efficacy, and how best to present these messages in the medium of internet-delivery among a larger sample of cancer survivors.

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Table 6- 1: Effects of internet-delivered behaviour change PA program on motivation at post-intervention in Nova Scotian cancer survivors, Sept-Dec 2014.

Outcome (N=84)	Baseline Mean (SD)	Post study Mean (SD)	Mean Change Mean (95% CI)	Unadjusted between group difference in Mean Change Mean (95% CI); p, Standardized effect size *d*	Adjusted between group difference in Mean Change[a] Mean (95% CI); p, Standardized effect size *d*
Intention					
UC	5.5 (1.4)	5.4 (1.7)	-0.1 (-0.5 to +0.2)	-0.4 (-1.0 to +0.1); p=.14, d=-0.32	-0.5 (-1.0 to +0.1); p=.11, d=-0.36
UCAN	5.4 (1.5)	4.8 (1.7)	-0.5 (-1.0 to -0.1)		
Planning					
UC	5.0 (1.9)	5.1 (1.7)	+0.1 (-0.2 to +0.5)	-0.4 (-1.1 to +0.3); p=.30, d=-0.23	-0.6 (-1.3 to +0.0); p=.06, d=-0.42
UCAN	4.4 (2.3)	4.1 (2.2)	-0.3 (-0.9 to +0.4)		
Perceived Control					
UC	5.8 (0.9)	5.8 (1.2)	+0.1 (-0.3 to +0.2)	-0.2 (-0.7 to +0.3); p=.38, d=-0.19	-0.4 (-0.8 to +0.1); p=.12, d=-0.35
UCAN	5.5 (1.3)	5.2 (1.3)	-0.3 (-0.7 to +0.1)		
Self-Efficacy					
UC	5.6 (1.3)	5.5 (1.5)	-0.1 (-0.5 to +0.3)	-0.5 (-1.1 to +0.1); p=.11, d=-0.35	-0.7 (-1.2 to -0.1); p=.019, d=-0.53
UCAN	5.1 (1.5)	4.6 (1.5)	-0.6 (-1.0 to -0.2)		
Affective Attitude					
UC	5.8 (0.9)	5.8 (1.0)	-0.0 (-0.2 to +0.3)	-0.3 (-0.7 to +0.1); p=.13, d=-0.34	-0.4 (-0.8 to -0.0); p=.044, d=-0.45
UCAN	5.4 (1.1)	5.2 (1.2)	-0.3 (-0.6 to +0.0)		
Instrumental Attitude					
UC	6.3 (0.8)	6.3 (0.8)	+0.1 (-0.2 to +0.3)	-0.4 (-0.9 to -0.0); p=.049, d=-0.44	-0.5 (-0.9 to -0.1); p=.026, d=-0.43
UCAN	6.2 (1.1)	5.9 (1.3)	-0.3 (-0.7 to +0.0)		
Injunctive Norm					
UC	6.1 (0.9)	6.1 (0.7)	-0.0 (-0.2 to +0.2)	-0.3 (-0.6 to +0.06); p=.11, d=-0.36	-0.2 (-0.6 to +0.1); p=.14, d=-0.33
UCAN	6.2 (1.1)	5.9 (1.2)	-0.3 (-0.6 to -0.0)		
Descriptive Norm					
UC	5.1 (1.4)	5.3 (1.2)	+0.2 (-0.1 to +0.5)	-0.3 (-0.7 to +0.2) p=.21, d=-0.27	-0.2 (-0.5 to +0.2) p=.34, d=-0.21
UCAN	5.3 (1.1)	5.2 (0.9)	-0.1 (-0.4 to +0.2)		

Abbreviations: CI, confidence interval; UC, usual care; UCAN, UWALK Cancer group. [a]Difference in mean change adjusted for baseline value.

Table 6- 2: Effects of internet-delivered behaviour change PA program on behavioural beliefs at post-intervention in Nova Scotian cancer survivors, Sept-Dec 2014.

Outcome	Baseline Mean (SD)	Post study Mean (SD)	Mean Change Mean (95% CI)	Unadjusted between group difference in Mean Change Mean (95% CI); p, Standardized effect size *d*	Adjusted between group difference in Mean Change[a] Mean (95% CI); p, Standardized effect size *d*
Feel better/Improve well-being					
UC	6.3 (0.8)	6.2 (0.9)	-0.1 (-0.4 to +0.2)	-0.3 (-0.7 to +0.1); p=.18, d=-0.30	-0.3 (-0.7 to +0.1); p=.19, d=-0.28
UCAN	6.4 (1.1)	6.0 (1.4)	-0.4 (-0.8 to -0.0)		
Reduce recurrence risk					
UC	5.1 (1.5)	5.2 (1.2)	+0.1 (-0.3 to +0.5)	-0.1 (-0.7 to +0.5); p=.75, d=-0.07	-0.1 (-0.6 to +0.4); p=.59, d=-0.12
UCAN	5.0 (1.6)	5.0 (1.8)	+0.0 (-0.4 to +0.4)		
Relieve stress					
UC	5.9 (1.4)	6.1 (0.9)	+0.2 (-0.1 to +0.6)	-0.4 (-0.9 to +0.1); p=.15, d=-0.32	-0.3 (-0.8 to +0.2); p=.19, d=-0.29
UCAN	6.1 (1.2)	5.9 (1.5)	-0.2 (-0.6 to +0.3)		
Improve energy level					
UC	5.9 (0.9)	5.9 (1.2)	+0.0 (-0.3 to +0.3)	-0.1 (-0.6 to +0.4); p=.72, d=-0.08	-0.0 (-0.5 to +0.4); p=.84, d=-0.04
UCAN	6.0 (1.2)	5.9 (1.2)	-0.1 (-0.5 to +0.3)		
Get mind off cancer					
UC	5.2 (1.7)	5.4 (1.6)	+0.3 (-0.3 to +0.9)	-0.2 (-1.0 to +0.6); p=.61, d=-0.11	-0.3 (-0.9 to +0.4); p=.45, d=-0.17
UCAN	5.1 (1.9)	5.2 (1.8)	+0.1 (-0.4 to +0.6)		
Live Longer					
UC	6.1 (1.0)	6.0 (1.0)	-0.1 (-0.5 to +0.2)	0.0 (-0.5 to +0.6); p=.88, d=0.03	-0.1 (-0.6 to +0.4); p=.65, d=-0.10
UCAN	5.7 (1.6)	5.6 (1.8)	-0.1 (-0.6 to +0.4)		
Improve fitness					
UC	6.5 (0.7)	6.4 (0.9)	-0.2 (-0.5 to +0.1)	-0.0 (-0.5 to +0.4); p=.88, d=-0.03	-0.1 (-0.5 to +0.3); p=.73, d=-0.08
UCAN	6.5 (1.1)	6.2 (1.2)	-0.2 (-0.6 to +0.1)		
Lose some weight					
UC	5.8 (1.4)	5.7 (1.5)	-0.1 (-0.4 to +0.2)	-0.2 (-0.7 to +0.3); p=.44, d=-0.18	-0.2 (-0.6 to +0.3); p=.50, d=-0.15
UCAN	5.9 (1.3)	5.6 (1.6)	-0.3 (-0.7 to +0.1)		
Improve immune system					
UC	5.9 (1.1)	5.7 (1.3)	-0.2 (-0.6 to +0.3)	-0.1 (-0.7 to +0.5); p=.67, d=-0.09	-0.1 (-0.6 to +0.4); p=.66, d=-0.10
UCAN	5.9 (1.3)	5.6 (1.3)	-0.3 (-0.7 to +0.1)		

Abbreviations: CI, confidence interval; UC, usual care; UCAN, UWALK Cancer group. [a]Difference in mean change adjusted for baseline value.

Table 6- 3: Effects of internet-delivered behaviour change PA program on normative beliefs at post-intervention in Nova Scotian cancer survivors, Sept-Dec 2014.

Outcome	Baseline Mean (SD)	Post study Mean (SD)	Mean Change Mean (95% CI)	Unadjusted between group difference in Mean Change Mean (95% CI); p, Standardized effect size *d*	Adjusted between group difference in Mean Change[a] Mean (95% CI); p, Standardized effect size *d*
Spouse/partner					
UC	6.1 (1.3)	5.9 (1.3)	-0.2 (-0.6 to +0.2)	+0.1 (-0.4 to +0.6); p=.67, d= 0.09	+0.1 (-0.3 to +0.6); p=.53, d= 0.14
UCAN	6.1 (1.5)	6.0 (1.1)	-0.1 (-0.4 to +0.3)		
Other family members					
UC	5.7 (1.4)	5.8 (1.2)	+0.1 (-0.3 to +0.5)	-0.3 (-0.8 to +0.3); p=.31, d= -0.22	-0.2 (-0.6 to +0.3); p=.39, d= -0.19
UCAN	5.9 (1.5)	5.7 (1.3)	-0.2 (-0.6 to +0.2)		
Best friends					
UC	5.9 (1.4)	5.7 (1.2)	-0.2 (-0.6 to +0.3)	+0.1 (-0.5 to +0.6); p=.82, d= 0.05	+0.0 (-0.4 to +0.5); p=.83, d= 0.05
UCAN	5.9 (1.4)	5.8 (1.2)	-0.1 (-0.4 to +0.2)		
Oncologist					
UC	5.8 (1.5)	5.4 (1.5)	-0.4 (-0.9 to +0.1)	+0.5 (-0.2 to +1.1); p=.17, d= 0.30	+0.4 (-0.1 to +1.0); p=.13, d= 0.33
UCAN	5.7 (1.7)	5.8 (1.3)	+0.0 (-0.4 to +0.5)		

Abbreviations: CI, confidence interval; UC, usual care; UCAN, UWALK Cancer group. [a]Difference in mean change adjusted for baseline value.

Table 6- 4: Effects of internet-delivered behaviour change PA program on control beliefs at post-intervention in Nova Scotian cancer survivors, Sept-Dec 2014.

Outcome	Baseline Mean (SD)	Post study Mean (SD)	Mean Change Mean (95% CI)	Unadjusted between group difference in Mean Change Mean (95% CI); p, Standardized effect size *d*	Adjusted between group difference in Mean Change[a] Mean (95% CI); p, Standardized effect size *d*
Bad weather					
UC	5.4 (1.6)	5.0 (1.6)	-0.4 (-0.8 to +0.0)	-0.6 (-1.4 to +0.2); p=.13, d=-0.34	-0.8 (-1.6 to -0.1); p=.030, d=-0.49
UCAN	4.8 (1.8)	3.8 (2.3)	-1.0 (-1.7 to -0.3)		
Tired/fatigued					
UC	4.9 (1.6)	4.6 (1.8)	-0.3 (-0.7 to +0.1)	-0.4 (-0.9 to +0.2); p=.23, d=-0.26	-0.4 (-1.0 to +0.1); p=.14, d=-0.33
UCAN	4.6 (1.7)	3.9 (1.9)	-0.7 (-1.1 to -0.3)		
Medical/health issues					
UC	3.9 (1.4)	3.8 (1.8)	-0.1 (-0.6 to +0.4)	-0.6 (-1.3 to +0.1); p=.09, d=-0.38	-0.7 (-1.3 to -0.1); p=.031, d=-0.48
UCAN	3.6 (1.6)	2.9 (1.7)	-0.7 (-1.2 to -0.2)		
Busy/limited time					
UC	5.0 (1.5)	4.6 (1.9)	-0.4 (-0.9 to +0.1)	-0.5 (-1.2 to +0.2); p=.13, d=-0.33	-0.6 (-1.3 to +0.0); p=.07, d=-0.41
UCAN	4.6 (1.8)	3.6 (2.0)	-0.9 (-1.4 to -0.4)		
Cancer recurrence					
UC	3.5 (1.5)	3.4 (1.7)	-0.1 (-0.5 to +0.2)	-0.6 (-1.4 to +0.1); p=.08, d=-0.40	-0.6 (-1.2 to +0.1); p=.09, d=-0.38
UCAN	3.7 (2.0)	2.9 (1.9)	-0.8 (-1.4 to -0.2)		
Pain/soreness					
UC	4.5 (1.6)	3.9 (1.7)	-0.5 (-1.0 to +0.0)	-0.7 (-1.4 to -0.0); p=.048, d=-0.44	-0.7 (-1.4 to -0.1); p=.020, d=-0.52
UCAN	4.3 (1.7)	3.2 (1.8)	-1.2 (-1.6 to -0.7)		
Family responsibilities					
UC	4.4 (1.5)	4.5 (1.6)	+0.0 (-0.5 to +0.6)	-1.1 (-1.9 to -0.3); p=.005, d=-0.62	-1.0 (-1.7 to -0.3); p=.005, d=-0.62
UCAN	4.7 (1.7)	3.6 (1.9)	-1.0 (-1.6 to -0.5)		
Boring					
UC	4.9 (1.7)	4.8 (1.7)	-0.1 (-0.6 to +0.3)	-0.8 (-1.4 to -0.1); p=.022, d=-0.51	-0.8 (-1.4 to -0.1); p=.016, d=-0.54
UCAN	4.9 (1.8)	4.0 (2.1)	-0.9 (-1.4 to -0.4)		
Back on treatment					
UC	3.1 (1.9)	3.2 (2.0)	+0.1 (-0.4 to +0.6)	-0.1 (-0.8 to +0.5); p=.72, d=-0.08	-0.1 (-0.7 to +0.5); p=.71, d=-0.08
UCAN	3.2 (2.0)	3.1 (2.0)	-0.0 (-0.5 to +0.4)		

Abbreviations: CI, confidence interval; UC, usual care; UCAN, UWALK Cancer group. [a]Difference in mean change adjusted for baseline value.

Chapter 7 – Discussion

Overview

The purpose of this dissertation was to design and test a physical activity (PA) behaviour change program among Nova Scotian cancer survivors using internet delivery. Using internet delivery to facilitate behaviour change has the advantage of increased efficiency and reach, and lower overall cost than print or face-to-face counselling. To our knowledge, the Active Nova Scotia (ANS) program is among the first internet-delivered behaviour change programs to be tested among breast cancer survivors and the first to be tested among prostate and colorectal cancer survivors. In addition, it is the first internet delivered program to use the Theory of Planned Behaviour (TPB) among cancer survivors. The ANS program was developed based on the correlates (Chapter 2) and the preferences (Chapter 3) determined in Study I.

Strengths and Limitations

The main strengths and limitations of the individual studies are discussed in the previous chapters. Overall, the general strengths include directly assessing the important correlates and preferences of PA in our sample prior to developing a PA program for the same population. This allowed us to develop targeted materials that would be specific and meaningful to the participants. Additionally, this dissertation provides the first direct comparison of PA correlates and preferences among breast, prostate and colorectal cancer survivors, and the first PA intervention among Nova Scotian cancer survivors which is an under-studied population despite higher incidence of most cancers.

This was a well-designed, 2-arm randomized trial comparing our intervention to a standard care control group. Moreover, the program materials were based in theory which has been shown to positively impact behaviour change (1). Additionally, the materials were

delivered in a mixed media format which may help increase engagement (2, 3). Each weekly module consisted of educational materials as well as a video featuring the lead researcher and images relevant to the topic. Other strengths of this research were the high rate of measurement completion at all time points and low attrition from the program.

Limitations of this trial include the inherent selection bias. Firstly, by using internet delivery, we automatically excluded those who did not have access to the internet, however small the percentage may be. Secondly, self-selection bias may have occurred by inviting people to an internet-delivered behaviour change designed to increase PA. It is possible that the most motivated to increase their PA and those most comfortable with the internet and web technology were more likely to volunteer for the study. Additionally, we had low engagement in the intervention group throughout the study. Finally, a significant limitation was using self-report data for our PA measurement introducing possible measurement error and biased reporting. Ideally, future studies should use objective measurement techniques such as accelerometry to ensure more complete and accurate data.

Future research

This dissertation provides the first data to directly compare these three cancer groups as well as the first data among Nova Scotian cancer survivors. Further research into the PA correlates and preferences of Nova Scotian cancer survivors should be conducted to corroborate our results. As well, focusing on different time points in the cancer continuum (i.e., during treatment or palliative care) instead of just the survivorship phase is important to assess PA effects on quality of life (QoL) at every stage. As mentioned previously, more accurate and objective measurement techniques should be used to assess PA levels to increase the reliability of findings. Assessing sedentary behaviour in addition to PA would

also be a worthy pursuit as sedentary behaviour has been independently linked to increased risk of chronic disease and all-cause mortality (4-6). PA programs among sedentary individuals have the potential to be even more effective as we illustrated in Chapter 5.

Researching and evaluating methods to increase engagement of internet-delivered interventions is an important step in future online behaviour change research. It would be beneficial to incorporate the most effective methods of web engagement and re-pilot this study to determine effectiveness of a modified website, and then perform another intervention on a larger scale. Additionally, future research should explore the efficacy of mobile health (mHealth) behaviour change techniques in this population. Smartphone technology is prolific with more than half of Canadians owning a smartphone and may be an ideal conduit for PA behaviour change interventions. Many are equipped with GPS and accelerometry technology and a brief search of application stores results in a multitude of options for PA tracking. This would provide a method of contact that would allow almost instant access to participants as well as a convenient method of intervention delivery.

Another potential avenue of research would be strategies to recruit those less motivated to participate in PA research. As mentioned previously, in PA research there is an inherent self-selection bias that favours people who are more motivated to become more active, therefore our results may not reflect the greater cancer population in Nova Scotia. Finally, participants commented often how they felt some measures "did not apply" to them as they had finished treatment more than five years ago. It may be worth finding a long term cancer QoL measure as the FACT-G asks about many side effects that may be considered shorter term.

Practical implications

Our preliminary research highlights potentially meaningful changes in total exercise minutes, especially among those who were more sedentary at baseline. Considering the potential reach of an internet-delivered intervention, even small effects may be significant when considering the broader population. Patients' activity levels should be assessed to identify those not meeting public health PA guidelines for intervention. Additionally, our study of PA correlates indicated there are potentially significant differences in what is most important to consider between cancer groups. A variety of approaches should be developed for materials depending on cancer type to be most effective.

Conclusions

Consistently higher than average cancer incidence rates among Atlantic Canadians instigated research among this understudied population. This dissertation has advanced the research in this area by directly comparing PA correlates and behaviour among three major cancer types, and testing TPB-based materials with an internet-delivered intervention. This dissertation highlights the importance of maintaining engagement when using a website to deliver a behaviour change program. Previous internet-based research with higher engagement rates showed favourable QoL and PA changes (7, 8) opposed to our results. Despite this we found promising PA changes among more historically sedentary participants which means using internet-delivery methods is feasible and efficacious among cancer survivors. Future interventions should focus on maximizing the effectiveness of a behaviour change program through best practices for eHealth and mHealth based research.

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Appendix A

Review of the Theory of Planned Behaviour and Physical Activity correlates in Cancer Survivors

Review of Physical Activity Preference Studies in Cancer Survivors

Review of Internet-based behaviour change programs among cancer survivors

Review of the Theory of Planned Behaviour and Physical Activity correlates in Cancer Survivors

To this researchers' knowledge there are 20 studies assessing the determinants of PA using the TPB among various cancer populations. Five looked at mixed cancer survivors (1-5), three studies investigated colorectal cancer survivors (6-8) and three breast cancer survivors (9-11). Individual studies examined NHL survivors (12), multiple myeloma survivors (13), adolescent cancer survivors (14), endometrial cancer survivors (15), brain cancer survivors (16), ovarian cancer survivors (17), bladder cancer survivors (18), young adult cancer survivors (19), and kidney cancer survivors (20). In general, studies have found that 23 to 69% of variance in PA intentions was explained using TPB constructs. Among the more recent studies, both affective (11, 19) and instrumental attitude (11, 19, 20) and PBC (19, 20) have been found to be unique contributors to the variance in PA intentions.

Courneya and Friedenreich examined the determinants of PA among colorectal cancer survivors during treatment using the TPB. Participants (n=110) completed a retrospective survey which assessed their beliefs, attitudes, norms, perceptions of control, intentions and PA behaviour during their treatment. All three TPB main variables were found to be significant determinants of PA and attitude alone was significant in determining PA intention (6).

Courneya and Friedenreich (1999) investigated using the TPB among breast cancer survivors during their cancer treatment in a retrospective design. Participants (n=164) were asked to recall their beliefs and PA behaviour during their treatment using a self-report questionnaire delivered through the mail. Intention and PBC were found to be significant

determinants of PA behaviour during treatment. Attitude and subjective norm were found to be significant determinants of PA intention (9).

Courneya and colleagues (1999) evaluated the TPB as a framework to understand PA motivation in cancer survivors. Sixty-six post-surgery colorectal cancer survivors completed a questionnaire that examined demographic, medical, past PA and TPB variables. PBC, subjective norm and attitude were found to explain 23% of the variance in PA intention with attitude the only variable to make a unique contribution (7) (Courneya et al, 1999).

Courneya, Keats and Turner (1) (2000) used the TPB as a framework to understand PA motivation and behaviour in bone marrow transplant (BMT) patients (n=37) in hospital. Participants completed a questionnaire to assess medical, demographic, past PA behaviour, PA behaviour during hospitalization and variables of the TPB. Attitude and PBC were found to explain 68% of the variance in PA intention (1) (Courneya, Keats & Turner, 2000).

Using a prospective design, Courneya, Blanchard and Laing (2001) examined using the TPB to understand PA intention among a sample of breast cancer survivors. A convenience sample of twenty-four women completed a questionnaire assessing medical, demographic, past PA and TPB variables. The TPB variables explained 49% of the variance in PA intention with subjective norm being the most important determinant. The key underlying beliefs identified were support from a spouse, physician, and friends and confidence in being able to attend fitness classes when having limited time, no one to engage in PA with, fatigue and other health problems (10) (Courneya, Blanchard & Laing, 2001).

A study by Blanchard and colleagues (2002) focused on Prince Edward Islanders. In this study, eighty-three breast cancer survivors and forty-six prostate cancer survivors living on Prince Edward Island were surveyed to investigate demographic, medical, and social

cognitive determinants of PA intention and behaviour. Attitude, subjective norm and PBC explained 45% of variance in PA intention in breast cancer survivors and 36% in prostate cancer survivors. Each construct made unique contributions to the variance in breast cancer but only PBC made a unique contribution for prostate cancer survivors. PA intention explained 30% and 36% of the variance in PA behaviour among breast and prostate cancer survivors, respectively with no unique contribution from PBC for either cancer group (2) (Blanchard et al, 2002).

A study with a sample of mixed cancer survivors used the TPB and the Five Factor Model (FFM) of personality to examine correlates of PA (Courneya et al, 2002). Participants completed a questionnaire at baseline to assess measures of the TPB, FFM, past PA, physical fitness, medical variables and demographics. Intention to engage in PA was significantly correlated with control beliefs, subjective norm, attitude and behavioural beliefs. The TPB variables explained 25% of the variance in PA intention with control beliefs and subjective norm being independent predictors (3).

Rhodes and Courneya (2003) examined the components of the TPB among mixed cancer survivors in the PA domain. Participants (n=302) were asked to complete a questionnaire that assessed the variables of the TPB and PA among cancer survivors who competed surgery and adjuvant therapy. Affective attitude, subjective norm and self-efficacy together explained 46% of variance in intention (4).

Courneya and colleagues (2005) explored correlates of PA in 399 non-Hodgkins lymphoma survivors. Participants completed a mailed survey that looked at demographics, past PA and constructs from the Theory of Planned Behaviour. Researchers found that about 50% of participants intended to engage in PA at levels that were sufficient for meeting public

health guidelines. Supporting the TPB, it was found that the model explained 55% of the variance in PA intentions with PBC, affective attitude and subjective norm being the most important correlates (12).

A survey was conducted by Hunt-Shanks and colleagues (2006) among 126 breast and 82 prostate cancer survivors that examined the demographic, medical and social cognitive correlates of PA. Among breast cancer survivors, results indicated that attitudes, subjective norm and PBC explained 66% of the variance in PA intention with instrumental attitude, subjective norm and PBC making significant unique contributions to intention. Among prostate cancer survivors, attitude, subjective norm and PBC explained 57% of the variance in PA intention with just subjective norm and PBC making significant unique contributions to intention. Significant differences were found between breast and prostate cancer survivors within affective attitude only (5) (Hunt-Shanks et al, 2006).

A study by Jones and colleagues (2006) used a cross-sectional survey to assess the demographic, medical, and social cognitive determinants of PA intentions among multiple myeloma cancer survivors. Of the seventy participants that completed the questionnaire, the data suggested that they had very positive instrumental attitudes, intentions, and subjective norms and moderate levels of PBC and affective attitudes. The TPB explained 43% of variance in PA intentions. Instrumental attitude and PBC were found to be independent predictors of PA; however, no demographic or medical variables moderated any associations between theory constructs and PA behaviour (13) (Jones et al, 2006).

Karvinen and colleagues (2007) investigated the determinants of PA in a sample of 354 endometrial cancer survivors. A mailed, cross-sectional survey that assessed PA, medical and demographic characteristics, and social-cognitive variables from the TPB was completed

by endometrial cancer survivors. It was found that the TPB explained 38% of the variance in PA intentions with self-efficacy and affective attitude being independent correlates. Age and BMI moderated the associations of the TPB with intention and behaviour (15) (Karvinen et al, 2007).

Keats and colleague (2007) investigated PA in adolescent cancer survivors using a retrospective design. Participants (n=59) were asked to complete a questionnaire that recalled their beliefs, attitudes, norms, perceptions of control intentions and PA post treatment. The TPB constructs were found to explain 34% of the variance in PA intention with affective attitude and instrumental attitude having unique contributions (14) (Keats et al, 2007).

Jones and colleagues (2007) employed a cross-sectional survey to assess the demographic, medical and social cognitive determinants of PA intentions in people diagnosed with primary brain cancer. A mailed survey was completed by 100 brain tumour survivors. The survey examined medical and demographic characteristics, past PA behaviour and social cognitive beliefs based on the Theory of Planned Behaviour. The TPB constructs combined to explain 32% of the variance in PA intentions with the most important determinants being affective attitude and PBC. Past PA behaviour was the only variable to be consistently correlated with any TPB constructs of the medical and demographic variables (5).

In a prospective study of the determinants of PA in bladder cancer survivors, 367 participants that lived in Alberta, Canada completed a mailed questionnaire that assessed demographic, medical, behavioural and social cognitive variables. Researchers found that adjuvant therapy, age and cancer invasiveness all had negative associations with PA. PBC, affective attitude, instrumental attitude and subjective norm explained 39% of the variance in

PA intentions. Overall, it was found that some medical and demographic variables predicted PA behaviour but these associations were mediated by the Theory of Planned Behaviour (18).

Stevinson and colleagues (2009) investigated the determinants of PA in a sample of 359 ovarian cancer survivors. A mailed survey that assessed PA, medical and demographic characteristics, and social-cognitive variables from the TPB was completed by ovarian cancer survivors living in Alberta, Canada. Variables found to be associated with meeting PA guidelines were younger age, higher education and income, being employed, lower body mass index, absence of arthritis, longer time since diagnosis, earlier disease stage and being disease free. The TPB variables accounted for 36% of the variance in PA guidelines (17).

Vallance and colleagues (2012) used a survey to study the utility of the two-component model of the TPB to determine PA among 524 rural and small town breast cancer survivors. Of these 524 participants, 35% were meeting PA guidelines. Intention explained 12% of the variance in PA behaviour (controlled for age, months since diagnosis, education and income). Adding PBC to the model did not increase the amount of explained variance. The TPB constructs explained 43% of the variance in PA intention (controlling for the same factors as previously). They found that affective attitude, instrumental attitude, descriptive norm and self-efficacy had direct effects on intention. Injunctive norm had a negative effect on intention (11).

A survey study by Belanger and colleagues (2012) examined the PA correlates among 588 young adult cancer survivors (YACS) in Alberta, Canada. Participants were mailed a questionnaire to fill out and return. The overall model explained 38% of the variance in PA with planning, intention, and affective attitude having significant independent associations

with PA. The second regression explained 67% of the variance in planning with intention providing the only significant independent association. For intention, the model explained 56% of the variance with PBC, affective attitude, and instrumental attitude having significant unique associations. The TPB appears to be useful for understanding PA in YACS (19).

Trinh and colleagues (2012) investigated the correlates of PA among 703 kidney cancer survivors. Participants were mailed a self-report survey that consisted of demographic and medical variables, standard PA and TPB items. The TPB was tested using structural equation modelling and demonstrated an adequate-to-good fit to the data. There were significant pathways to PA from PBC, planning, and intention; and to planning from intention. In addition, there were significant model pathways to intention from instrumental attitude, descriptive norm, and PBC. Overall, the TPB accounted for 69% of variance in intention, 63% of variance in planning and 42% of the variance in PA. The TPB appears to be a useful model for explaining PA in KCS. Developing PA interventions using the TPB may be effective in promoting PA in KCS (20).

Lowe and colleagues (2012) explored the determinants of PA among 50 palliative care cancer patients in Edmonton, Canada. Participants completed a survey via interviewer-administration that assessed TPB constructs, and PA using the Physical Activity Scale for the Elderly (PASE). Constructs that correlated with total PA were affective attitude, self-efficacy, and intention. Those reporting more than 60 minutes of total PA were more likely to have higher affective attitude and self-efficacy. Participants <60 years of age and normal or underweight reported higher weekly minutes of total PA. Though a small sample, this study provides valuable information on the strongest correlates of PA among palliative cancer patients (21).

Finally, Ungar and colleagues (2015) examined the differences in PA determinants between active and insufficiently active cancer patients. The authors assessed 64 participants from Heidelberg, Germany with a cross-sectional survey that gathered information on socio-demographic, illness-related, PA, and TPB related variables. This study found that TPB variables differed between those active and insufficiently active with self-efficacy having the largest effect. The strength of TPB variables explaining intention for PA also differed between the active and insufficiently active groups. Negative attitudes had a stronger effect than positive attitudes for insufficiently active participants. The authors conclude that eliciting both negative and positive attitudes will help determine more accurate explanations of intentions among those who are insufficiently active (22).

Review of Physical Activity Preference Studies in Cancer Survivors

Among the fifteen studies reviewed (23-37) all reported that the majority of participants were interested in receiving information about and capable of engaging in a tailored PA program. Studies that solicited information regarding specific programming preferences reported an overwhelming preference for recreational activities with walking being most preferred specific activity. Many preferences vary among cancer survivor groups and are influenced by demographic and medical variables.

Demark-Wahnefried et al, (2000) conducted a mail-out survey regarding health behaviours and health programs which was completed by 978 breast and prostate cancer survivors. The participants were asked about current health behaviours and their interest in pursuing healthy behaviours in diet and PA. The majority (80%) of the sample indicated they were interested in health promoting programs with most (53%) respondents preferring to receive mailed literature as opposed to other media (23).

In another study, Jones and Courneya (2002) documented the PA preferences of cancer survivors. The study consisted of a mailed survey which was completed by 307 prostate, breast, colorectal and lung cancer survivors. The survey asked questions regarding PA and program and counselling preferences. The majority (84%) of participants indicated that they would possibly be interested in receiving PA counselling at some point during their cancer experience. Eighty-five percent of the participants preferred to receive counselling face-to-face, with 77% preferring to receive the counselling from a PA specialist affiliated with a cancer centre. With respect to programming preferences, participants indicated preferences for recreational activities (98%), walking (81%), supervised activity (57%) and moderate intensity PA (56%). Additional information reported by the participants indicated that morning PA (48%), being active alone (44%), and at home (40%) were preferable (24).

A further study by Vallance et al, (2006) examined PA preferences in a sample of non-Hodgkin's lymphoma (NHL) survivors. Similar to the methods of the above study, the mailed survey asked PA and program preference questions in a sample of 431 NHL survivors. The majority of participants (77%) 'preferred' or 'maybe preferred' to receive PA counselling at some point after their diagnosis. Walking was the most favoured activity (55%) and similar proportions indicated they would rather engage in activity alone (31%) or with others (35%). As in the other cancer studies above, the majority of participants preferred moderate intensity activity (62%); however, contrary to the previous study (24) (Jones & Courneya, 2002) 59% of participants preferred unsupervised/self-paced PA (25) (Vallance et al, 2006).

Karvinen et al, (2006) surveyed the PA preferences of 386 endometrial cancer survivors. Similar to the above studies, it was found that most (76.9%) participants 'would

be' or 'might be' interested in participating in a PA program. The majority (81.7%) of people surveyed also felt they would be capable of actually doing the program. Again, walking was found to be the preferred activity (68.6%), and moderate intensity was the preferred intensity (61.1%). This sample also preferred to receive counselling face-to-face (82.8%) from a PA specialist associated with a cancer centre (40.9%) at a cancer centre (41%). The study also found that the participants prefer to be active at home (32.7%) but there was no significant difference between the desire to engage in activities alone (23.8%), with friends (22.6%) and having no preference (32.7%) (26) (Karvinen et al, 2006).

Jones et al, (2007) investigated similar constructs to the previously mentioned studies by Karvinen et al, (26) (2006), Vallance et al, (25) (2006) and Jones and Courneya (24) (2002), but with brain cancer survivors. One hundred and six brain tumour survivors completed a questionnaire that assessed PA preferences during and after treatment. Results showed that equal proportions of participants preferred to be active at home or with family. Different from other studies (24) (Jones & Courneya, 2002); a higher percent of people preferred receiving information by way of technologically-based approaches (48.1% via internet, 40.6% via computer program, 49.1% via email) rather than face-to-face (29.3%). Again, walking was found to be the most preferred activity (53%) followed by resistance training (36%) and cycling (19%). There was a significant difference for perceived ability in participating in PA between 'during treatment' and the 'post treatment,' but no significant difference was reported between the actual preferences between the during- and post-treatment periods (27).

In a study by Karvinen et al, (2007) 397 bladder cancer survivors completed a mailed survey to determine optimal PA programs for this population. Participants answered similar

questions as the other above mentioned cancer studies with similar findings. Most participants indicated they would be interested (81.1%) and able to participate (84.3%) in a PA program specifically designed for bladder cancer survivors. It was found that participants were strongly interested in participating in PA programs at home (53.7%) and doing walking (81.1%). Moderate intensity (61.7%), schedule flexibility (56.9%) and unsupervised (70.6%) activities were most preferred among the group (28).

Rogers and colleagues (2008) surveyed 192 breast cancer survivors to assess differences in PA counselling preferences, program preferences and telephone/internet access to investigate potential mode of delivery. Individuals preferred to receive counselling at home (36%), face-to-face (61%) with a PA specialist (51%). Moderate intensity (64%), unsupervised (49%) PA was preferred. Similar to other research, walking was the most preferred type of activity for winter (46%) and summer (65%). All participants reported telephone access in their home and only 19% did not have internet access at work or at home (29).

Another study by Rogers and colleagues (2009) assessed PA counselling and program preferences of head and neck cancer survivors (n=90). Researchers found that there was no preference for counselling source (66%), counselling delivery (47%) or PA variability (52%). This sample of head and neck cancer survivors indicated that they would prefer to be active outdoors (49%), in the morning (47%) and alone (52%). Walking was the most preferred type of activity listed in the summer (47%) and the winter (44%) (30).

A study among rural breast cancer survivors (Rogers et al, 2009) found up to half were open to various counselling options, with the most popular options were counselling after treatment (36%), face-to-face (47%), and from an exercise specialist (40%). Rural

breast cancer survivors preferred home-based (63%), unsupervised (47%), moderate intensity exercise (65%) that was primarily walking. The strongest preference correlates include higher education with exercise specialist, higher environment score with outdoors, more comorbidities with low intensity and counselling after cancer treatment, higher social support with exercising with friends or family, sedentary or insufficient physical activity with low intensity, and lower household income with preferring supervised exercise (31).

Stevinson and colleagues examined the PA counselling and program preferences among a sample of 359 ovarian cancer survivors living in Alberta, Canada. A population based survey was mailed to participants and gathered information on demographic and medical variables, self-report PA levels and PA counselling and program preferences. Walking was again the most preferred type of activity (62.7%) with preference for the morning (48.9%), at home (48.9%), and with friends (30.5%) and family or alone (29%). It was found that some demographic variables (e.g., age, education level, income level, and employment status) influenced the PA program preferences of the participants but there were no differences based on medical variables (32).

Lowe and colleagues assessed the PA preferences and interest among 50 palliative cancer patients. Patients recruited completed a survey with interviewer assistance that asked about PA behaviour, program and counselling preferences and current ability and interest in PA. 92% of participants indicated they were interested and able to participate in a PA program, with 84% preferring to do so in their own homes. Most (64%) stated that walking was their favourite activity and were most interested in a walking program (72%) followed by a resistance training program (12%). Participants indicated they preferred up to three

sessions per week (56%) and less than 20 minutes per session (66%). Associations were in contrast to previous studies showing no influence of age, sex, and past PA behaviour (38).

A study by Gjerset and colleagues (2011) investigated the interest and preferences for PA among 1,284 Norwegian cancer survivors. A questionnaire was mailed to a sample of survivors across six different cancer types (breast, cervical, prostate, testicular, ovarian, or lymphoma) which collected information on demographic and medical variables, self-report PA levels and PA counselling and program preferences. Approximately 76% of the sample indicated that they would or might be interested in receiving PA counselling at some point after their cancer diagnosis. As in most of the previous studies, walking was the most preferred activity followed by resistance training and stretching (33).

Belanger and colleagues (2012) examined the counselling and program preferences among young adult cancer survivors. They found that the majority were interested or maybe interested (78%) and able or maybe able to participate (88%) in a PA program for young adult cancer survivors. Preferred method of counselling delivery was from a fitness expert at a cancer centre (50%), by brochure/pamphlet (64%), face-to-face (47%) or email (46%). Similar to previous studies, walking was the preferred type of physical activity in both the summer (40%) and winter (51%) followed by biking (33%) in the summer and skiing (33%) in the winter (34).

Murnane, Geary and Milne explored the PA programming preferences and levels of 92 cancer patients currently undergoing radiotherapy. Participants were assessed pre-treatment and undergoing treatment. The majority of participants indicated that undergoing radiotherapy had affected their PA levels (79%) and were interested in receiving information about PA during treatment (71%). A home-based independent PA program was preferred by

53% of the sample. This study highlighted the fact that patients undergoing radiotherapy would be interested in a PA program to increase PA levels (39).

A survey to determine PA preferences among 703 kidney cancer survivors by Trinh and colleagues (2012) found over 80% of the sample felt they at least may be able to participate in a PA program designed for kidney cancer survivors and more than 70% were potentially interested in doing so. The most common PA preferences were to receive PA information from a fitness expert at a cancer center (56%), receive information via print material (50%), start a PA program sometime after treatment (37%), engage in PA with a spouse (40%), engage in PA at home (52%), do moderate intensity PA (58%). Participants indicated walking was the most preferred activity in both the summer (69%) and winter (48%). Age, sex, and current PA were the characteristics most consistently associated with PA preferences (35).

Vallance and colleagues (2012) examine breast cancer survivors living in rural areas and small towns. Results show 78% of survivors indicated they would have possibly (i.e., yes or maybe) been interested in receiving PA information at the time of diagnosis. Overall, 85% felt they would possibly be able to participate in a PA program. Receiving chemotherapy was negatively associated with wanting to receive PA counselling, PA program interest, and PA program ability. The most preferred types of PA were walking (51 %), flexibility and similar activities (e.g., yoga, stretching) (36 %), and strength training (27 %) (37).

McGowan and colleagues (2013) surveyed 600 colorectal cancer survivors were randomly identified by the Alberta Cancer Registry. Most of the sample indicated that they were interested (85%) and able (84%) to participate in a PA program. The most common PA preferences of colorectal cancer survivors were to receive PA counselling from a fitness

expert at a cancer center (47%), receive PA information in the form of print materials (63%), start a PA program after cancer treatment (61%), do PA at home (56%), and walk in both the summer (49%) and winter (37%). In addition, oncologists and nurses were identified as preferences from whom colorectal cancer survivors would like to receive PA information. Chi-square analyses identified that age, education, annual family income, and current PA were the demographic variables most consistently associated with PA preferences (36).

A survey by Philip and colleagues (2014) examined the PA preferences of 175 non-small cell lung cancer survivors. Participants were asked to complete a questionnaire that gathered information on demographic and medical characteristics, PA levels, and PA preferences. Most participants were interested in receiving PA advice (62%), before treatment (68%), from a physician (80%), face-to-face (95%) and within the context of cancer care (92%). Most felt capable of performing a PA program (73%) and almost half indicated walking to be their preferred type of activity (43%). Significant associations were found for age, sex, education lee, income, PA levels, comorbidities, time posttreatment and obesity (40).

Finally, Tyrrell and colleagues (2014) examined the PA preferences of 239 gynecologic cancer survivors living in Nova Scotia, Canada. The questionnaire collected medical and demographic information, PA levels, and PA programming and counselling preferences. Results show that most preferred a home-based (81%), morning (79%) PA program. Significant associations were found for age, employment status, income, marital status, treatment status, time since diagnosis, and PA level suggesting these variables had an influence the PA preferences of participants (41).

Internet-based behaviour change programs among cancer survivors

A literature search for internet-based PA behaviour change programs among cancer survivors resulted in only two studies (42, 43). Valle and colleagues (2013) performed a randomized trial of a Facebook-based PA intervention for young adult cancer survivors (YACS). They recruited 86 YACS between the ages of 21 and 39 years that had been diagnosed with cancer. The participants were randomized to one of two Facebook-based groups; a self-help comparison group or the intervention group (FITNET) which featured intervention components based on SCT. Baseline and 12 week (post-intervention) questionnaires were completed online. Retention rates were 77% overall and they found engagement was slightly better, though not significant, among the SC group. They found no significant group by time interactions for moderate to vigorous PA, however, there was a significant difference in change of light PA between groups (43).

Lee and colleagues (2014) recruited 59 South Korean breast cancer survivors into a 12 week we-based randomized controlled trial using the TTM. Participants were randomized into either a control group which received a 50-page booklet on diet and exercise, or the web-group which included a self-management diet and exercise program that used TTM based strategies. Methods used to increase engagement were tailored education, action planning, automated feedback, and automatic SMS reminders. Overall, the proportion of participants who met PA guidelines and had improvements in physical functioning, fatigue and self-efficacy with respect to exercise was greater in the intervention group than the control group (42).

A broader search revealed, more recently, two meta-analyses (44, 45), six systematic reviews (46-51) and three recent individual studies (52-54) examining various types of

eHealth or mHealth health behaviour change interventions. Of the recent individual studies using web-based behaviour change interventions, two were among the general population (52, 54) and one was among a diabetic population (53).

Duncan and colleagues (2014) examined a web and mobile based PA and diet intervention among 301 adult males aged 35-54 living in Queensland, Australia. Community based recruiting resulted in 327 expressing interest and 301, 159 and 148 completed baseline, 3-month, and 9-month assessments respectively, with 125 completing all three measures (completers). Participants were randomized to either the IT-based intervention or a print-based intervention. Both groups received educational materials, self-monitoring capacity. The IT-based intervention provided the additional aspects of automated feedback based on progress and goal completion, as well as the ability to interact with other participants in the group. Challenges were developed based on SCT and self-regulation theory. There were no significant between-group or group-by-time interactions for any PA or diet behaviour examined. There was an initial reduction in web usage between Weeks 1 and 3 followed by a continued decline throughout the remaining weeks. Despite mixed support for the intervention changing health literacy, there was no difference between the delivery modes in improving PA behaviour indicating they are both useful (54).

A randomized controlled trial by Jennings and colleagues (2014) determined the effectiveness of a web-based program designed to increase PA in Australian adults with type 2 diabetes. 397 participants completed baseline measures and were randomized into wither the 12-week web intervention or the control group. Both groups had access to a website; the control group, one with static information and the intervention group, one that used a self-management approach with materials based on the TPB. At post-intervention 66% completed

assessments and at 36 weeks 47% had completed assessments. Intention to treat analysis showed significant time effects for PA but no group-by-time interactions. These results declined for the 36 week follow up despite the overall favourable review of the website. Again, similar to other web-based studies, attrition remains an issue, specifically among the intervention groups (53).

Finally, Schulz and colleagues (2014) examined the effects of two types of web-based delivery methods among 5,055 adults in the Netherlands. This trial had three tailored-information arms; one a sequential method of delivery (changing unhealthy behaviours one at a time), one simultaneous (changing unhealthy behaviours all at the same time) or the control group. Those in both tailored groups reported small behavioural changes with the sequential groups having more significant effect when compared to control after one year. At follow up (two years), the simultaneous group was more effective. Both interventions were rated favourably by the participants (52).

Webb and colleagues (2010) performed a systematic review and meta-analysis of the impact of theoretically based behaviour change techniques and mode of delivery on efficacy. They analyzed 85 studies encompassing all health behaviour change interventions to determine which program characteristics were most effective. Overall, a small but significant effect d=0.16; 95% CI = 0.09-0.23) was found for behaviour change programs. Using theory more extensively was associated with an increase in effect and specifically using the TPB seems to have larger effects on behaviour (d=0.36; 95% CI = 0.15-0.56). Additionally, using other methods of communication concurrently (e.g., text messages) was associated with higher effectiveness (45).

A second meta-analysis by Davies and colleagues (2012) examined internet-delivered interventions designed to increase PA levels. Thirty-four articles found an overall mean effect of d=0.14. PA was the primary target behaviour in 25 of the studies. The majority focused on the general population and did not screen for baseline PA levels. All but two studies used theory to develop their intervention, most commonly SCT and TTM. Moderator analysis showed studies that included educational materials had a larger effect (d=0.20) on PA than those that did not include these materials (d=0.08) (44).

Vandelanotte and colleagues (2007) performed a review of website delivered PA interventions. Fifteen studies were included in the review; seven of which focused only on PA with the rest targeting more than one behaviour. Nine studies based interventions on theories including SCT, TTM and TPB. Eight of the studies also included components that were not web-based. Eight of these studies reported an improvement in PA. More participant contacts and shorter follow-up times were associated with better outcomes. Intervention outcomes did not produce any associations (49).

A systematic review by Brouwer and colleagues (2011) aimed to identify which characteristics of internet-delivered healthy lifestyle promotion interventions were related to the most exposure. They found a large variety of techniques were being used among 64 studies included in the review. Among the many techniques, providing feedback, having interactive elements, peer/counsellor support and having an additional contact via email or phone were used most often, indicating greater exposure (51).

Kohl and colleagues (2013) reviewed systematic review of online, lifestyle behaviour interventions to determine their reach, effectiveness and use, as well as any knowledge gaps. 41 papers were included, of which most were aimed at weight management behaviours such

as PA and diet. In terms of reach, the population was quite homogeneous reaching more young, white, highly educated women, living in higher income countries. As with other studies, this review found small effects on behaviour. Determining which aspects of the interventions were the most effective was difficult due to the large variety of techniques. Decreasing use, and therefore effectiveness, remains a problem among internet-delivered interventions (48).

A review by Kuijpers and colleagues (2013) focused on the ability of web-based interventions to influence patient empowerment and PA specifically among those with chronic disease in order to provide a recommendation for cancer survivors. Nineteen papers reporting on 18 unique studies were included in this study, with the majority focusing on diabetes. They identified seven key elements among the majority of the interventions including education, self-monitoring, feedback/tailored information, self-management training, personalized exercise program, and communication with either health care providers or fellow patients. The authors could not comment on the individual effectiveness of these elements as they were used in different combinations among the studies. Despite only two studies showing a significant difference between groups, the majority of those that didn't found positive increases for all the groups (i.e., minimal intervention for control group was still effective in changing PA). The authors conclude that clear methodological description and consistency among study elements would strengthen assertions of "what works and why", however, results suggest beneficial effects on patient empowerment and PA levels (47).

Maher and colleagues (2014) reviewed the effectiveness of online, social network based health behaviour interventions. Ten studies were included in the review and included

commercial (n=2) and research (n=3) social network sites, and multicomponent interventions delivered in part on existing social media sites (Facebook n=4, Twitter n=1). Nine of ten studies reported significant improvement in an aspect of behaviour change or outcomes however, effect sizes were generally small. Only three studies used theory with two using SCT and one using Social Learning Theory (SLT). Using social media sites may address the issues of reach, engagement and retention with which many online interventions struggle. The four Facebook studies reviewed here achieved retention rates of (77-96%) however they still reported low engagement (5-15%) (46).

Finally, Bossen and colleagues (2014) reviewed the effectiveness of self-guided, web-based PA interventions among those with chronic disease. They found seven eligible studies to include in this review. Five of the seven studies were theory driven using TTM, SCT, self-management theory or social ecological theory. Effect sizes reported ranged from 0.13 to 0.56 indicating a positive trend toward web-based PA interventions being effective among those with chronic disease. As with many other reviews, studies reviewed had low retention and engagement rates. The authors suggested increasing the inclusion of "push factors" that encourage use such as email reminders, weekly updates or short text messages (50). Overall, these meta-analyses and reviews indicate that web-based PA interventions are capable of producing small effects across the general population and chronic disease populations.

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Appendix B – Study I materials

Invitation letter from Researchers

Invitation letter from Cancer Care Nova Scotia

Postcard reminder from Cancer Care Nova Scotia

Questionnaire - Physical activity among Nova Scotian Cancer Survivors

Invitation Letter from Researchers

Dear Sir/Madam,

We are researchers from Dalhousie University and the University of Alberta. We are working together to conduct a research study on physical activity and cancer survivors. Cancer Care Nova Scotia is contacting you on our behalf to see if you might be interested in participating in a survey study which requires the voluntary participation of cancer survivors. The study has been approved by Cancer Care Nova Scotia, Capital District Health Authority Research Ethics Committee and the University of Alberta Health Research Ethics Board, and has met rigorous requirements for ethical approval.

The study is about exploring the potential role of physical activity (PA) in Nova Scotian cancer survivors. Recent research has suggested that PA is beneficial for cancer survivors, but we do not know about the PA habits, beliefs, and attitudes of Nova Scotian cancer survivors. The information gained from this study will be used to help develop physical activity programs to improve quality of life and health among cancer survivors living in Nova Scotia.

To participate in the study, all you need to do is complete the enclosed questionnaire. For this study, you will not be asked to do any PA tests or follow any PA program; just complete the one-time survey that is enclosed. If you agree to participate, please simply complete and return the enclosed questionnaire in the business reply envelope provided. No postage is necessary. The questionnaire should take approximately 30-45 minutes to complete.

If we have not heard from you in a few weeks, Cancer Care Nova Scotia will be sending you a postcard reminder on our behalf and then a second copy of the questionnaire. If you do not wish to participate in the study, simply ignore the materials the registry will be sending you. Alternatively, you can send us back the unanswered questionnaire in the envelope provided to ensure that the registry will not send you any further materials about this study.

Your participation in this study is completely voluntary. Any information that you provide will be held in strict confidence. It is only through voluntary participation in research projects that we increase our knowledge about issues that are important to Nova Scotian cancer survivors, and we hope that you find the time to assist us. If you have any questions about the study, or about completing the questionnaire, please contact the Principal Investigator, Cindy Forbes, by e-mail at ccforbes@ualberta.ca or phone at 1 (780) 492-2829.

Thank you for considering our study.
Sincerely,

Cynthia C Forbes, MSc PhD Candidate, Supervised by:	Kerry S. Courneya, PhD Professor and Canada Research Chair in Physical Activity and Cancer University of Alberta	Chris Blanchard, PhD Associate Professor Dalhousie University

Invitation Letter from Cancer Care Nova Scotia

On behalf of *Cancer Care Nova Scotia* (CCNS), I am writing to invite you to participate in a cancer research study on physical activity and cancer survivors.

How we got your name
Your name was identified from the Nova Scotia Cancer Registry at *Cancer Care Nova Scotia*. We are a program of the Nova Scotia Department of Health & Wellness. Our job is to set standards, monitor services, and support cancer research. The Registry is a database that contains the names of all people who have a reported cancer condition in this province. The information collected by the Registry is used to study and monitor cancer in Nova Scotia.

Your privacy is very important
One of *Cancer Care Nova Scotia's* responsibilities is to ensure that all personal information in the Registry is kept private. From time to time, we are contacted by researchers who want to talk with Nova Scotians about their cancer experience. The Registry is not allowed to give your name to any researcher, so we are contacting you on their behalf. This study is being conducted by Drs. Chris Blanchard and Kerry Courneya from Dalhousie University and the University of Alberta. It has received ethical approval from the Research Ethics Board at Capital Health in Nova Scotia. Detailed information about the study and what you will be asked to do is enclosed.

What is required of you
If you agree to participate in this study please complete the enclosed questionnaire and return it to the Registry in the prepaid, self-addressed envelope. The questionnaire takes approximately 30-45 minutes to complete. A detailed letter from the researcher with more information about the study is included with the questionnaire. Returned questionnaires will be forwarded to the researcher after any personal identifying information is removed.

Thank you for taking the time to read this letter. If you have any questions or concerns please contact CCNS at our toll free line 1-866-599-2267 and you will be put through to Rosalee Walker the Cancer Registry Research Assistant or the Registry Director, Maureen Macintyre. If it is more convenient, please contact Ms. Walker directly at (902) 473-3494 or Ms. MacIntyre directly at (902) 473-6084. To talk directly to the Principal Investigator, please call Cindy Forbes at 1 (780) 492-2829.

Sincerely,

Maureen MacIntyre, MHSA
Registry Director

Postcard Follow up

Physical Activity in Nova Scotian Cancer Survivors

A few weeks ago, Cancer Care Nova Scotia sent you a letter inviting you to consider participating in a survey study. This postcard is just a friendly reminder to complete the questionnaire and mail it back in the paid envelope provided.

Thank you in advance for considering our request.

Maureen MacIntyre, Director, SEU
Phone: (902) 473-4645 or 1-866-599-2267

Study I Questionnaire

Date Completed: _____ Identification #_____

Physical Activity and Health in Nova Scotian Cancer Survivors

Principal Investigators: Chris Blanchard, PhD, Dalhousie University
Kerry S. Courneya, PhD, University of Alberta

Cynthia C Forbes, MSc, PhD Candidate, University of Alberta

Instructions

Thank you for agreeing to participate in this study. In this questionnaire, we are going to ask you a series of questions about your cancer, health, and physical activity. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible. The survey should take about 30-45 minutes to complete. All responses are confidential. If at all possible, please complete all questions so that we can include your responses in our analysis. If you have any questions about completing the survey, please email Cindy Forbes at (ccforbes@ualberta.ca) or phone 1 780 492-2829.

1. Please use the scale below to guide your responses to these questions.

1	2	3	4	5	6	7	8	9
none	15 mins or less	30 mins	1 hour	2 hours	3 hours	4 hours	5 hours	6+ hours

a. On a typical **WEEKDAY**, how much time do you spend (from when you wake up until you go to bed) doing the following?

1. watching television (including videos on VCR/DVD)	1	2	3	4	5	6	7	8	9
2. playing computer or video games	1	2	3	4	5	6	7	8	9
3. sitting while listening to music on the radio, tapes, or CDs	1	2	3	4	5	6	7	8	9
4. sitting and talking on the phone	1	2	3	4	5	6	7	8	9
5. doing paperwork or computer work (office work, emails, paying bills, etc.)	1	2	3	4	5	6	7	8	9
6. sitting and reading a book or magazine	1	2	3	4	5	6	7	8	9
7. playing a musical instrument	1	2	3	4	5	6	7	8	9
8. doing arts and crafts	1	2	3	4	5	6	7	8	9
9. sitting and driving/riding in a car, bus, or train	1	2	3	4	5	6	7	8	9

b. On a typical **WEEKEND DAY**, how much time do you spend per day (from when you wake up until you go to bed) doing the following?

1. watching television (including videos on VCR/DVD)	1	2	3	4	5	6	7	8	9
2. playing computer or video games	1	2	3	4	5	6	7	8	9
3. sitting while listening to music on the radio, tapes, or CDs	1	2	3	4	5	6	7	8	9
4. sitting and talking on the phone	1	2	3	4	5	6	7	8	9
5. doing paperwork or computer work (office work, emails, paying bills, etc.)	1	2	3	4	5	6	7	8	9
6. sitting and reading a book or magazine	1	2	3	4	5	6	7	8	9
7. playing a musical instrument	1	2	3	4	5	6	7	8	9
8. doing arts and crafts	1	2	3	4	5	6	7	8	9
9. sitting and driving/riding in a car, bus, or train	1	2	3	4	5	6	7	8	9

IMPORTANT:

For the rest of this survey, we are going to ask you questions about leisure-time physical activity. Leisure time means activity done during your free time and does not include your work/job or household chores. Physical activity (PA) means any exercise or sport that results in a substantial increase in energy expenditure (resulting in a noticeable increase in heart rate and breathing rate). Examples of exercises and sports include brisk walking, jogging, cycling, swimming, hockey, golf, curling, and dancing. We will use PA as a short name for physical activity throughout this survey.

2. For this first question, we would like you to recall your average weekly participation in leisure time PA during the past month.

When answering these questions please remember:

- only count PA sessions that lasted 10 minutes or longer in duration.
- only count PA that was done during free time (i.e., not occupation or housework).
- note that the main difference between the categories 'a,' 'b', and 'c' is the intensity of the endurance (aerobic) PA and category 'd' is for strength (resistance) exercise.
- please write the average frequency on the first line and the average duration on the second.
- if you did not do any PA in one of the categories, please write in "0".

Considering a typical week (7 days) over the PAST MONTH how many days on average did you do the following kinds of PA and what was the average duration?

	Average Frequency Days Per Week (0-7 days)	Average Duration (in minutes)
a. VIGOROUS EXERCISE (HEART BEATS RAPIDLY, SWEATING) (e.g., running, aerobics classes, cross country skiing, vigorous swimming, vigorous bicycling).	_____	_____
b. MODERATE EXERCISE (NOT EXHAUSTING, LIGHT PERSPIRATION) (e.g., fast walking, tennis, easy bicycling, easy swimming, popular and folk dancing).	_____	_____
c. LIGHT EXERCISE (MINIMAL EFFORT, NO PERSPIRATION) (e.g., easy walking, yoga, bowling, lawn bowling, shuffleboard).	_____	_____

d. STRENGTH EXERCISES (e.g., weight lifting, sit-ups, push-ups)

Have you done any strength exercises in the past month? Yes No

If yes, what type(s) of strength exercise did you do? _____

If yes, how often did you do them? _____ days per week.

If yes, how long did they usually take you? _____ minutes each day.

3. For these next questions, we are going to ask you about regular PA. We define regular PA as moderate intensity PA (e.g., brisk walking) done for at least 150 minutes per week (2.5 hours) OR vigorous intensity PA (e.g., jogging) done for at least 75 minutes per week (1.25 hours).

a. What do you think would be the main benefits for you if you participated in regular PA and what would make PA fun and enjoyable for you? (**List up to three each**).

Most important benefits for you	What would make it fun/enjoyable for you?
_____	_____
_____	_____
_____	_____

b. What factors would make it easier or more difficult for you to stick with a regular PA program? (**List up to three each**).

Factors that make it easy for you	Factors that make it difficult for you
_____	_____
_____	_____
_____	_____

c. Which people or groups important to you would approve of you doing regular PA and which people/groups do regular PA themselves? (**List up to three each**).

Important people that would approve	Important people that do PA themselves
_____	_____
_____	_____
_____	_____

4. The following statements and questions ask you to rate how you feel about participating in regular PA over the next month. Please pay careful attention to the words at each end of the scale and circle the number that best represents how you feel. Please answer all items from (a) to (f).

I think that for me to participate in regular PA over the next month would be:

(a)	1 extremely useless	2 quite useless	3 slightly useless	4 neutral	5 slightly useful	6 quite useful	7 extremely useful
(b)	1 extremely unenjoyable	2 quite unenjoyable	3 slightly unenjoyable	4 neutral	5 slightly enjoyable	6 quite enjoyable	7 extremely enjoyable
(c)	1 extremely harmful	2 quite harmful	3 slightly harmful	4 neutral	5 slightly beneficial	6 quite beneficial	7 extremely beneficial
(d)	1 extremely painful	2 quite painful	3 slightly painful	4 neutral	5 slightly pleasurable	6 quite pleasurable	7 extremely pleasurable
(e)	1 extremely unimportant	2 quite unimportant	3 slightly unimportant	4 neutral	5 slightly important	6 quite important	7 extremely important
(f)	1 extremely boring	2 quite boring	3 slightly boring	4 neutral	5 slightly fun	6 quite fun	7 extremely fun

5. This next set of statements and questions asks you to rate how other people in your life would feel about you participating in regular PA over the next month. Please pay careful attention to the words at the end of each scale and circle the number that best represents how they might feel. Please answer all items from (a) to (c).

I think that if I participated in regular PA over the next month, most people who are important to me would be:

(a)	1 extremely disapproving	2 quite disapproving	3 slightly disapproving	4 neutral	5 slightly approving	6 quite approving	7 extremely approving
(b)	1 extremely discouraging	2 quite discouraging	3 slightly discouraging	4 neutral	5 slightly encouraging	6 quite encouraging	7 extremely encouraging
(c)	1 extremely unsupportive	2 quite unsupportive	3 slightly unsupportive	4 neutral	5 slightly supportive	6 quite supportive	7 extremely supportive

6. This next question asks you to rate how much PA you think other people in your life are likely to do themselves over the next month.

I think that over the next month, most people who are important to me will be:

(a)	1 extremely inactive	2 quite inactive	3 slightly inactive	4 neutral	5 slightly active	6 quite active	7 extremely active

I think that over the next month, most people who are important to me will participate in regular PA.

(a)	1 strongly disagree	2 moderately disagree	3 slightly disagree	4 neutral	5 slightly agree	6 moderately agree	7 strongly agree

7. These next statements and questions ask you to rate how likely it is that <u>you would be able</u> to participate in regular PA over the next month <u>if you were really motivated</u>. Please pay careful attention to the words in each scale. Circle the number that best represents how you feel.

If you were really motivated…

a. How much control would you have over doing regular PA over the next month?

1	2	3	4	5	6	7
very little control			some control			complete control

b. Whether or not I engage in regular PA over the next month is completely up to me.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	slightly disagree	neutral	slightly agree	moderately agree	strongly agree

c. How much do you feel that engaging in PA over the next month is beyond your control?

1	2	3	4	5	6	7
Not at all						Very much

d. Participating in regular PA over the next month would be...

1	2	3	4	5	6	7
extremely difficult	quite difficult	slightly difficult	neutral	slightly easy	quite easy	extremely easy

e. If I wanted to, I could easily engage in regular PA over the next month.

1	2	3	4	5	6	7
strongly disagree	moderately disagree	slightly disagree	neutral	slightly agree	moderately agree	strongly agree

f. How confident are you that you could do regular PA over the next month?

1	2	3	4	5	6	7
not at all confident		somewhat confident		quite confident		completely confident

8. This next set of questions asks you about your motivation and plans to do regular PA over the next month. Pay careful attention to the words at the end of each scale.

a. Do you intend to do regular PA over the next month?

1	2	3	4	5	6	7
no, not really			somewhat intend			strongly intend

b. How motivated are you to do regular PA over the next month?

1	2	3	4	5	6	7
not at all motivated		somewhat motivated		quite motivated		extremely motivated

c. Do you have plans for when, where, and what type of PA you will do in the next month?

1	2	3	4	5	6	7
No plans						**Detailed plans**

d. I have made plans concerning 'when' I am going to engage in regular PA over the next month.

1	2	3	4	5	6	7
No plans						**Detailed plans**

e. I have made plans concerning 'where' I am going to engage in regular PA over the next month.

1	2	3	4	5	6	7
No plans						**Detailed plans**

f. I have made plans concerning 'what' kind of regular PA I am going to engage in over the next month.

1	2	3	4	5	6	7
No plans						**Detailed plans**

g. I have made plans concerning 'how' I am going to get to a place to engage in regular PA over the next month.

1	2	3	4	5	6	7
No plans						**Detailed plans**

h. I have made plans concerning 'who' I am going to be physically active with over the next month.

1	2	3	4	5	6	7
No plans						**Detailed plans**

9. Please use the scale below to guide your responses to the next set of 9 questions.

1	2	3	4	5	6	7
extremely unlikely	quite unlikely	slightly unlikely	neutral	slightly likely	quite likely	extremely likely

If you were to do regular PA over the next month, do you think you would…

a. feel better and improve your well-being	1	2	3	4	5	6	7
b. reduce the risk of your cancer returning	1	2	3	4	5	6	7
c. relieve stress	1	2	3	4	5	6	7
d. improve your energy level	1	2	3	4	5	6	7
e. get your mind off cancer	1	2	3	4	5	6	7
f. live longer	1	2	3	4	5	6	7
g. improve fitness	1	2	3	4	5	6	7
h. lose some weight	1	2	3	4	5	6	7
i. improve your immune system	1	2	3	4	5	6	7

10. Please use the scale below to guide your responses to the next set of 4 questions.

1	2	3	4	5	6	7
extremely unsupportive	quite unsupportive	slightly unsupportive	neutral	slightly supportive	quite supportive	extremely supportive

How supportive do you think each of the following people would be if you tried to do regular PA over the next month?

a. spouse / partner (if applicable)	1	2	3	4	5	6	7
b. other family members	1	2	3	4	5	6	7
c. best friend (s)	1	2	3	4	5	6	7
d. oncologist (cancer doctor)	1	2	3	4	5	6	7

11. Please use the scale below to guide your responses to the next set of 9 questions.

1	2	3	4	5	6	7
not at all confident		somewhat confident		quite confident		completely confident

If you were really motivated, how confident are you that you could do regular PA over the next month even if…

a. the weather was very bad	1	2	3	4	5	6	7
b. you felt tired or fatigued	1	2	3	4	5	6	7
c. you had medical / health problems	1	2	3	4	5	6	7

d. you got very busy and had limited time	1	2	3	4	5	6	7
e. you had a recurrence of your cancer	1	2	3	4	5	6	7
f. you had pain or soreness	1	2	3	4	5	6	7
g. you had additional family responsibilities	1	2	3	4	5	6	7
h. the activity became boring	1	2	3	4	5	6	7
i. you went back on cancer treatments	1	2	3	4	5	6	7

12. This next set of questions asks you about your PA preferences.

a. Would you have liked to receive information about a PA program at some point after your cancer diagnosis?

_____ Yes _____ No _____ Maybe/Unsure

***Even if you responded NO, please answer the following questions**.

b. Do you think you would be able to do a PA program for cancer survivors?

_____ Yes _____ No _____ Maybe/Unsure

c. Would you be interested in doing a PA program for cancer survivors?

_____ Yes _____ No _____ Maybe/Unsure

d. When would you have liked to start a PA program (**check one**)?

_____ at the time of diagnosis _____ during treatment _____ right after treatment

_____ 3-6 months after treatment _____ at least 1 year after treatment

e. If you were to engage in regular PA, what types of PA would you be most interested in doing in the summer and the winter (List up to three)?

Summer PA Winter PA

_____ _____

_____ _____

_____ _____

f. Who would you prefer to do regular PA with (**check all that apply**)?

___ alone ___ other cancer survivors ___ family (excluding spouse)

___ friends ___ spouse

g. Who would you like to receive PA information from (**check all that apply**)?

_____ oncologist _____ fitness expert from the community

_____ cancer support group _____ fitness expert from a cancer center

_____ nurse _____ Cancer Care Nova Scotia/Canadian Cancer Society

h. How would you prefer to receive information about PA (**check all that apply**)?

_____ brochures/print materials _____ self-help video _____ on the internet

_____ telephone _____ face-to-face _____ by e-mail

i. Where would you prefer to do a PA program (**check all that apply**)?

_____ outside around my neighbourhood _____ in my home

_____ at a community fitness center _____ at a cancer center

j. When would you prefer to do a PA program (**check one**)?

_____ morning _____ afternoon _____ evening

k. Would you be interested in a program that would help you increase your PA level (**check one**)?

_____ No _____ Yes _____ Maybe/Unsure

l. If you were to engage in regular PA, what would you prefer? (**check only one for each question a to e**):

i) _____light intensity _____moderate intensity _____vigorous intensity

ii) _____the same activity each session _____different activities each session

iii) _____supervised/instructed _____unsupervised/self-paced

iv) _____spontaneous/flexible _____scheduled (i.e., specific days/times)

v) _____group activities _____individual activities

m. Do you have any PA equipment in your home?

____ No ____Yes (please list)_____

n. Do you currently have a fitness center membership?

____ No ____ Yes (where?) _____

o. Do you have access to the internet?

_____ No _____ Yes

p. Would you be interested in receiving PA information through the internet?

_____ No _____ Yes

q. Would you have been able and willing to complete this survey on-line?

_____ No _____ Yes

13. This next question asks you for your home address. This information is very important because it will allow us to understand how the community you live in affects your physical activity and health. We will be able to examine the environment around your home using geographic information systems (GIS). This technology can provide sophisticated measures of the availability and accessibility of fresh fruit and vegetables, the diversity of stores in the food environment, the walkability of a community, and the availability of private and public resources for physical activity such as recreation and activity centers, parks, trails, and bike paths. For this reason it is very important information.

In order for us to understand how the community affects the physical activity and health of cancer survivors, we will need you to voluntarily disclose your address. Please note that all information is held in strict confidence. The address that you provide will not be linked to you in any way. Nevertheless, if you are uncomfortable in providing your home address, please feel free to enter only your postal code or leave this question blank. Thank you for considering our request.

Address: _____

_____

City/Town:_____

Postal Code:_____

14. This next set of questions asks you to describe your home, neighbourhood, or cancer centre. Please circle the best answer that corresponds with your view of your home, neighbourhood, or cancer centre.

		Strongly Disagree	Disagree	Agree	Strongly Agree
(a)	Many shops, stores, markets or other places to buy things I need are within easy walking distance of my home	1	2	3	4
(b)	My neighbourhood has several free or low cost recreation facilities, such as parks, walking trails, bike paths, and recreation centers.	1	2	3	4
(c)	There are well-maintained sidewalks on most of the streets in my neighbourhood.	1	2	3	4
(d)	There are many attractive natural sights in my neighbourhood (such as landscaping, views…).	1	2	3	4
(e)	It feels unsafe to walk along the streets in my neighbourhood because there is so much traffic.	1	2	3	4
(f)	There is a high crime rate in my neighbourhood.	1	2	3	4
(g)	I have exercise equipment I can use at home.	1	2	3	4
(h)	I have appropriate work-out attire (shoes, clothes).	1	2	3	4
(i)	My oncologist or nurse recommended engaging in physical activity.	1	2	3	4
(j)	My cancer centre gave me health education materials (e.g., pamphlets, videos, websites) about physical activity.	1	2	3	4
(k)	My cancer centre has a fitness centre/gym.	1	2	3	4
(l)	My cancer centre offers PA classes	1	2	3	4

15. This next part of the questionnaire is needed to help understand the medical characteristics of the people participating in the study. For this reason it is very important information. All information is held in strict confidence. Please answer the questions to the best of your knowledge. If you don't know the answer to a question, just circle "don't know" (DK).

a. When were you diagnosed with cancer (month/year)? _____. DK

b. Which type of cancer did/do you have? _____ breast _____ prostate
_____ rectal _____ colon

c. Was your cancer described as "localized" (confined to the area) or "metastasized" (spread to other parts of the body) (please circle)?

Localized Metastasized DK

d. Did your treatment include surgery (please circle)? Yes No DK

e. Did your treatment include radiation therapy (please circle)? Yes No DK

f. Did your treatment include chemotherapy/drugs (please circle)? Yes No DK

g. Did your treatment include hormone therapy (please circle)? Yes No DK

h. What is the <u>current status</u> of your cancer treatments?

_____ I have completed all my cancer treatments.

_____ I am still receiving cancer treatments (If so, what? _____).

i. Have you ever had a recurrence of your cancer? Yes No

j. What is the <u>current status</u> of your cancer?

_____ the doctors have told me that the cancer is gone from my body.

_____ the doctors have told me that I still have some cancer in my body.

16. This next part of the questionnaire is needed to help understand the demographic characteristics of the people participating in the study. For this reason it is very important information. All information is held in strict confidence.

a. (i) Age: _____ (ii) Sex: _____ Male _____ Female

b. Current Marital Status: Never Married _____ Married _____ Common Law _____

Separated _____ Widowed _____ Divorced _____

c. Education (Please check highest level attained):

Some High School _____ Completed High School _____

Some University/College _____ Completed University/College _____

Some Graduate School _____ Completed Graduate School _____

d. Annual Family Income: < 20,000 _____ 20-39,999 _____ 40-59,999 _____

60-79,999 _____ 80-99,999 _____ > 100,000 _____

e. Current Employment Status: Disability _____ Retired _____ Part Time _____

Homemaker _____ Full Time _____ Temporarily Unemployed _____

f. Height _____ Weight _____

g. What is your primary ethnic origin or race (please circle)?

White Black Hispanic Asian Aboriginal Other _____

h. Do you own a dog? _____ Yes _____ No

17. The next set of questions ask you about your smoking and diet habits and current health. This information is to help us understand other important health issues. Please provide as honest and accurate responses as possible.

a. Which of the following best describes your current smoking?

____ Never Smoked ____ Ex-Smoker ____ Occasional ____ Regular Smoker (smoke every day)

b. Which of the following best describes your current alcohol consumption?

____ Never Drink ____ Social Drinker ____ Regular Drinker (drink every day)

c. How would you rate your general health?

_____ Excellent_____ Very Good _____ Good _____ Fair _____ Poor

d. Has a doctor or nurse ever told you that you had any of the following conditions? (check all that apply):

High blood pressure	_____ No	_____ Yes		High cholesterol	_____ No	_____ Yes	
Heart attack	_____ No	_____ Yes		Stroke	_____ No	_____ Yes	
Emphysema	_____ No	_____ Yes		Chronic bronchitis	_____ No	_____ Yes	
Diabetes	_____ No	_____ Yes		Other cancer	_____ No	_____ Yes	
Angina (chest pains)	_____ No	_____ Yes		Arthritis	_____ No	_____ Yes	

Any other long term health condition? _____

e. In the past month, was your ability to participate in physical activity limited by a health condition, injury, or disability?

1	2	3	4	5
No, Not at All	A Little	Somewhat	Quite a lot	Completely

f. At any time after your diagnosis of cancer, did anyone involved in your cancer care or treatment discuss exercise with you? _____ Yes _____ No

If yes, who was it? (check all that apply)

_____ cancer doctor (oncologist) _____ nurse _____ physiotherapist

_____ nutritionist _____ psychologist _____ family doctor

_____ other: (please list): _____

If yes, what did they say?

_____
_____
_____
_____
_____

18. Would you be interested in participating in a possible future exercise study? If yes, please provide your contact information. Please note that this does not mean that you have to participate in any future exercise study, it only means that we may contact you to see if you are interested if we do another exercise study.

Name: _____

Address: _____

_____

Telephone: Home: _____ cell: _____

E-mail: _____

How do you prefer we contact you? _____

Anything else you would like to tell us? In this final section, please feel free to make any comments concerning your health, the questionnaire itself, physical activity and sport, or anything else you think may be helpful to us. All comments are welcome.

Thank you very much for participating in this research. Please place the completed questionnaire in the stamped envelope and return it to us at your earliest convenience.

Appendix C – Study II materials

Invitations to study (mail, email, telephone)

Consent form

Questionnaires (baseline, post intervention, and follow-up)

Invitation email

Good day!

My name is Cindy Forbes. I am currently a PhD student at the University of Alberta in Edmonton, Alberta. I previously did my undergraduate degree at StFX in Antigonish and grew up in Pictou, Nova Scotia, which will always be "home" to me.

A while back, you took part in a voluntary survey study looking at physical activity among Nova Scotian cancer survivors. We thank you for completing that survey, and we are pleased to inform you that you were one of more than 700 Nova Scotian cancer survivors who completed that survey! Moreover, we are very pleased to share with you the first publication of the results from that study (see attachment below).

We are also very pleased that you were one of 415 Nova Scotian cancer survivors who indicated that we could contact you about a future physical activity study. At this time, we are very excited to offer you the opportunity to participate in another study, which is designed to help you increase your physical activity level using a web-based program.

For this new study, we would ask you to visit a website that will let you track your activity as well as get tips and information specific to cancer survivors. This exercise part of this study is home-based so you can engage in activity at home, at a gym or around the neighbourhood. You will also complete surveys at the study start, finish and a 12 week follow up.

I have included two documents below for you to read that give a bit more detail.

If this sounds like something you may be interested in, simply reply to this email. If you have any questions or concerns feel free to email me at activeNS@ualberta.ca or give me a phone call at 780-492-2829.

Take care and I look forward to working with you again!

Cindy

Invitation Letter

Dear Sir/Madam,

Previously, the Nova Scotia Cancer Registry contacted you on my behalf to see if were interested in participating in a survey study on physical activity which required the voluntary participation of breast, prostate and colorectal cancer survivors. We thank you for completing that survey, and we are pleased to inform you that you were one of more than 700 Nova Scotian cancer survivors who completed that survey! Moreover, we are very pleased to share with you the first publication of the results from that study.

We are also very pleased that you were one of 415 Nova Scotian cancer survivors who indicated that we could contact you about a future physical activity study. At this time, we are very excited to offer you the opportunity to participate in another study, which is designed to help you increase your physical activity level using a web-based program.

If you decide to participate in this study, you will be randomly assigned to 1 of 2 physical activity groups: (1) a self-directed exercise group or (2) a website exercise group. Randomization means the group that you are assigned will be determined by chance. You will have an equal chance of being assigned to one of the two programs.

Both groups will be asked to complete a consent form and to fill out some questionnaires. For the self-directed exercise group, you be given physical activity guidelines to follow on your own. The website exercise group will be asked to visit a website which will provide additional information about increasing physical activity. Both programs will be home-based, meaning that you will exercise in your home, around your neighbourhood or at a local fitness facility. Those in the self-directed exercise group will have the opportunity to use the website after the study is completed.

The information gained from this study will be used to help develop physical activity programs to improve quality of life among Nova Scotian cancer survivors.

This is a physical activity study and you may be asked to exercise at a moderate-to-vigorous intensity. For more study information, please read the enclosed information letter.

Your participation in this study is completely voluntary. Any information that you provide will be held in strict confidence. Through voluntary participation in research projects like this we are able to increase our knowledge about issues that are important to Nova Scotian cancer survivors. Thank you for taking time to consider our project. If you have any questions about the study, or would like to participate, please contact the study coordinator, Cindy Forbes, by email at activeNS@ualberta.ca or by phone, at (780) 492-2829.

Thank you for considering our study.

Sincerely,

Kerry S. Courneya, PhD
Primary Investigator
University of Alberta
Professor and Canada Research Chair
in PA and Cancer

Cynthia C Forbes, MSc
PhD Candidate
Co-Investigator
Study Coordinator

Follow up message for non-responders

Hello!

Last week we sent you an invitation to participate in a new study. We haven't heard back from you so we thought we would touch base and see how you are doing.

This study is asking you to test an online physical activity program that gives tips and information specific to cancer survivors and allows you to track your activity. The time commitment is fairly minimal, just a few minutes a day!

You can contact us anytime at activeNS@ualberta.ca or give us a call at 780-492-2829. We will happily answer any questions you may have.

If you would be able to let us know either way if you can participate, that would be great. That way we will know to not contact you about this study any further.

We look forward to hearing from you!

Invitation Telephone Script

Hello my name is Cindy Forbes. I am calling because you took part in a survey study that examined physical activity among Nova Scotian cancer survivors. In that study you indicated you would be interested in being contacted again for future studies. Q1: I am wondering if you would be interested in hearing about another opportunity to take part in a physical activity study (Go to A1a or A1b)?

A1a: No: Ok, no problem. Can I give you my number if you change your mind? Thank you for your time and have a great day!

A1b: Yes: Wonderful! We would like to develop a website for Nova Scotian cancer survivors to visit that would help them increase their PA levels. Q2: Do you have access to the internet at home or at work (Go to A2a or A2b)?

A2a: No: This study is taking place online so I am afraid you are not eligible. Sorry about that. Would you still like to be kept on the contact list for any other future studies? Thank you very much for your time and have a great day.

A2b: Yes: Great! This study will have two different groups that you could potentially be assigned to, one which would contain PA guidelines and recommendations for cancer survivors, or the other which will contain the same guidelines along with tips and advice, a PA log that will allow you to track your activity, discussion forums that allow you to talk with others in the program as well and activities to complete online. Q3: If you were to take part in this study, you have an equal chance of being placed in either group, do you understand (if no, ask what questions they may have about the study methods)?

Would you like to participate in a web-based study to increase your physical activity?

No: Ok, no problem. Can I give you my number if you change your mind? Thank you for your time and have a great day!

Yes: That's excellent. Thank you very much. May I have your email address to send you an invitation to complete a questionnaire online? Once you complete the questionnaire you will be randomized to one of the groups and sent your assignment with the website details.

Do you have any questions for me?

Thank you very much for your time and I look forward to seeing you progress through the study!

Consent Form

RESEARCH SUBJECT INFORMATION

TRIAL TITLE: Efficacy of an internet-delivered home-based physical activity intervention among Nova Scotian breast, prostate and colorectal cancer survivors

INVESTIGATORS: Kerry Courneya, PhD
Professor and Canada Research Chair in Physical Activity and Cancer
Director, Behavioural Medicine Laboratory and Fitness Center
Faculty of Physical Education and Recreation
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This form is part of the process of informed consent. It is designed to explain this research study and what will happen to you if you choose to be in the study.

If you would like to know more about something mentioned in this consent form, or have any questions at any time regarding this research study, please be sure to ask your doctor, nurse or Study Coordinator [Cindy Forbes, email: activeNS@ualberta.ca or tel: (780) 492-2829]. Read this consent form carefully to make sure you understand all the information it provides. You do not have to take part in this study and your care does not depend on whether or not you take part.

This study may not help you directly, but we hope that it will teach us something that will help others in the future.

Your participation in this study is entirely voluntary. Please take your time to make your decision. It is recommended that you discuss with your friends and/or family about whether to participate in this study.

"WHY IS THIS STUDY BEING DONE?"

Many studies have shown that physical activity improves quality of life, physical fitness and fatigue for cancer survivors. Studies have also shown that only a small percentage of cancer survivors, are getting enough physical activity for health benefits. The purpose of this study is to find out if a new web-delivered program can help Nova Scotian cancer survivors increase their physical activity and improve their quality of life. This research is being done

because we do not have any web-delivered programs designed specifically to help cancer survivors increase their physical activity levels.

Dr. Kerry Courneya of the University of Alberta and Cindy Forbes are conducting this study that will examine the effects of a web-delivered, home-based physical activity program versus a standard physical activity recommendation among Nova Scotian cancer survivors. The study is the first in the world to investigate this question. Cindy is conducting this study as part of her doctoral dissertation research.

"WHAT DO WE HOPE TO LEARN?"

We hope to learn whether a web-delivered physical activity program can help Nova Scotian cancer survivors increase their physical activity and improve their quality of life and health.

"WHAT IS INVOLVED IN THIS STUDY?"

You will be asked to complete the following tasks over the course of your involvement in the study:

Complete three self-administered questionnaires (which will take about 20-45 minutes each to fill out). The questionnaires will be completed at the beginning of the program (baseline), at the end of the web-based portion of the program (at 12 weeks), and at the end of the entire program (at 24 weeks).

Following your initial (baseline) assessments, you will be randomly assigned to 1 of 2 groups: (1) a standard physical activity recommendation based on Canada's Physical Activity guidelines or (2) a dynamic home-based physical activity website. Randomization means the treatment that you are assigned will be determined by chance. It is like flipping a coin. Randomization is done by a computer program. You will have an equal chance of being assigned to one of the two programs.

Self-directed exercise**:** those randomized to this group will be given the standard recommendation for physical activity based on the Canadian Activity guide and 2008 Guidelines for Americans that have been deemed safe and feasible for cancer survivors. Once the study is completed, this group will receive access to the website intervention and the information presented.

Website exercise group: This group will be asked to enter and track physical activity minutes and/or steps per day online. The site has tracking ability, personalized feedback and motivational rewards, social media functionality, and goal setting aspects. Additionally, there will be weekly educational topics available for you to read and use to increase your physical activity minutes.

"HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?"

Overall, we have invited over 400 Nova Scotian cancer survivors to take part in this study, and we hope that approximately 170 Nova Scotian cancer survivors will participate.

"HOW LONG WILL I BE INVOLVED IN THE STUDY?"

Completion of the questionnaires will be done at the beginning of the program (baseline), at the end of the program (at 12 weeks) and at a 12 week follow up (24 weeks). You will be asked to visit the website and exercise on your own for 12 weeks. In total, the research study will last about 24 weeks. The researchers can take you off the study group early for reasons such as:
Your cancer comes back.
Your doctor feels that you are unable to participate in a physical activity program.

"WHAT ARE MY RISKS/SIDE EFFECTS?"

There are a few risks associated with participating in this research. Some risk is associated with adoption of physical activity. It is possible that some people will experience muscle soreness and fatigue in the beginning of the program. This type of response is usual, and generally poses no threat to health. Do not take any over the counter medications without speaking to your doctor first. If the soreness persists more than five days, or might be associated with a muscle or joint injury, participants should see a physician.

"ARE THERE ANY BENEFITS TO PARTICIPATING IN THIS STUDY?"

If you agree to take part in this study, you will receive free access to a targeted website designed to help you increase exercise levels. If you follow the program, it is likely that your fitness level, quality of life and your health may improve with participation. Both groups may learn more about physical activity and fitness in general. Moreover, we hope the information learned from this study will help other Nova Scotian cancer survivors in the future.

"CAN I WITHDRAW FROM THIS STUDY?"

Taking part in this study is voluntary; you may withdraw from the study at any time if you wish to do so. If you decide to stop participating in the study, we encourage you to talk to our Study Coordinator first. Simply inform the researcher of your wish. Should you decide to withdraw from the study at any time, information collected on you up until that point would still be utilized in this study unless you request to remove the information. The information collected in this study will be used for research and teaching purposes, and to help develop guidelines for helping improve the quality of life and health for people with cancer.

"ARE THERE COSTS TO ME FOR TAKING PART IN THIS STUDY?"

There are no mandatory financial costs to you for participating in this study. Should you wish, you may purchase a physical activity tracker (e.g., pedometer, fitbit, smartphone application etc.) to help you track your activity.

"WHAT ARE MY RIGHTS AS A PARTICIPANT?"

If you suffer an injury or become ill as a result of participating in this research, you will receive all medical treatments (or services) recommended by your doctors. No compensation will be provided beyond this point. However, it is important to note that nothing said in this consent form alters your legal rights to recover damages (e.g., legal action).

If new information becomes available or there are changes to the study that may affect your health or willingness to continue in the study, you will be told in a timely manner.

"WILL MY PERSONAL INFORMATION BE KEPT CONFIDENTIAL?"

Identifiable health information will be collected during this study. This information may be used by the researchers who are carrying out this study, and may be disclosed to others as described below. Any research proposal to use information that identifies you for a purpose other than this study must be approved in advance by the University of Alberta Health Research Ethics Board. Direct access to your identifiable health information collected for this study will be restricted to the researchers who are directly involved in this study.

Your identifiable health information may need to be inspected or copied from time to time for quality assurance (to make sure the information being used in the study is accurate) and for data analysis (to do statistical analysis that will not identify you). The following organizations may do this inspection:

Health Canada, the Canadian regulatory body.
University of Alberta Health Research Ethics Board, the institutional review board at this centre

Any disclosure of your identifiable health information will be in accordance with the Nova Scotia Personal Health Information Act and the Alberta Health Information Act. Any disclosure of your identifiable health information to another individual or organization not listed here will need the approval of the University of Alberta Health Research Ethics Board.

Your identifiable health information collected as part of this study, which includes responses to the questionnaires, will be kept confidential. We will be retaining the anonymous data file for a period of 7 years after the completion of the research project. The data will be stored in the Behavioural Medicine Laboratory. This laboratory is secure. If a secondary analysis is planned using the data, appropriate ethical approval will be obtained.

The researchers who are directly involved in your study may share information about you with other researchers, but you will not be identified in that shared information except by a number. The key that indicates what number you have been assigned will be kept secure by the researchers directly involved with your study and will not be released.

Although absolute confidentiality can never be guaranteed, the University of Alberta Health Research Ethics Board will make every effort to keep your identifiable health information confidential, and to follow the ethical and legal rules about collecting, using and disclosing this information in accordance with the Nova Scotia Personal Health Information Act and other regulatory requirements.

"WHO DO I CONTACT IF I HAVE QUESTIONS OR PROBLEMS?"

For information about this study, you may contact the Investigators Kerry Courneya and Cindy Forbes firstly by email at activeNS@ualberta.ca or alternatively by phone at (780) 492-2829 to answer any questions. You are also able to contact the University of Alberta Research Ethics Office at 780-492-2615 (collect calls accepted).

Active Nova Scotia Baseline Survey

Web-delivered, home-based PA intervention Baseline Questionnaire
Thank you for agreeing to participate in this study. In this questionnaire, we are going to ask you a series of questions about yourself. Many of the questions ask you about your physical and mental health, and some may be viewed as personal. It is important to answer these questions if at all possible. All responses are completely confidential and will never be used in any way that could link them to you. Many of the questions may seem similar but it is important to treat each question separately and provide an answer for each. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible. The questionnaire should take about 20-35 minutes of your time to complete. If you have any questions about completing the questionnaire, please contact Cindy Forbes (Co-Investigator) at ccforbes@ualberta.ca or 780-492-2829.

This set of questions asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. Answer every question by marking a single answer. If you are unsure about how to answer a question please give the best answer you can.

In general, would you say your health is:
- ○ Excellent
- ○ Very Good
- ○ Good
- ○ Fair
- ○ Poor

Compared to one year ago, how would you rate your health in general now?
- ○ Much better now than one year ago
- ○ Somewhat better now than one year ago
- ○ About the same as one year ago
- ○ Somewhat worse than one year ago
- ○ Much worse than one year ago

The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
a. Vigorous Activities, such as running, lifting heavy objects, participating in strenuous sports	○	○	○
b. Moderate Activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○	○	○
c. Lifting or carrying groceries	○	○	○
d. Climbing several flights of stairs	○	○	○
e. Climbing one flight of stairs	○	○	○

f. Bending, kneeling or stooping	○	○	○
g. Walking more than a mile	○	○	○
h. Walking several hundred yards	○	○	○
i. Walking one hundred yards	○	○	○
j. Bathing or dressing yourself	○	○	○

During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
b. Accomplished less than you would like	○	○	○	○	○
c. Were limited in the kind of work or other activities	○	○	○	○	○
d. Had difficulty performing the work or other activities (e.g., it took extra effort)	○	○	○	○	○

During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
b. Accomplished less than you would like	○	○	○	○	○
c. Did work or other activities less carefully than usual	○	○	○	○	○

During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

○ Not at all

○ Slightly

○ Moderately

○ Quite a bit

○ Extremely

How much bodily pain have you had during the past 4 weeks?

○ None

○ Very mild

○ Mild

○ Moderate

○ Severe

○ Very severe

During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

○ Not at all

○ Slightly

○ Moderately

○ Quite a bit

○ Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks…

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of life?	○	○	○	○	○
b. Have you been very nervous?	○	○	○	○	○
c. Have you felt so down in the dumps that nothing could cheer you up?	○	○	○	○	○
d. Have you felt calm and peaceful?	○	○	○	○	○
e. Did you have a lot of energy?	○	○	○	○	○
f. Have you felt downhearted and depressed?	○	○	○	○	○
g. Did you feel worn out?	○	○	○	○	○
h. Have you been happy?	○	○	○	○	○
i. Did you feel tired?	○	○	○	○	○

During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

○ All of the time

○ Most of the time

○ Some of the time

○ A little of the time

○ None of the time

How TRUE or FALSE is <u>each</u> of the following statements for you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a. I seem to get sick a little easier than other people	○	○	○	○	○
b. I am as healthy as anybody I know	○	○	○	○	○
c. I expect my health to get worse	○	○	○	○	○
d. My health is excellent	○	○	○	○	○

Below is a list of statements that other people who have had cancer have said are important to their quality of life. Please indicate the extent to which you have experienced each of the statements <u>during the past 7 days</u> by selecting the appropriate choice. During the <u>PAST WEEK</u>:

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. I have a lack of energy	○	○	○	○	○
2. I have nausea	○	○	○	○	○
3. Because of my physical condition, I have trouble meeting the needs of my family	○	○	○	○	○
4. I have pain	○	○	○	○	○
5. I am bothered by side effects of treatment	○	○	○	○	○
6. I feel sick	○	○	○	○	○
7. I am forced to spend time in bed	○	○	○	○	○
8. I feel close to my friends	○	○	○	○	○
9. I get emotional support from my family	○	○	○	○	○
10. I get support from my friends	○	○	○	○	○
11. My family has accepted my illness	○	○	○	○	○
12. I am satisfied with family communication about my illness	○	○	○	○	○
13. I feel close to my partner (or the person who is my main support)	○	○	○	○	○
14. I am satisfied with my sex life	○	○	○	○	○
15. I feel sad	○	○	○	○	○
16. I am satisfied with how I am coping with my illness	○	○	○	○	○
17. I am losing hope in the fight against my illness	○	○	○	○	○
18. I feel nervous	○	○	○	○	○
19. I worry about dying	○	○	○	○	○
20. I worry that my condition will get worse	○	○	○	○	○
21. I am able to work (include work at home)	○	○	○	○	○

22. My work (include work at home) is fulfilling	○	○	○	○	○
23. I am able to enjoy life	○	○	○	○	○
24. I have accepted my illness	○	○	○	○	○
25. I am sleeping well	○	○	○	○	○
26. I am enjoying the things I usually do for fun	○	○	○	○	○
27. I am content with the quality of my life right now	○	○	○	○	○

During the <u>PAST WEEK</u>: FATIGUE SYMPTOMS

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. I feel fatigued	○	○	○	○	○
2. I feel weak all over	○	○	○	○	○
3. I feel listless ("washed out")	○	○	○	○	○
4. I feel tired	○	○	○	○	○
5. I have trouble starting things because I am tired	○	○	○	○	○
6. I have trouble finishing things because I am tired	○	○	○	○	○
7. I have energy	○	○	○	○	○
8. I am able to do my usual activities	○	○	○	○	○
9. I need to sleep during the day	○	○	○	○	○
10. I am too tired to eat	○	○	○	○	○
11. I need help doing my usual activities	○	○	○	○	○
12. I am frustrated by being too tired to do the things I want to do	○	○	○	○	○
13. I have to limit my social activity because I am tired	○	○	○	○	○

For this next question, we would like you to recall the amount of exercise you have done in the past month. When answering these questions please: only count exercise sessions that lasted 10 minutes or longer in duration. Only count exercise that was done during free time (i.e., not occupation or housework). Note that the main difference between the first three categories is the intensity of the endurance (aerobic) exercise and the fourth category is for strength (resistance) exercise. Please type the average frequency on the first line and the average duration on the second. If you did not do any exercise in one of the categories, please write in "0".Considering a typical week (7 days) how many times on the average did you do the following kinds of exercise in the past month?

a. VIGOROUS/STRENUOUS EXERCISE (HEART BEATS RAPIDLY, SWEATING) (e.g., running, aerobics classes, cross country skiing, vigorous swimming, vigorous bicycling).

Times Per Week (days per week)

Average Duration (minutes per session)

b. MODERATE EXERCISE (NOT EXHAUSTING, LIGHT PERSPIRATION) (e.g., fast walking, tennis, easy bicycling, easy swimming, popular and folk dancing).

Times Per Week (days per week)

Average Duration (minutes per session)

c. LIGHT/MILD EXERCISE (MINIMAL EFFORT, NO PERSPIRATION) (e.g., easy walking, yoga, bowling, lawn bowling, shuffleboard).

Times Per Week (days per week)

Average Duration (minutes per session)

d. RESISTANCE/STRENGTH EXERCISE (e.g., lifting weights, push ups, sit ups therabands).

Times Per Week (days per week)

Average Duration (minutes per session)

For the rest of this survey, we are going to ask you questions about leisure-time physical activity. Leisure time means activity done during your free time and does not include your work/job or household chores. Physical activity (PA) means any exercise or sport that results in a substantial increase in energy expenditure (resulting in a noticeable increase in heart rate and breathing rate). Examples of exercises and sports include brisk walking, jogging, cycling, swimming, hockey, golf, curling, and dancing. We will use PA as a short name for physical activity throughout the rest of this survey. The following statements and questions ask you to rate how you feel about participating in regular PA over the next 3 months. Regular PA means that you get 150 minutes of moderate intensity activity, 75 minutes of vigorous intensity activity or a combination of both throughout the week. For example, this may mean you get 30 moderate minutes/5 days a week or 25 vigorous minutes/3 days a week or 30 moderate minutes/3 days a week plus 60 vigorous minutes once a week. Please pay careful attention to the words at each end of the scale and select the answer that best represents how you feel. Please answer all items below.

I think that for me to participate in regular PA over the next 3 months would be:

- ○ Extremely useful
- ○ Quite useful
- ○ Slightly useful
- ○ Neutral
- ○ Slightly useless
- ○ Quite useless
- ○ Extremely useless

I think that for me to participate in regular PA over the next 3 months would be:

- ○ Extremely enjoyable
- ○ Quite enjoyable
- ○ Slightly enjoyable
- ○ Neutral
- ○ Slightly unenjoyable
- ○ Quite unenjoyable
- ○ Extremely unenjoyable

I think that for me to participate in regular PA over the next 3 months would be:

- ○ Extremely beneficial
- ○ Quite beneficial
- ○ Slightly beneficial
- ○ Neutral
- ○ Slightly harmful
- ○ Quite harmful
- ○ Extremely harmful

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

- ○ Extremely pleasurable
- ○ Quite pleasurable
- ○ Slightly pleasurable
- ○ Neutral
- ○ Slightly painful
- ○ Quite painful
- ○ Extremely painful

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

- ○ Extremely important
- ○ Quite important
- ○ Slightly important
- ○ Neutral
- ○ Slightly unimportant
- ○ Quite unimportant
- ○ Extremely unimportant

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

- ○ Extremely fun
- ○ Quite fun
- ○ Slightly fun
- ○ Neutral
- ○ Slightly boring
- ○ Quite boring
- ○ Extremely boring

This next set of statements and questions asks you to rate how other people in your life would feel about you participating in <u>regular</u> PA <u>over the next 3 months</u>. Please pay careful attention to the words at the end of each scale and select the answer that best represents how they might feel. Please answer all items.

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

- ○ Extremely approving
- ○ Quite approving
- ○ Slightly approving
- ○ Neutral
- ○ Slightly disapproving

○ Quite disapproving

○ Extremely disapproving

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

○ Extremely encouraging

○ Quite encouraging

○ Slightly encouraging

○ Neutral

○ Slightly discouraging

○ Quite discouraging

○ Extremely discouraging

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

○ Extremely supportive

○ Quite supportive

○ Slightly supportive

○ Neutral

○ Slightly unsupportive

○ Quite unsupportive

○ Extremely unsupportive

These next questions ask you to rate how much PA you think other people in your life are likely to do themselves over the <u>next 3 months</u>.

I think that over the <u>next 3 months</u>, most people who are important to me will be:

○ Extremely active

○ Quite active

○ Slightly active

○ Neutral

○ Slightly inactive

○ Quite inactive

○ Extremely inactive

I think that over the <u>next 3 months</u>, most people who are important to me will participate in regular PA.

○ Extremely agree

○ Quite agree

○ Slightly agree

- ○ Neutral
- ○ Slightly disagree
- ○ Quite disagree
- ○ Extremely disagree

These next statements and questions ask you to rate how likely it is that <u>you would be able</u> to participate in regular PA over the next 3 months <u>if you were really motivated</u>. Please pay careful attention to the words in each scale. Circle the number that best represents how you feel. IF YOU WERE REALLY MOTIVATED...

How much control would you have over doing regular PA over the <u>next 3 months</u>?

Drag the hand to the preferred answer along the scale.
- ○ Complete control
- ○ 6
- ○ 5
- ○ Some control
- ○ 3
- ○ 2
- ○ Very little control

Whether or not I engage in regular PA over the <u>next 3 months</u> is completely up to me.
- ○ Strongly agree
- ○ Moderately agree
- ○ Slightly agree
- ○ Neutral
- ○ Slightly disagree
- ○ Moderately disagree
- ○ Strongly disagree

How much do you feel that engaging in PA over the <u>next 3 months</u> is beyond your control?

Drag the hand to the preferred answer along the scale.
- ○ Very much
- ○ 6
- ○ 5
- ○ 4
- ○ 3
- ○ 2

○ Not at all

Participating in regular PA over the next 3 months would be...
○ Extremely easy

○ Quite easy

○ Slightly easy

○ Neutral

○ Slightly difficult

○ Quite difficult

○ Extremely difficult

If I wanted to, I could easily engage in regular PA over the next 3 months.
○ Strongly agree

○ Moderately agree

○ Slightly agree

○ Neutral

○ Slightly disagree

○ Moderately disagree

○ Strongly disagree

How confident are you that you could do regular PA over the next 3 months?

Drag the hand to the preferred answer along the scale.
○ Not at all confident

○ 2

○ Somewhat confident

○ 4

○ Quite confident

○ 6

○ Completely confident

This next set of questions asks you about your motivation and plans to do regular PA over the next 3 months. Pay careful attention to the words at the end of each scale.

Do you intend to do regular PA over the next 3 months?

Drag the hand to the preferred answer along the scale.
○ Strongly intend

○ 6

○ 5

○ Somewhat intend

○ 3

○ 2

○ No, not really

How motivated are you to do regular PA over the <u>next 3 months</u>?

Drag the hand to the preferred answer along the scale.

○ Completely motivated

○ 6

○ Quite motivated

○ 4

○ Somewhat motivated

○ 2

○ Not at all motivated

Please use the scale below to guide your responses to the next set of 6 questions. 1 2 3 4 5 6 7
No plans Detailed plans

	1	2	3	4	5	6	7
a. Do you have plans for when, where, and what type of PA you will do in the <u>next 3 months</u>?	○	○	○	○	○	○	○
b. I have made plans concerning 'when' I am going to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
c. I have made plans concerning 'where' I am going to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
d. I have made plans concerning 'what' kind of regular PA I am going to engage in over the <u>next 3 months</u>.	○	○	○	○	○	○	○
e. I have made plans concerning 'how' I am going to get to a place to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
f. I have made plans concerning 'who' I am going to be physically active with over the <u>next 3 months</u>.	○	○	○	○	○	○	○

Please use the scale below to guide your responses to the next set of 9 questions. 1 2 3 4 5 6 7
Extremely unlikely Quite unlikely Slightly unlikely Neutral Slightly likely Quite likely Extremely likely

If you were to do regular PA over the <u>next 3 months</u>, do you think you would…

	1	2	3	4	5	6	7
a. feel better and improve your well-being	○	○	○	○	○	○	○

b. reduce the risk of your cancer returning	○	○	○	○	○	○	○
c. relieve stress	○	○	○	○	○	○	○
d. improve your energy level	○	○	○	○	○	○	○
e. get your mind off cancer	○	○	○	○	○	○	○
f. live longer	○	○	○	○	○	○	○
g. improve fitness	○	○	○	○	○	○	○
h. lose some weight	○	○	○	○	○	○	○
i. improve your immune system	○	○	○	○	○	○	○

Please use the scale below to guide your responses to the next set of 4 questions. 1 2 3 4 5 6 7 Extremely unsupportive Quite unsupportive Slightly unsupportive Neutral Slightly supportive Quite supportive Extremely supportive

How supportive do you think each of the following people would be if you tried to do regular PA over the <u>next 3 months.</u>

	1	2	3	4	5	6	7
a. spouse / partner (if applicable)	○	○	○	○	○	○	○
b. other family members	○	○	○	○	○	○	○
c. best friend(s)	○	○	○	○	○	○	○
d. oncologist (cancer doctor)	○	○	○	○	○	○	○

Please use the scale below to guide your responses to the next set of 9 questions. 1 2 3 4 5 6 7 not at all confident somewhat confident quite confident completely confident

If you were really motivated, how confident are you that you could do regular PA over the <u>next 3 months</u> even if...

	1	2	3	4	5	6	7
a. the weather was very bad	○	○	○	○	○	○	○
b. you felt tired or fatigued	○	○	○	○	○	○	○
c. you had medical/health problems	○	○	○	○	○	○	○
d. you got very busy and had limited time	○	○	○	○	○	○	○
e. you had a recurrence of your cancer	○	○	○	○	○	○	○
f. you had pain or soreness	○	○	○	○	○	○	○
g. you had additional family responsibilities	○	○	○	○	○	○	○
h. the activity became boring	○	○	○	○	○	○	○
i. you went back on cancer treatments	○	○	○	○	○	○	○

This next part of the questionnaire is needed to help understand the medical characteristics of the people participating in the study. For this reason it is very important information. All information is held in

strict confidence. Please answer the questions to the best of your knowledge. If you don't know the answer to a question, just select "Don't know".

When were you diagnosed with cancer (month/year)?

____/__/__ (YYYY/MM/DD)

Which type of cancer did/do you have?

○ Breast

○ Prostate

○ Colon

○ Rectal

Was your cancer described as "localized" (confined to the area) or "metastasized" (spread to other parts of the body)?

○ Localized

○ Metastasized

○ Don't know

Treatment Types.

	Yes	No	Don't know
Did your treatment include surgery?	○	○	○
Did your treatment include radiation therapy?	○	○	○
Did your treatment include chemotherapy/drugs?	○	○	○
Did your treatment include hormone therapy?	○	○	○

What is the <u>current status</u> of your cancer treatments?

○ I have completed all my cancer treatments

○ I am still receiving cancer treatments (If so, what?) _____

Have you ever had a recurrence of your cancer?

○ Yes

○ No

What is the <u>current status</u> of your cancer?

○ The doctors have told me that the cancer is gone from my body

○ The doctors have told me that I still have some cancer in my body

This next part of the questionnaire is needed to help understand the demographic characteristics of the people participating in the study. For this reason it is very important information. All information is held in strict confidence.

Age:

Sex:
- ○ Male
- ○ Female

Current Marital Status:
- ○ Never Married
- ○ Married
- ○ Common Law
- ○ Separated
- ○ Widowed
- ○ Divorced

Education (highest level attained):
- ○ Some High School
- ○ Completed High School
- ○ Some University/College
- ○ Completed University/College
- ○ Some Graduate School
- ○ Completed Graduate School

Annual Family Income:
- ○ <20,000
- ○ 20-39,999
- ○ 40-59,999
- ○ 60-79,999
- ○ 80-99,999
- ○ >100,000
- ○ Prefer not to answer

Current Employment Status:
- ○ Disability
- ○ Retired
- ○ Part Time
- ○ Homemaker

○ Full Time

○ Temporarily Unemployed

Height (inches)

Weight (pounds)

What is your primary ethnic origin or race

○ White

○ Black

○ Hispanic

○ Asian

○ Aboriginal

○ Other

Do you own a dog?

○ Yes

○ No

The next set of questions ask you about your smoking and diet habits and current health. This information is to help us understand other important health issues. Please provide as honest and accurate responses as possible.

Which of the following best describes your current smoking?

○ Never Smoked

○ Ex-Smoker

○ Occasional

○ Regular Smoker (smoke every day)

Which of the following best describes your current alcohol consumption?

○ Never Drink

○ Social Drinker

○ Regular Drinker (drink every day)

Has a doctor or nurse ever told you that you had any of the following conditions?

	Yes	No
High blood pressure	○	○

Heart attack	○	○
Emphysema	○	○
Diabetes	○	○
Angina (chest pains)	○	○
High cholesterol	○	○
Stroke	○	○
Chronic bronchitis	○	○
Other cancer	○	○
Arthritis	○	○

Any other long term health condition?

○ No

○ Yes _____

In the <u>past month</u>, was your ability to exercise limited by a health condition, injury, or disability?

○ No, Not at All

○ A Little

○ Somewhat

○ Quite a lot

○ Completely

Anything else you would like to tell us? On this final question, please feel free to make any comments concerning your cancer, your treatments, the questionnaire, the exercise program, or anything else you think may be helpful to us. All comments are welcome.

Thank you very much for your participation in this research project.

Active Nova Scotia Post Study Survey

Web-delivered, home-based PA intervention Post Questionnaire

Thank you for your continued participation in this study. At this post-intervention questionnaire, we are going to ask you many of the same questions as in the first questionnaire. However, it is important to answer these questions based on what you are thinking and feeling right now, and not on how you answered the questions the last time. This will give us important information about how your thoughts and feelings have changed. It is important to answer as many of these questions as possible. All responses are completely confidential and will never be used in any way that could link them to you. Many of the questions may seem similar but it is important to treat each question separately and provide an answer for each. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible. The questionnaire should take about 30-45 minutes of your time to complete. If you have any questions about completing the questionnaire, please contact Cindy Forbes (Study Coordinator) at 780-492-2829 or ccforbes@ualberta.ca.

This set of questions asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. Answer every question by marking a single answer. If you are unsure about how to answer a question please give the best answer you can.

In general, would you say your health is:

Excellent	Very Good	Good	Fair	Poor
○	○	○	○	○

Compared to one year ago, how would you rate your health in general now?

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse than one year ago	Much worse than one year ago
○	○	○	○	○

The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
a. Vigorous Activities, such as running, lifting heavy objects, participating in strenuous sports	○	○	○
b. Moderate Activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○	○	○
c. Lifting or carrying groceries	○	○	○
d. Climbing several flights of stairs	○	○	○
e. Climbing one flight of stairs	○	○	○
f. Bending, kneeling or stooping	○	○	○
g. Walking more than a mile	○	○	○
h. Walking several hundred yards	○	○	○
i. Walking one hundred yards	○	○	○

j. Bathing or dressing yourself	○	○	○

During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of your physical health</u>?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
b. Accomplished less than you would like	○	○	○	○	○
c. Were limited in the kind of work or other activities	○	○	○	○	○
d. Had difficulty performing the work or other activities (e.g., it took extra effort)	○	○	○	○	○

During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> (such as feeling depressed or anxious)?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
b. Accomplished less than you would like	○	○	○	○	○
c. Did work or other activities less carefully than usual	○	○	○	○	○

During the <u>past 4 weeks</u>, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

Not at all	Slightly	Moderately	Quite a bit	Extremely
○	○	○	○	○

How much <u>bodily</u> pain have you had during the <u>past 4 weeks</u>?

None	Very mild	Mild	Moderate	Severe	Very severe
○	○	○	○	○	○

During the <u>past 4 weeks</u>, how much did <u>pain</u> interfere with your normal work (including both work outside the home and housework)?

Not at all	Slightly	Moderately	Quite a bit	Extremely
○	○	○	○	○

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks…

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of life?	○	○	○	○	○
b. Have you been very nervous?	○	○	○	○	○
c. Have you felt so down in the dumps that nothing could cheer you up?	○	○	○	○	○
d. Have you felt calm and peaceful?	○	○	○	○	○
e. Did you have a lot of energy?	○	○	○	○	○
f. Have you felt downhearted and depressed?	○	○	○	○	○
g. Did you feel worn out?	○	○	○	○	○
h. Have you been happy?	○	○	○	○	○
i. Did you feel tired?	○	○	○	○	○

During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
○	○	○	○	○

How TRUE or FALSE is each of the following statements for you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a. I seem to get sick a little easier than other people.	○	○	○	○	○
b. I am as healthy as anybody I know.	○	○	○	○	○
c. I expect my health to get worse.	○	○	○	○	○
d. My health is excellent.	○	○	○	○	○

Below is a list of statements that other people who have had cancer have said are important to their quality of life. Please indicate the extent to which you have experienced each of the statements during the past 7 days by selecting the appropriate choice. During the PAST WEEK:

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. I have a lack of energy.	○	○	○	○	○
2. I have nausea.	○	○	○	○	○
3. Because of my physical condition, I have trouble meeting the needs of my family.	○	○	○	○	○

4. I have pain.	○	○	○	○	○
5. I am bothered by side effects of treatment.	○	○	○	○	○
6. I feel sick.	○	○	○	○	○
7. I am forced to spend time in bed.	○	○	○	○	○
8. I feel close to my friends.	○	○	○	○	○
9. I get emotional support from my family.	○	○	○	○	○
10. I get support from my friends.	○	○	○	○	○
11. My family has accepted my illness.	○	○	○	○	○
12. I am satisfied with family communication about my illness.	○	○	○	○	○
13. I feel close to my partner (or the person who is my main support).	○	○	○	○	○
14. I am satisfied with my sex life.	○	○	○	○	○
15. I feel sad.	○	○	○	○	○
16. I am satisfied with how I am coping with my illness.	○	○	○	○	○
17. I am losing hope in the fight against my illness.	○	○	○	○	○
18. I feel nervous.	○	○	○	○	○
19. I worry about dying.	○	○	○	○	○
20. I worry that my condition will get worse.	○	○	○	○	○
21. I am able to work (include work at home).	○	○	○	○	○
22. My work (include work at home) is fulfilling.	○	○	○	○	○
23. I am able to enjoy life.	○	○	○	○	○
24. I have accepted my illness.	○	○	○	○	○
25. I am sleeping well.	○	○	○	○	○
26. I am enjoying the things I usually do for fun.	○	○	○	○	○
27. I am content with the quality of my life right now.	○	○	○	○	○

During the <u>PAST WEEK</u>: FATIGUE SYMPTOMS

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. I feel fatigued.	○	○	○	○	○
2. I feel weak all over.	○	○	○	○	○
3. I feel listless (“washed out”).	○	○	○	○	○
4. I feel tired.	○	○	○	○	○

5. I have trouble starting things because I am tired.	○	○	○	○	○
6. I have trouble finishing things because I am tired.	○	○	○	○	○
7. I have energy.	○	○	○	○	○
8. I am able to do my usual activities.	○	○	○	○	○
9. I need to sleep during the day.	○	○	○	○	○
10. I am too tired to eat.	○	○	○	○	○
11. I need help doing my usual activities.	○	○	○	○	○
12. I am frustrated by being too tired to do the things I want to do.	○	○	○	○	○
13. I have to limit my social activity because I am tired.	○	○	○	○	○

For this question, we would like you to recall the amount of exercise you have done in the past month. When answering these questions please: → only count exercise sessions that lasted 10 minutes or longer in duration. → only count exercise that was done during free time (i.e., not occupation or housework). → note that the main difference between the first three categories is the intensity of the endurance (aerobic) exercise and the fourth category is for strength (resistance) exercise. → please select the average frequency on the first line and type the average duration on the second. → if you did not do any exercise in one of the categories, please use "0" to indicate this. Considering a typical week (7 days) how many times on the average did you do the following kinds of exercise in the past month?

a. VIGOROUS/STRENUOUS EXERCISE (HEART BEATS RAPIDLY, SWEATING)(e.g., running, aerobics classes, cross country skiing, vigorous swimming, vigorous bicycling).

Times Per Week (days per week)

Choose the average number of days per week.

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

[ ]

b. MODERATE EXERCISE (NOT EXHAUSTING, LIGHT PERSPIRATION)(e.g., fast walking, tennis, easy bicycling, easy swimming, popular and folk dancing).

Times Per Week (days per week)

Choose the average number of days per week

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

[ ]

c. LIGHT/MILD EXERCISE (MINIMAL EFFORT, NO PERSPIRATION)(e.g., easy walking, yoga, bowling, lawn bowling, shuffleboard).

Times Per Week (days per week)

Choose the average number of days per week

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

[ ]

d. RESISTANCE/STRENGTH EXERCISE (e.g., lifting weights, push ups, sit ups therabands).

Times Per Week (days per week)

Choose the average number of days per week

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

[ ]

For the rest of this survey, we are going to ask you questions about leisure-time physical activity. Leisure time means activity done during your free time and does not include your work/job or household chores. Physical activity (PA) means any exercise or sport that results in a substantial increase in energy expenditure (resulting in a noticeable increase in heart rate and breathing rate). Examples of exercises and sports include brisk walking, jogging, cycling, swimming, hockey, golf, curling, and dancing. We will use PA as a short name for physical activity throughout the rest of this survey. The following statements and questions ask you to rate how you feel about participating in regular PA over the next 3 months. Regular PA means that you get 150 minutes of moderate intensity activity, 75 minutes of vigorous intensity activity or a combination of both throughout the week. For example, this may mean you get 30 moderate minutes/5 days a week or 25 vigorous minutes/3 days a week or 30 moderate minutes/3 days a week plus 60 vigorous minutes once a week. Please pay careful attention to the words at each end of the scale and select the answer that best represents how you feel. Please answer all items below.

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely useful	Quite useful	Slightly useful	Neutral	Slightly useless	Quite useless	Extremely useless
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely enjoyable	Quite enjoyable	Slightly enjoyable	Neutral	Slightly unenjoyable	Quite unenjoyable	Extremely unenjoyable
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely beneficial	Quite beneficial	Slightly beneficial	Neutral	Slightly harmful	Quite harmful	Extremely harmful
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely pleasurable	Quite pleasurable	Slightly pleasurable	Neutral	Slightly painful	Quite painful	Extremely painful
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely important	Quite important	Slightly important	Neutral	Slightly unimportant	Quite unimportant	Extremely unimportant
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely fun	Quite fun	Slightly fun	Neutral	Slightly boring	Quite boring	Extremely boring
○	○	○	○	○	○	○

This next set of statements and questions asks you to rate how other people in your life would feel about you participating in <u>regular</u> PA <u>over the next 3 months</u>. Please pay careful attention to the words at the end of each scale and select the answer that best represents how they might feel. Please answer all items.

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

Extremely approving	Quite approving	Slightly approving	Neutral	Slightly disapproving	Quite disapproving	Extremely disapproving
○	○	○	○	○	○	○

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

Extremely encouraging	Quite encouraging	Slightly encouraging	Neutral	Slightly discouraging	Quite discouraging	Extremely discouraging
○	○	○	○	○	○	○

I think that if I participated in regular PA over the next 3 months, most people who are important to me would be:

Extremely supportive	Quite supportive	Slightly supportive	Neutral	Slightly unsupportive	Quite unsupportive	Extremely unsupportive
○	○	○	○	○	○	○

These next questions ask you to rate how much PA you think other people in your life are likely to do themselves over the next 3 months.

I think that over the next 3 months, most people who are important to me will be:

Extremely active	Quite active	Slightly active	Neutral	Slightly inactive	Quite inactive	Extremely inactive
○	○	○	○	○	○	○

I think that over the next 3 months, most people who are important to me will participate in regular PA.

Extremely agree	Quite agree	Slightly agree	Neutral	Slightly disagree	Quite disagree	Extremely disagree
○	○	○	○	○	○	○

These next statements and questions ask you to rate how likely it is that you would be able to participate in regular PA over the next 3 months if you were really motivated. Please pay careful attention to the words in each scale. Select the number that best represents how you feel. IF YOU WERE REALLY MOTIVATED...

How much control would you have over doing regular PA over the next 3 months?

Very little control	2	3	Some control	5	6	Complete control
○	○	○	○	○	○	○

Whether or not I engage in regular PA over the next 3 months is completely up to me.

Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
○	○	○	○	○	○	○

How much do you feel that engaging in PA over the next 3 months is beyond your control?

Not at all	2	3	4	5	6	Very much
○	○	○	○	○	○	○

Participating in regular PA over the next 3 months would be...

Extremely easy	Quite easy	Slightly easy	Neutral	Slightly difficult	Quite difficult	Extremely difficult
○	○	○	○	○	○	○

If I wanted to, I could easily engage in regular PA over the next 3 months.

Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
○	○	○	○	○	○	○

How confident are you that you could do regular PA over the <u>next 3 months</u>?

Not at all confident	2	Somewhat confident	4	Quite confident	6	Completely confident
○	○	○	○	○	○	○

This next set of questions asks you about your motivation and plans to do regular PA over the <u>next 3 months</u>. Pay careful attention to the words at the end of each scale.

Do you intend to do regular PA over the <u>next 3 months</u>?

No, not really	2	3	Somewhat intend	5	6	Strongly intend
○	○	○	○	○	○	○

How motivated are you to do regular PA over the <u>next 3 months</u>?

Not at all motivated	2	Somewhat motivated	4	Quite motivated	6	Completely motivated
○	○	○	○	○	○	○

This next set of questions asks you about your <u>specific plans</u> to do regular PA over the <u>next 3 months.</u>

	No plans	2	3	4	5	6	Detailed plans
a. Do you have plans for when, where, and what type of PA you will do in the <u>next 3 months</u>?	○	○	○	○	○	○	○
b. I have made plans concerning 'when' I am going to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
c. I have made plans concerning 'where' I am going to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
d. I have made plans concerning 'what' kind of regular PA I am going to engage in over the <u>next 3 months</u>.	○	○	○	○	○	○	○
e. I have made plans concerning 'how' I am going to get to a place to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
f. I have made plans concerning 'who' I am going to be physically active with over the <u>next 3 months</u>.	○	○	○	○	○	○	○

If you were to do regular PA over the <u>next 3 months</u>, do you think you would…

	Extremely unlikely	Quite unlikely	Slightly unlikely	Neutral	Slightly likely	Quite likely	Extremely likely
a. feel better and improve your well-being?	○	○	○	○	○	○	○
b. reduce the risk of your cancer returning?	○	○	○	○	○	○	○
c. relieve stress?	○	○	○	○	○	○	○
d. improve your energy level?	○	○	○	○	○	○	○
e. get your mind off cancer?	○	○	○	○	○	○	○
f. live longer?	○	○	○	○	○	○	○
g. improve fitness?	○	○	○	○	○	○	○
h. lose some weight?	○	○	○	○	○	○	○
i. improve your immune system?	○	○	○	○	○	○	○

How supportive do you think each of the following people would be if you tried to do regular PA over the <u>next 3 months</u>?

	Extremely unsupportive	Quite unsupportive	Slightly unsupportive	Neutral	Slightly supportive	Quite supportive	Extremely supportive
a. spouse / partner (leave blank if N/A).	○	○	○	○	○	○	○
b. other family members.	○	○	○	○	○	○	○
c. best friend(s).	○	○	○	○	○	○	○
d. oncologist (cancer doctor).	○	○	○	○	○	○	○

If you were really motivated, how confident are you that you could do regular PA over the <u>next 3 months</u> even if...

Not at all	2	Somewhat	4	Quite	6	Completely

	confident		confident		confident		confident
a. the weather was very bad?	○	○	○	○	○	○	○
b. you felt tired or fatigued?	○	○	○	○	○	○	○
c. you had medical/health problems?	○	○	○	○	○	○	○
d. you got very busy and had limited time?	○	○	○	○	○	○	○
e. you had a recurrence of your cancer?	○	○	○	○	○	○	○
f. you had pain or soreness?	○	○	○	○	○	○	○
g. you had additional family responsibilities?	○	○	○	○	○	○	○
h. the activity became boring?	○	○	○	○	○	○	○
i. you went back on cancer treatments?	○	○	○	○	○	○	○

Program Evaluation: The next few questions ask you about what you liked and didn't like about the <u>Active Nova Scotia program only</u>. These questions DO NOT refer to the website itself, only the information included in the Active Nova Scotia group. You will have the opportunity to evaluate the website specifically further along in this survey.

Select the option which best applies to you and your opinions of the Active Nova Scotia program.

	Didn't do program	Strongly disagree	Disagree	Agree	Strongly agree
I enjoyed the Active Nova Scotia program.	○	○	○	○	○
If I had any concerns I knew who to contact.	○	○	○	○	○
I would continue to participate in the Active Nova Scotia program.	○	○	○	○	○
I increased my PA because I was in this study.	○	○	○	○	○
This study made me more aware of the amount of PA I get each day.	○	○	○	○	○
The topics for each information post were useful and relevant.	○	○	○	○	○
I liked the videos for the information posts.	○	○	○	○	○
The videos in the information posts were not	○	○	○	○	○

burdensome on my computer.

What did you like about the Active Nova Scotia program specifically?

If you haven't any specific comments, please write N/A in the space below.

What didn't you like about Active Nova Scotia? What would you change?

If you haven't any specific comments, please write N/A in the space below.

If you were unable to participate in the website portion of the program, what prevented you from doing so?

If not applicable to you, please write N/A in the space below.

What would have made it easier for you to participate in the website portion of the program?

If not applicable to you, please write N/A in the space below.

The next few questions ask you about what you liked and didn't like about the website specifically. Select the option which best applies to you and your opinions of the UWALK website

	Didn't visit website	Strongly disagree	Disagree	Agree	Strongly agree
I was able to easily find my way around the website.	○	○	○	○	○
I was able to easily record my PA on the website.	○	○	○	○	○
I would recommend this website to other people.	○	○	○	○	○
I will continue to use the website now that the Active Nova Scotia program has finished.	○	○	○	○	○

What did you like about the website specifically?

If you haven't any specific comments, please write N/A in the space below.

What didn't you like about the website specifically? What would you change?

If you haven't any specific comments, please write N/A in the space below.

Anything else you would like to tell us? On this final question, please feel free to make any comments concerning your cancer, your treatments, the questionnaire, the exercise program, or anything else you think may be helpful to us. All comments are welcome.

Thank you very much for your participation in this research project.

Active Nova Scotia Follow up survey

Web-delivered, home-based PA intervention Follow-up Questionnaire

Thank you for your continued participation in this study. At this post-intervention questionnaire, we are going to ask you many of the same questions as in the first questionnaire. However, it is important to answer these questions based on what you are thinking and feeling right now, and not on how you answered the questions the last time. This will give us important information about how your thoughts and feelings have changed. It is important to answer as many of these questions as possible. All responses are completely confidential and will never be used in any way that could link them to you. Many of the questions may seem similar but it is important to treat each question separately and provide an answer for each. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible. The questionnaire should take about 30-45 minutes of your time to complete. If you have any questions about completing the questionnaire, please contact Cindy Forbes (Study Coordinator) at 780-492-2829 or ccforbes@ualberta.ca.

This set of questions asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. Answer every question by marking a single answer. If you are unsure about how to answer a question please give the best answer you can.

In general, would you say your health is:

Excellent	Very Good	Good	Fair	Poor
○	○	○	○	○

Compared to one year ago, how would you rate your health in general now?

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse than one year ago	Much worse than one year ago
○	○	○	○	○

The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
a. Vigorous Activities, such as running, lifting heavy objects, participating in strenuous sports	○	○	○
b. Moderate Activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○	○	○
c. Lifting or carrying groceries	○	○	○
d. Climbing several flights of stairs	○	○	○
e. Climbing one flight of stairs	○	○	○
f. Bending, kneeling or stooping	○	○	○
g. Walking more than a mile	○	○	○
h. Walking several hundred yards	○	○	○
i. Walking one hundred yards	○	○	○

j. Bathing or dressing yourself	○	○	○

During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of your physical health</u>?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
b. Accomplished less than you would like	○	○	○	○	○
c. Were limited in the kind of work or other activities	○	○	○	○	○
d. Had difficulty performing the work or other activities (e.g., it took extra effort)	○	○	○	○	○

During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> (such as feeling depressed or anxious)?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
b. Accomplished less than you would like	○	○	○	○	○
c. Did work or other activities less carefully than usual	○	○	○	○	○

During the <u>past 4 weeks</u>, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

Not at all	Slightly	Moderately	Quite a bit	Extremely
○	○	○	○	○

How much <u>bodily</u> pain have you had during the <u>past 4 weeks</u>?

None	Very mild	Mild	Moderate	Severe	Very severe
○	○	○	○	○	○

During the <u>past 4 weeks</u>, how much did <u>pain</u> interfere with your normal work (including both work outside the home and housework)?

Not at all	Slightly	Moderately	Quite a bit	Extremely
○	○	○	○	○

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks…

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of life?	○	○	○	○	○
b. Have you been very nervous?	○	○	○	○	○
c. Have you felt so down in the dumps that nothing could cheer you up?	○	○	○	○	○
d. Have you felt calm and peaceful?	○	○	○	○	○
e. Did you have a lot of energy?	○	○	○	○	○
f. Have you felt downhearted and depressed?	○	○	○	○	○
g. Did you feel worn out?	○	○	○	○	○
h. Have you been happy?	○	○	○	○	○
i. Did you feel tired?	○	○	○	○	○

During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
○	○	○	○	○

How TRUE or FALSE is each of the following statements for you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a. I seem to get sick a little easier than other people.	○	○	○	○	○
b. I am as healthy as anybody I know.	○	○	○	○	○
c. I expect my health to get worse.	○	○	○	○	○
d. My health is excellent.	○	○	○	○	○

Below is a list of statements that other people who have had cancer have said are important to their quality of life. Please indicate the extent to which you have experienced each of the statements during the past 7 days by selecting the appropriate choice. During the PAST WEEK:

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. I have a lack of energy.	○	○	○	○	○
2. I have nausea.	○	○	○	○	○
3. Because of my physical condition, I have trouble meeting the needs of my family.	○	○	○	○	○

4. I have pain.	○	○	○	○	○
5. I am bothered by side effects of treatment.	○	○	○	○	○
6. I feel sick.	○	○	○	○	○
7. I am forced to spend time in bed.	○	○	○	○	○
8. I feel close to my friends.	○	○	○	○	○
9. I get emotional support from my family.	○	○	○	○	○
10. I get support from my friends.	○	○	○	○	○
11. My family has accepted my illness.	○	○	○	○	○
12. I am satisfied with family communication about my illness.	○	○	○	○	○
13. I feel close to my partner (or the person who is my main support).	○	○	○	○	○
14. I am satisfied with my sex life.	○	○	○	○	○
15. I feel sad.	○	○	○	○	○
16. I am satisfied with how I am coping with my illness.	○	○	○	○	○
17. I am losing hope in the fight against my illness.	○	○	○	○	○
18. I feel nervous.	○	○	○	○	○
19. I worry about dying.	○	○	○	○	○
20. I worry that my condition will get worse.	○	○	○	○	○
21. I am able to work (include work at home).	○	○	○	○	○
22. My work (include work at home) is fulfilling.	○	○	○	○	○
23. I am able to enjoy life.	○	○	○	○	○
24. I have accepted my illness.	○	○	○	○	○
25. I am sleeping well.	○	○	○	○	○
26. I am enjoying the things I usually do for fun.	○	○	○	○	○
27. I am content with the quality of my life right now.	○	○	○	○	○

During the <u>PAST WEEK</u>: FATIGUE SYMPTOMS

	Not at all	A little bit	Somewhat	Quite a bit	Very much
1. I feel fatigued.	○	○	○	○	○
2. I feel weak all over.	○	○	○	○	○
3. I feel listless (“washed out”).	○	○	○	○	○
4. I feel tired.	○	○	○	○	○

5. I have trouble starting things because I am tired.	○	○	○	○	○
6. I have trouble finishing things because I am tired.	○	○	○	○	○
7. I have energy.	○	○	○	○	○
8. I am able to do my usual activities.	○	○	○	○	○
9. I need to sleep during the day.	○	○	○	○	○
10. I am too tired to eat.	○	○	○	○	○
11. I need help doing my usual activities.	○	○	○	○	○
12. I am frustrated by being too tired to do the things I want to do.	○	○	○	○	○
13. I have to limit my social activity because I am tired.	○	○	○	○	○

For this question, we would like you to recall the amount of exercise you have done in the past month. When answering these questions please: → only count exercise sessions that lasted 10 minutes or longer in duration. → only count exercise that was done during free time (i.e., not occupation or housework). → note that the main difference between the first three categories is the intensity of the endurance (aerobic) exercise and the fourth category is for strength (resistance) exercise. → please select the average frequency on the first line and type the average duration on the second. → if you did not do any exercise in one of the categories, please use "0" to indicate this. Considering a typical week (7 days) how many times on the average did you do the following kinds of exercise in the past month?

a. VIGOROUS/STRENUOUS EXERCISE (HEART BEATS RAPIDLY, SWEATING) (e.g., running, aerobics classes, cross country skiing, vigorous swimming, vigorous bicycling).

Times Per Week (days per week)

Choose the average number of days per week.

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

[ ]

b. MODERATE EXERCISE (NOT EXHAUSTING, LIGHT PERSPIRATION) (e.g., fast walking, tennis, easy bicycling, easy swimming, popular and folk dancing).

Times Per Week (days per week)

Choose the average number of days per week

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

c. LIGHT/MILD EXERCISE (MINIMAL EFFORT, NO PERSPIRATION) (e.g., easy walking, yoga, bowling, lawn bowling, shuffleboard).

Times Per Week (days per week)

Choose the average number of days per week

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

d. RESISTANCE/STRENGTH EXERCISE(e.g., lifting weights, push ups, sit ups therabands).

Times Per Week (days per week)

Choose the average number of days per week

0	1	2	3	4	5	6	7
○	○	○	○	○	○	○	○

Average Duration (minutes/session)

Enter the average amount of minutes per session.

For the rest of this survey, we are going to ask you questions about leisure-time physical activity. Leisure time means activity done during your free time and does not include your work/job or household chores. Physical activity (PA) means any exercise or sport that results in a substantial increase in energy expenditure (resulting in a noticeable increase in heart rate and breathing rate). Examples of exercises and sports include brisk walking, jogging, cycling, swimming, hockey, golf, curling, and dancing. We will use PA as a short name for physical activity throughout the rest of this survey. The following statements and questions ask you to rate how you feel about participating in regular PA over the next 3 months. Regular PA means that you get 150 minutes of moderate intensity activity, 75 minutes of vigorous intensity activity or a combination of both throughout the week. For example, this may mean you get 30 moderate minutes/5 days a week or 25 vigorous minutes/3 days a week or 30 moderate minutes/3 days a week plus 60 vigorous minutes once a week. Please pay careful attention to the words at each end of the scale and select the answer that best represents how you feel. Please answer all items below.

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely useful	Quite useful	Slightly useful	Neutral	Slightly useless	Quite useless	Extremely useless
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely enjoyable	Quite enjoyable	Slightly enjoyable	Neutral	Slightly unenjoyable	Quite unenjoyable	Extremely unenjoyable
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely beneficial	Quite beneficial	Slightly beneficial	Neutral	Slightly harmful	Quite harmful	Extremely harmful
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely pleasurable	Quite pleasurable	Slightly pleasurable	Neutral	Slightly painful	Quite painful	Extremely painful
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely important	Quite important	Slightly important	Neutral	Slightly unimportant	Quite unimportant	Extremely unimportant
○	○	○	○	○	○	○

I think that for me to participate in <u>regular PA</u> over the <u>next 3 months</u> would be:

Extremely fun	Quite fun	Slightly fun	Neutral	Slightly boring	Quite boring	Extremely boring
○	○	○	○	○	○	○

This next set of statements and questions asks you to rate how other people in your life would feel about you participating in <u>regular</u> PA <u>over the next 3 months</u>. Please pay careful attention to the words at the end of each scale and select the answer that best represents how they might feel. Please answer all items.

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

Extremely approving	Quite approving	Slightly approving	Neutral	Slightly disapproving	Quite disapproving	Extremely disapproving
○	○	○	○	○	○	○

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

Extremely encouraging	Quite encouraging	Slightly encouraging	Neutral	Slightly discouraging	Quite discouraging	Extremely discouraging
○	○	○	○	○	○	○

I think that if I participated in <u>regular PA</u> over the <u>next 3 months</u>, most people who are important to me would be:

Extremely supportive	Quite supportive	Slightly supportive	Neutral	Slightly unsupportive	Quite unsupportive	Extremely unsupportive
○	○	○	○	○	○	○

These next questions ask you to rate how much PA you think other people in your life are likely to do themselves over the <u>next 3 months</u>.

I think that over the <u>next 3 months</u>, most people who are important to me will be:

Extremely active	Quite active	Slightly active	Neutral	Slightly inactive	Quite inactive	Extremely inactive
○	○	○	○	○	○	○

I think that over the <u>next 3 months</u>, most people who are important to me will participate in regular PA.

Extremely agree	Quite agree	Slightly agree	Neutral	Slightly disagree	Quite disagree	Extremely disagree
○	○	○	○	○	○	○

These next statements and questions ask you to rate how likely it is that <u>you would be able</u> to participate in regular PA over the next 3 months <u>if you were really motivated</u>. Please pay careful attention to the words in each scale. Select the number that best represents how you feel. IF YOU WERE REALLY MOTIVATED...

How much control would you have over doing regular PA over the <u>next 3 months</u>?

Very little control	2	3	Some control	5	6	Complete control
○	○	○	○	○	○	○

Whether or not I engage in regular PA over the <u>next 3 months</u> is completely up to me.

Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
○	○	○	○	○	○	○

How much do you feel that engaging in PA over the <u>next 3 months</u> is beyond your control?

Not at all	2	3	4	5	6	Very much
○	○	○	○	○	○	○

Participating in regular PA over the <u>next 3 months</u> would be...

Extremely easy	Quite easy	Slightly easy	Neutral	Slightly difficult	Quite difficult	Extremely difficult
○	○	○	○	○	○	○

If I wanted to, I could easily engage in regular PA over the <u>next 3 months</u>.

Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
○	○	○	○	○	○	○

How confident are you that you could do regular PA over the <u>next 3 months</u>?

Not at all confident	2	Somewhat confident	4	Quite confident	6	Completely confident
○	○	○	○	○	○	○

This next set of questions asks you about your motivation and plans to do regular PA over the <u>next 3 months</u>. Pay careful attention to the words at the end of each scale.

Do you intend to do regular PA over the <u>next 3 months</u>?

No, not really	2	3	Somewhat intend	5	6	Strongly intend
○	○	○	○	○	○	○

How motivated are you to do regular PA over the <u>next 3 months</u>?

Not at all motivated	2	Somewhat motivated	4	Quite motivated	6	Completely motivated
○	○	○	○	○	○	○

This next set of questions asks you about your <u>specific plans</u> to do regular PA over the <u>next 3 months.</u>

	No plans	2	3	4	5	6	Detailed plans
a. Do you have plans for when, where, and what type of PA you will do in the <u>next 3 months</u>?	○	○	○	○	○	○	○
b. I have made plans concerning 'when' I am going to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
c. I have made plans concerning 'where' I am going to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
d. I have made plans concerning 'what' kind of regular PA I am going to engage in over the <u>next 3 months</u>.	○	○	○	○	○	○	○
e. I have made plans concerning 'how' I am going to get to a place to engage in regular PA over the <u>next 3 months</u>.	○	○	○	○	○	○	○
f. I have made plans concerning 'who' I am going to be physically active with over the <u>next 3 months</u>.	○	○	○	○	○	○	○

If you were to do regular PA over the <u>next 3 months</u>, do you think you would…

	Extremely unlikely	Quite unlikely	Slightly unlikely	Neutral	Slightly likely	Quite likely	Extremely likely
a. feel better and improve your well-being?	○	○	○	○	○	○	○
b. reduce the risk of your cancer returning?	○	○	○	○	○	○	○
c. relieve stress?	○	○	○	○	○	○	○
d. improve your energy level?	○	○	○	○	○	○	○
e. get your mind off cancer?	○	○	○	○	○	○	○
f. live longer?	○	○	○	○	○	○	○
g. improve fitness?	○	○	○	○	○	○	○
h. lose some weight?	○	○	○	○	○	○	○
i. improve your immune system?	○	○	○	○	○	○	○

How supportive do you think each of the following people would be if you tried to do regular PA over the <u>next 3 months</u>?

	Extremely unsupportive	Quite unsupportive	Slightly unsupportive	Neutral	Slightly supportive	Quite supportive	Extremely supportive
a. spouse / partner (leave blank if N/A).	○	○	○	○	○	○	○
b. other family members.	○	○	○	○	○	○	○
c. best friend(s).	○	○	○	○	○	○	○
d. oncologist (cancer doctor).	○	○	○	○	○	○	○

If you were really motivated, how confident are you that you could do regular PA over the <u>next 3 months</u> even if...

	Not at all confident	2	Somewhat confident	4	Quite confident	6	Completely confident
a. the weather was very bad?	○	○	○	○	○	○	○
b. you felt tired or fatigued?	○	○	○	○	○	○	○
c. you had medical/health problems?	○	○	○	○	○	○	○
d. you got very busy and had limited time?	○	○	○	○	○	○	○
e. you had a recurrence of your cancer?	○	○	○	○	○	○	○
f. you had pain or soreness?	○	○	○	○	○	○	○
g. you had additional family responsibilities?	○	○	○	○	○	○	○
h. the activity became boring?	○	○	○	○	○	○	○
i. you went back on cancer treatments?	○	○	○	○	○	○	○

Anything else you would like to tell us? On this final question, please feel free to make any comments concerning your cancer, your treatments, the questionnaire, the exercise program, or anything else you think may be helpful to us. All comments are welcome.

Thank you very much for your participation in this research project.

Appendix D – Active Nova Scotia content

Group assignment emails

Sample weekly update emails

Active Nova Scotia Help Guide

Group assignment emails

Usual care group

Hi [First name],

Thank you for completing your questionnaire!

This email is to inform you that you have been randomized to the self-directed exercise group!

Your next steps will be to follow your regular routine over the next 10 weeks. When the 10 weeks are up you will receive an invitation to complete the post study survey. After another 12 weeks, there will be another follow up survey. Once the follow up is completed you will be sent details on how to access the website and information included.

If you have any questions or concerns please email me at activeNS@ualberta.ca or call me at 1 (780) 492-2829.

Thank you again for agreeing to be a part of this exciting research!

Take care,

Cindy

ANS group

Hi [First name],

Thank you for completing your questionnaire!

This email is to inform you that you have been randomized to the website intervention group!

Your next steps will be to follow this link (or copy and paste this link: http://uwalk.ca/groups/join/5by12mqxt0/) and set up a profile on our UWALK website. This registration process will automatically put you in the private community "Active Nova Scotia". The status "private" means that anyone who has not been invited will be unable to see who is in the community. However, once you are in the community, you will be able to see all the other members.

For this reason, we are asking you to only use your initials for your name when registering. For example, when it asks for your first and last name, I would only put C F. I will be able to monitor this so if you forget and use your whole name, I will be able to change it to initials for you.

Once you complete the registration, you will be on the page called "My Home". To find the special group information that was developed just for you, head to "Teams &

Communities" and then "My Communities". Here you will find the community "Active Nova Scotia" where you and your fellow participants will see the study program.

If you have any questions or concerns, or if you have trouble with the registration process, please email me at activeNS@ualberta.ca or call me at 1 (780) 492-2829.

Thank you again for agreeing to be a part of this exciting research!

Take care,

Cindy

Sample of weekly emails to ANS group

Meeting or close to meeting guidelines

Hi [First name],

You are doing great! Good job visiting the site and keeping track of your activity!

This week's new information post will talk about how to exercise smart and safe. Follow this link and read through the tips on how to be prepared for your exercise sessions and what to look out for when something isn't quite right.

Here is a summary of your activity so far:
0 flights of stairs
0 steps
0 minutes of vigorous activity
0 minutes of moderate activity

Overall, that is equal to 0 steps this week!

Nice work. You've been working hard to get all those minutes and steps in. Keep it up!

Once again, if you missed last week, you can find ithere!

Keep up the great work!

Take care

Cindy

Encouragement email: some activity

Hi [First name],

You're doing well! Good job visiting the site and keeping track of some of your activity.

This week's new information post will talk about how to exercise smart and safe. Follow this link and read through the tips on how to be prepared for your exercise sessions and what to look out for when something isn't quite right.

Here is a summary of your activity so far:

0 flights of stairs

0 steps
0 minutes of vigorous activity
0 minutes of moderate activity

Overall, that is equal to 0 steps this week!

Keep adding those minutes and steps! You're doing a great job.

Once again, if you missed last week, you can find it here!

Take care

Cindy

No recorded activity

Hi [First name],

I hope you are doing well.

This week's new information post will talk about how to exercise smart and safe. Follow this link and read through the tips on how to be prepared for your exercise sessions and what to look out for when something isn't quite right.

So far this week you haven't tracked any activity on the site. Remember that you can add your activity in the form of moderate or vigorous minutes, steps or flights of stairs.

Increase your exercise at your own pace! If you have been keeping track a different way, you can always add activity from the past on the log page to update your previous weeks.

Once again, if you missed last week, you can find it here!

Take care

Cindy

Active Nova Scotia website content

Introduction/Program overview page

Let's get started!

The amount of people surviving cancer and living long and healthier lives is increasing. There are close to 1 million cancer survivors living in Canada right now, but cancer treatments can sometimes take their toll on people's health and well-being.

Research is now telling us that exercising after cancer may help get your body back into shape, keep a positive outlook on life, and perhaps even live longer.

Scientific research tells us that cancer survivors may be at an increased risk of:

Heart disease
Recurrence of their cancer
Getting a different cancer
Fatigue
Decline in muscular strength
Memory problems
Osteoporosis (brittle bones)
Incontinence

By exercising regularly, you can reduce your risk and even prevent some or all of these problems.

This web site will help you add exercise into your daily life. You will find information here in the Active Nova Scotia group that will make you to think about your own exercise habits, setting goals, and overcoming some of the barriers that prevent you from exercising.

Preliminary research with cancer survivors has shown that exercise may help you:

reduce the risk of your cancer coming back
reduce the chances of dying from your cancer
and increase the chances of living a longer life

Exercise may also help you:

improve your physical fitness and functioning
improve your muscle strength and bone density
cope with the side effects of your cancer treatment
reduce your fatigue and increase your energy
improve your outlook on life and feel better about yourself
manage your weight

help you sleep
reduce stress and anxiety
keep your memory sharp

The trial that you are enrolled in will help everyone gain more insight into how exercise benefits cancer survivors.

Are you finding it difficult to get back into exercise after your cancer treatments? You are not alone! Cancer survivors tell us that often they stop exercising while having treatment. This becomes a serious concern if you never regain pre-diagnosis exercise levels.

Use this web site to help you get back into exercise!

Week 1: Welcome!

[Video]

Thank you for your interest in this study! This week we are going to give you a brief orientation to the study and the website. Please explore the website and its many functions. If you need help, we have a guide for new users here [pdf of help guide].

The main areas to concentrate on are the "Teams and Groups" and "Track your Activity".

Teams and Groups is where you will find your special Active Nova Scotia content that is only for you! Under "My Groups" you will see you are a member of a private group. No one will be able to see the members of the group except those in it!

"Track your activity" can be found on your "My Home" page and will take you to your log book to enter your activity for the day!

On to Exercise!

What should my goal be?

Start with a weekly goal of 150 minutes of moderate activity, 75 minutes of vigorous aerobic activity or some combination of the two as recommended by the Public Health Agency of Canada, Canadian Society of Exercise Physiologists and the Canadian and American Cancer Societies.

Starting towards this goal is as simple as walking out your front door!

What types of activity do I do?

Do what you like best! Brisk walking has been found to be a favourite among cancer survivors. You can walk with your friends or family!

There are many other types of activities you could do as well. Biking, skiing, team sports, snowshoeing - the list goes on! Find something you like and go for it!

[images of Cindy doing different activities]

How hard do I exercise?

This depends on the kind of exercise you do. There are two different kinds of exercise; aerobic exercise and strength exercise.

Aerobic activity

This means any activity that increases your heart rate for any length of time.

[image of Cindy walking in workout gear]

Moderate = increases your heart rate and breathing rate but doesn't leave you out of breath (e.g., brisk walking, bike riding, skating or aerobic classes).

[image of Cindy running]

Vigorous = sweating and breathing hard (e.g., jogging, running, cross-country skiing or hockey).

Strength exercise

Strength activities may include weight lifting, yoga, pilates or calisthenics.

[image of Cindy weight lifting]

2-3 times per week, 10-15 repetitions of 8-10 different exercises for various muscle groups.

How often should I exercise?

3-7 days a week depending on how long and how hard you are working out. We will help you and give you some tips to encourage you to be active every day!

How to gauge intensity

To tell how hard you are working, you should know how to calculate your resting and exercise heart rates.

To do this, find your pulse on your wrist or your neck (see pictures below to show you where).

[Images side by side: one finding radial pulse; one finding carotid]

Using a watch or clock with a second hand, find your pulse in one of the two places and count how many beats you feel for 30 seconds. Once you get a number then multiply it by two. That is your resting heart rate.

Calculate your maximum exercise heart rate using the resting heart rate you just measured.

[Calculation for heart rate reserve]

Now calculate your exercise heart rate range by choosing an intensity range. If you are a new exerciser, start around 50% of your maximum exercise heart rate calculated above.

[Equation for calculating exercise heart rate ranges]

Week 2: Exercise Myths!

3 Myths about PA

Myth #1: No pain, no gain!

[image]

False: Many health benefits come from moderate activities like brisk walking. This type of activity is anything that makes you breathe harder without feeling out of breath.

Myth #2: You have to exercise for at least 30 minutes at a time in order to get any health benefits.

[image]

False: building up 30 minutes of extra exercise a day is needed to gain health benefits but it does not have to be all at once. You can do 10 minute bouts of exercise at a time, three times a day for the same health benefits. You can plan these bouts, (going to the gym or taking an aerobics class) or you can leave it unplanned, (taking the stairs instead of an elevator).

Myth#3: After age 50, there is no point in exercising

[image]

False: exercise is helpful for people of all ages. Exercise can help to prevent brittle bones, some cancers, high blood pressure and heart disease. Exercise can also help improve aching joints. Best of all, exercise may help you live longer and healthier!

Week 3: Exercise smart and safe!

Five tips for healthy and safe exercise

1. Stretching

Stretching properly is important in preventing many of these symptoms. Here are some stretches to do that are simple and easy to do in your home.

[image]

2. Hydration

It is very important to drink fluids before, during and after exercise, especially if it is warm outside.

- Drink 2 cups of water 2 hours before exercise and
- 1 cup for every 15 minutes of activity.

Bring a water bottle with you so you have something to sip on!

3. Shoes

Good shoes are the most important exercise equipment you can own. Properly fitting shoes provide support and cushioning and can help prevent injuries.

Talk with someone at a sporting goods store and ask for help finding the best shoes for your feet.

Here are some things to think about when shopping for new footwear:

- Your feet tend to swell as the day goes on so shop for shoes in the afternoon or evening to get the best fit
- Measure the length and width of your foot while standing up
- Try your shoes on with the same socks you use to exercise and orthotics if you wear them
- The best shoes are the ones that feel great, not cost the most
- Don’t leave with shoes that need to be “broken in”, they should feel good right away. If they don’t feel good, don’t buy them.

4. Clothing

Exercising in comfortable, appropriate clothing is also important to the enjoyment of your activity.

Wear clothing that is breathable, cool and that will allow a full range of movement. Of course, it is very important to have well-fitting socks that are made from a breathable material. This will help reduce blisters and keep your feet healthy.

Dress for the weather. Everyone knows Nova Scotia weather can change from one minute to the next. Wear layers of breathable clothing to make sure you will be warm enough.

Especially important in the winter is protection for your head, hands and feet. Wear a hat and warm gloves and appropriate socks and boots for the winter.

When exercising always wear sunscreen and take sunglasses to protect your eyes.

When doing higher impact activities like jogging or aerobic classes, it is important to have a proper sports bra. If your sports bra isn't comfortable, try going for a professional fitting.

5. Precautions

Exercise is generally safe for everyone to do. There are still precautions you should take, especially if you have a history of heart problems, bone or muscle problems, your cancer has come back or any other condition that may impact your ability to exercise.

Stop exercising immediately if you have any of the following happen to you:

- An unusual, irregular pulse
- Extreme tiredness
- Unusual muscle weakness
- Irregular joint or bone pain (besides everyday aches and pains)
- Unusual leg cramps or pains
- Chest pain
- Sudden nausea (feeling like you are going to vomit) during exercise
- Dizziness, blurred vision, fainting
- Severe shortness of breath or difficulty breathing
- Fever or shaking with chills
- Numbness or loss of feeling in hands or feet

If you don’t have an exercise buddy and you exercise outside, take a phone with you in case you need to make an emergency call. Tell someone about your planned route just in case.

Week 4: Goals and Planning

Now you have 3 weeks of exercise under your belt, congratulations! Let’s talk about goals.

Have a look at your exercise patterns so far and think of a goal to beat what you've already done!

If you are averaging 120 minutes of moderate activity a week, your goal could be to get to 150 minutes a week. That could mean adding another day of 30 moderate minutes, adding an extra 10 minutes onto your routine three times a week or increasing the intensity of your some of your existing 120 minutes.

Something to keep in mind when making a goal, is to make it a SMART goal.

Making a SMART goal uses the following guidelines:

[image]

Specific	Determine exactly what you are going to do and how
Measurable	Make it easy to measure
Attainable	Set a short term goal that is within your reach, not something huge that may be more long term
Realistic	Set a goal that is realistic, relevant and rewarding
Timely	Be sure to set a reasonable time frame that will give you enough time to reach your goal, but not so much time as it will be inevitable

Here is an example of a SMART walking goal: “I am going to walk 30 minutes every day this week.” This goal is Specific, Measurable, Attainable, Realistic and Timely.

When you complete a goal, reward yourself with something you enjoy and can look forward to. It can be going to a movie you have wanted to see, getting a new piece of equipment for exercising or enjoying a picnic at the beach.

Go to the goals [hyperlink “goals” to goal section] section of your web site now and add a goal!

Planning

[image of someone planning]

Keep up with setting new goals when you meet and beat your old ones!

Don’t be discouraged if something came up and you didn't make your goal this week. The key to staying on track is to have detailed plans (and back up plans) for what, when, where, how and with whom you will exercise.

Example: Cheryl has a running background from her youth but has not run in the last 20 years. Cheryl’s goal is to complete a 5 kilometer run.

- What: She will be working towards this goal by both running and walking. She is building towards all running.
- When: Cheryl is going to walk/run 5 days a week for 30 minutes after work.
- Where: Cheryl works in a small town that has trails along the waterfront where she can walk/run.
- How: Cheryl will walk/run on the trails around her workplace after work.
- Who: Cheryl knows a few people at work that are beginner members in a running club that may want to join her.

Think about these questions for yourself:

- What activity will you be engaging in to meet your goals?
- When will you doing this activity? Be specific!
- Where will you be doing this activity?
- How are you going to do this activity?
- Who are you going to do this activity with?

Week 5: Benefits of Exercise

7 reasons exercise is good for you!

Exercising regularly can help you live longer and prevent chronic disease!

Some very important benefits include:

- having a healthy heart (good blood pressure, cholesterol and overall heart strength)
- managing weight
- keeping up strength and flexibility
- helping with arthritis and mobility

[image of healthy heart][image on one side, text on other]

Studies show that exercise can help prevent and even reverse heart disease. Regular exercise can help keep your blood pressure and blood cholesterol at normal levels which means a healthier heart!

[image of person on scale]

Carrying extra body fat can lead to a lot of different health problems including chronic diseases like heart disease, diabetes and cancer. Regular exercise is an important tool for staying a healthy weight.

[image of someone running and image of weight training]

Exercising regularly can also keep your body strong and flexible. Having good strength, balance and flexibility can prevent falls and help to keep you living independently.

[image of healthy bones and joints]

Keeping active helps you maintain healthy bones and joints to help prevent osteoporosis and arthritis.

Above all else, exercise can help reduce the risk of your cancer coming back and can help you live longer!

Feel good about yourself

[images for good self-esteem]

Exercise helps cancer survivors have a better personal outlook and feel healthier in general. Exercise helps you remain independent and able to perform daily activities without any help.

Keeping up this level of exercise increases self-confidence and self-esteem. You will feel better more often!

Depression and Anxiety

[image for depression/feeling better etc]

Taking part in regular exercise may also help reduce symptoms of depression and anxiety. Since depression is one of the most common psychological symptoms experienced by cancer patients, this fact is especially important. A recent study among breast cancer survivors found that exercise may be helpful for those with clinical depression.

More energy

[image of energetic people]

Exercise can increase your energy levels and reduce symptoms of tiredness. Survivors often report they like to exercise because it gives them more energy!

Exercise helps you reduce your tiredness by making your red blood cells work better. Red blood cells carry oxygen from your lungs to the rest of your body. When you are active, you are helping your body use the oxygen in your blood efficiently and you feel more energized!

Studies show that as little as 30 minutes of brisk walking a day can help reduce tiredness.

Stress relief

[image of stressed out person/image of happy person]

Every one of us deals with stress every day. One great way to help deal with stress is exercise. It can be a healthy distraction from your everyday challenges.

Many breast, prostate and colorectal cancer survivors in Nova Scotia said they like to exercise because it helps them relieve stress. Research with other survivors also shows stress relief to be a major benefit of exercise. Survivors also say they like to exercise because it helps keep their mind off their cancer and the fear of recurrence.

Studies in the general population show that regular exercise reduces stress and anxiety.

Better Sleep

[image of someone happily sleeping]

Getting enough sleep is also linked to better management of fatigue, pain, depression, functioning, increased quality of life, and even better cancer related outcomes.

Recent research tells us that getting regular exercise can help you sleep and may be a more attractive option than taking sleeping medication. There are very few side effects from exercise when compared to medication which means less interference in other aspects of life.

Quality of Life

[images of older people doing everyday things]

After reading all the benefits that exercise can have, it's clear that it can have a huge impact on your quality of life. Exercise may help a variety of health aspects including aerobic fitness, muscular strength, fatigue, depression, anxiety, self-esteem, and functional ability. These are important factors in how we enjoy our everyday lives.

Week 6: Make it Fun!

5 ways to keep exercise fun!

Find new ways to have fun with your exercise with these tips!

[image] [these tips could likely be two to a row]

Exercise with friends or a group! Instead of dreading exercise, look forward to spending time with your friends.

[image]

Enjoy the outdoors. Take a walk on a trail or go for a bike ride in the countryside. Enjoy the fresh air and the beautiful Nova Scotian scenery.

[image]

Be sure to always use equipment that works well and is in good repair. Having a nice facility nearby with friendly staff can make the exercise experience much more enjoyable!

[image]

Enjoy music or a favorite TV program while you exercise as long as safety permits!

[image]

Switch up your routine by doing a different activity. Bike instead of walking or play a sport with some friends! Adding variety can help keep you excited about exercise and you might find new activities you enjoy.

In the end, the best way to keep motivation up is to remember all the benefits and good feelings that come along with being active on a regular basis!

Week 7: Overcoming Barriers to Exercise

8 tips to deal with barriers!

Other Health Concerns

People that have health issues like osteoporosis (brittle bones), diabetes, heart disease, hypertension, and arthritis are all encouraged to start exercising. Exercise can actually help prevent and manage many of these conditions.

If you have other health or medical problems, you should always check with your family doctor before starting your exercise program. Always start exercising at an easy level that your body can tolerate. Choose activities that are appropriate for your specific conditions. For example, if you find walking hard on your arthritis, consider swimming or resistance training.

[image of someone visiting their doctor]

Many different types of exercise are recommended for people with:

- Different types of cancer
- Diabetes
- Hypertension
- Heart disease
- Overweight/Obesity
- Arthritis
- Fibromyalgia

The list goes on! Check with your doctor or a physical activity expert for more information.

Not enough time

"Time" is often cited as a reason that prevents people from exercising. There are many constraints on our time and it can be a challenge to fit activity into the routine.

Exercise specialists propose a 10-minute solution!

If you don't have an entire half an hour to exercise, try doing 10 minute bouts 3 times a day. For example, you can do some simple strength exercises in the morning, go for a 10 minute walk during lunch then walk around the neighbourhood after supper. Simple, easy and you get 30 minutes of activity a day!

Here are some time management strategies to try that will help you exercise

[image stationary bike and tv][again these could be two to a row]

Combine exercise with other activities e.g., walking or running on a treadmill while watching your favourite TV show

[image walking or biking to store]

Be an active commuter. If possible, walk or bike to work or to pick up a few groceries

[image person in suit walking]

Exercise while waiting for a meeting or appointment. If a colleague or appointment is running behind, use that time and go for a walk.

[image walking on sidelines]

Be an active spectator at sporting events. When watching your kids or grandkids play sports, walk around the field instead of sitting in the stands

[image setting an alarm]

Simply wake up 30 minutes earlier or go to bed 30 minutes later.

[image putting appointments in calendar]

Schedule exercise appointments in advance rather than waiting to see if it will fit in or not

Are you at work a lot? Here are some work friendly tips:

[image walking with briefcase][two to a row]

If possible, walk to work a couple times a week

[image professionals walking in a park with coffee]

Invite some co-workers to start a lunchtime walking group

[image walking up stairs instead of elevator]

Take stairs whenever possible rather than the escalator or elevator

[image bus stop]

If you take the bus to work and time permits, get off a few stops earlier than usual and walk the rest of the way

Bad Weather

[images of NS weather]

Snowy, rainy, windy; a typical Nova Scotian day can have it all so it's important to have a back-up plan for these days. There are some alternatives to exercising outside when the weather is just not cooperating.

Hit the gym!

[image of gym]

If you have access to a facility nearby or in your condo building or work area then try walking on a treadmill, swim a few laps or walking around a track. For your first visit to a new facility, arrange a tour and get to know the staff.

If you still want to brave the outdoors, try some of these tips for exercising outside in cold weather.

[image walking outdoors in winter]

Start out slowly to make sure your muscles have lots of time to warm up.

Walk at a more moderate or slow pace to avoid slips and falls. Roads and paths can be icy so shorten your stride to reduce fall risk.

[image of carrying water bottles]

Make sure you bring water. Winter air is dryer than summer and you still sweat away water.

[image of someone walking with a sweater tied around waist][image of someone walking with scarf and mitts][image of good shoes]

Wear layers when exercising. You can always shed a layer or two if needed.

Be sure to wear gloves, a hat and a scarf to keep you warm.

Get a good pair of outdoor walking shoes. Lightweight hiking boots are a great option for warmth and comfort.

Check with a local physical activity expert. They will always have ideas for surviving cold weather.

Location/travel

If you have to travel to exercise this may be a barrier. There are some strategies that may help you continue your program!

Try working out during lunch if you are able.

[image of meeting a friend at the gym]

Make exercise appointments with a friend. You will be more likely to keep the appointment if someone is waiting for you. You may even be able to carpool.

[image of two people walking around the neighbourhood]

If you can't get to a facility, try walking around your neighbourhood or using an exercise dvd.

Motivation/lazy

[image of couch potato/napping on the couch]

Keeping up the willingness to do exercise can be very difficult. Remember all the benefits of exercise and how great you feel afterwards. Check out the section on how to keep exercise fun and interesting to learn some tips on keeping up motivation!

Week 8: Social Support

Many cancer doctors now encourage survivors to do regular exercise. Here is what some medical oncologists in Canada say about exercise.

[Testimonials from Oncologists]

"The studies that are emerging in the exercise and cancer area are very supportive of the role that exercise can play. Here at the Cross Cancer Institute, we place a lot of emphasis on continuing to be active both during and after breast cancer treatment. We have found that exercise can improve your physical fitness as well as your quality of life. I recommend to all my patients to do their best to stay active as much as possible."

—Dr. John Mackey, Medical Oncologist, Cross Cancer Institute

"Breast cancer treatments often leave patients with fatigue and weakened immune systems. Based on our research as well as others, there has been good evidence of both physical and psychological benefits of exercise both during and after treatments. All the patients that I see at our centre go for physical fitness testing and a specialized exercise program is then developed for them. Exercise is a non-toxic, inexpensive, easy activity that doesn't have to be done in a fancy facility. And it's never too late to start."

—Dr. Roanne Segal, Medical Oncologist, Ottawa Regional Cancer Centre

Survivors that have been in our research studies have also stated on many occasions that they benefited greatly from an exercise program.

"I think the most important benefits were increase in stamina, strength. After going through the chemo, it's pretty draining. I found my stamina has increased dramatically since I started this thing [exercise trial]." Ralph

[Testimonials from participants]

Having support can help you exercise

Your spouse, partner or another friend can help motivate you to get out there and do some exercise. If possible, encourage them to exercise along with you! You can even challenge each other to exercise more. Set goals together and you may be more apt to complete them!

Just remember to celebrate together as well when you reach these goals!

[image of friends exercising together][image of friends getting coffee together]

Think about what kind of activities or rewards you could do with your friends to celebrate your success!

Other family members can help too

Having the support of your family to do exercise is very helpful in starting and continuing a program. You have the chance now to be a healthy living role model for your spouse, kids, grandkids or any other family member!

[image of adults playing with kids]

Here are some tips on how to be active with your family:

- Take lessons in a new sport like tennis or golf
- Go for a walk or bike ride in your neighbourhood
- Go to the nearest park or green space and play games such as baseball, soccer or Frisbee
- Go for a hike (or snowshoe) in a nature preserve or nearby trail and try to identify wildlife with your kids or grandkids
- Use a skipping rope or mini trampoline. It's great exercise and can be done pretty much anywhere

Think about the activities you could do over the next three months with your family!

How can your friends help?

Your friends can be a great source of motivation for exercise. If you are both just starting to exercise, invite them along with you. This will help keep you both on track and will be mutually supportive. If they already exercise, ask if you can join them. They will be a great source of encouragement as well!

Meeting friends for activity sessions can be great fun! Organize an informal walking club. Meet a group in a central location and going for a walk together a few times a week. Remember that even just brisk walking on most days of the week may help you live longer and prevent your cancer from coming back.

[image of learn to run group]

You can also sign up for a class or learn to run clinic with friends. Many sporting goods stores will have walking and running clinics designed for beginners. These programs usually last between 10-12 weeks and have a learning portion where instructors talk about helpful hints and tips!

Work Friends

Coworkers can also be a great source of support for exercise. Get a group of coworkers to join you in an exercise break!

[image of office exercise competition]

Start a friendly office competition to see who can do the most steps over a specific time period or "race" to a destination by recording your distances of each activity and seeing who gets there first!

[image of group at run for the cure or underwear affair]

Organize or join a group that is working toward an event, such as the Run for the Cure or another charitable event. This will raise money for a great cause and contribute to you and your coworkers health!

Week 9: Bumps in the road!

Causes of relapse

A relapse can occur because of a specific situation or event. These situations are often unavoidable, so it is important to recognize that they have the potential to cause relapse. Examples of situations that could cause relapse include:

- on a holiday or vacation

- leaving one job for another
- moving to another city or house
- other commitments and demands (family, school, committees)
- relationship difficulties
- having out of town family and friends visiting

Respond in a positive way by thinking about the situation, deciding how you will handle it and making plans to keep on track. While you are trying to change some of your lifestyle behaviours it is important that you don't get too disappointed if you relapse.

Strategies to avoid relapse

The following strategies will help you to prevent and recover from relapse:

- stay positive
- reset your goals
- manage your time effectively
- increase social support for your behaviour change

Recognize that setbacks to occur. This does not mean you have failed, in fact it happens to everyone, even the most active people. The difference now, is that you now have the skills and knowledge to make the changes in your physical activity behaviour to get you back on track!

Now you have the rest of your life to continue to develop and use your skills to maintain an active and healthy lifestyle!

ACTIVE NOVA SCOTIA

HELP GUIDE FOR NEW USERS

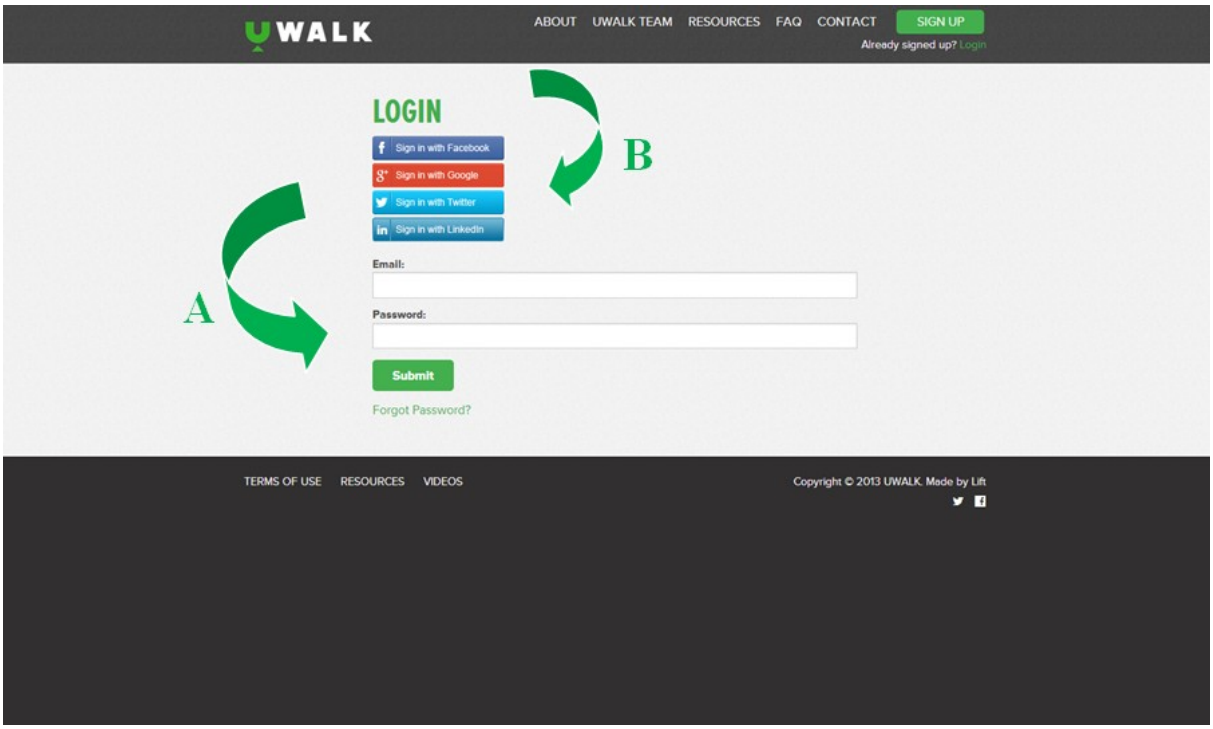
300

WELCOME TO ACTIVE NOVA SCOTIA!

This guide aims to help you with hints and tips to show you how to get the most out of our website. We will give you lots of useful information that will get you started on the road to success.

Signing In

- Visit the main signin page here and enter your email and password or sign in using social media!



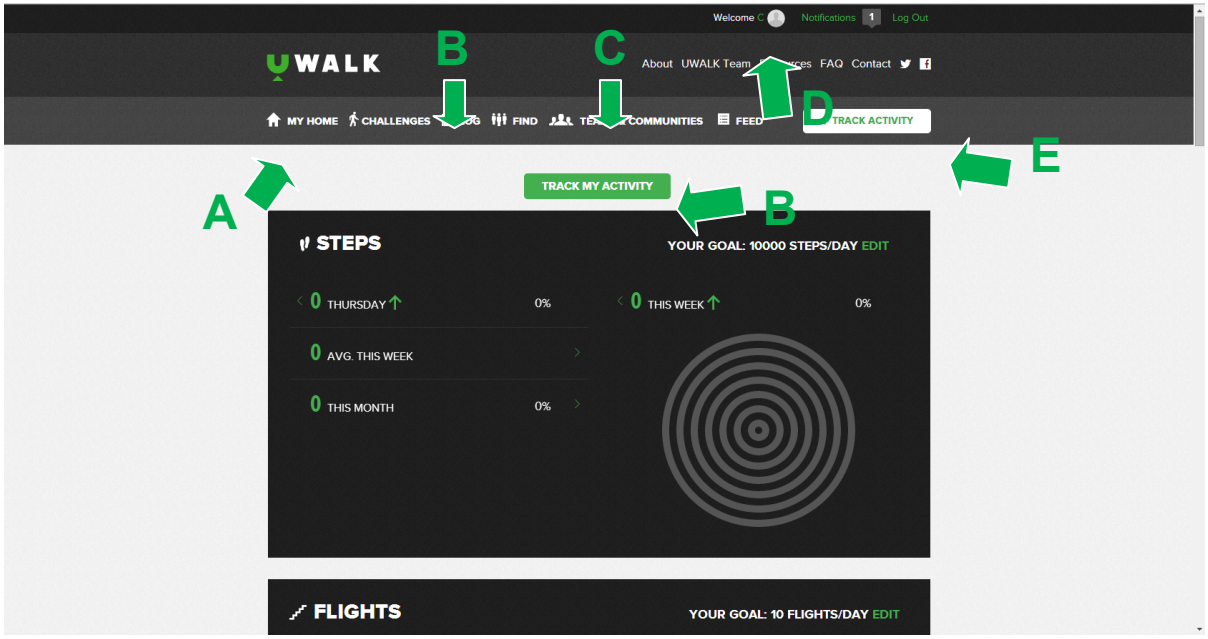
My Home

The first page you will see, after signing in, is "My Home". Here you will find the links to the other pages as well as a summary of your activity for the week.

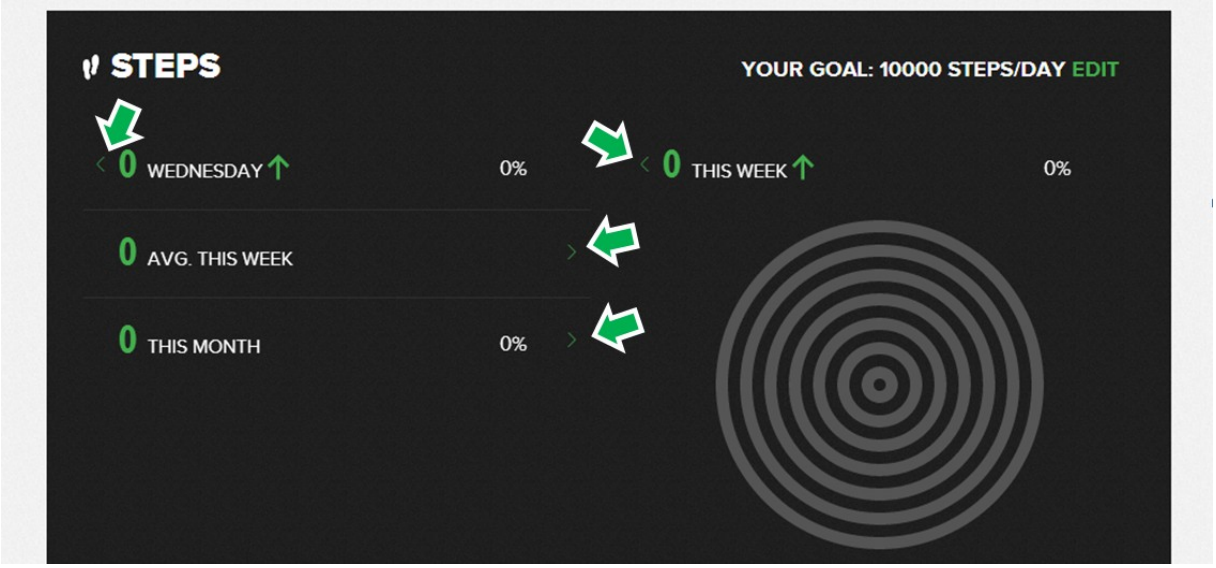
The picture below is showing a new person who just signed in for the first time:

A. This is your "My Home" button. It will take you back to this page.

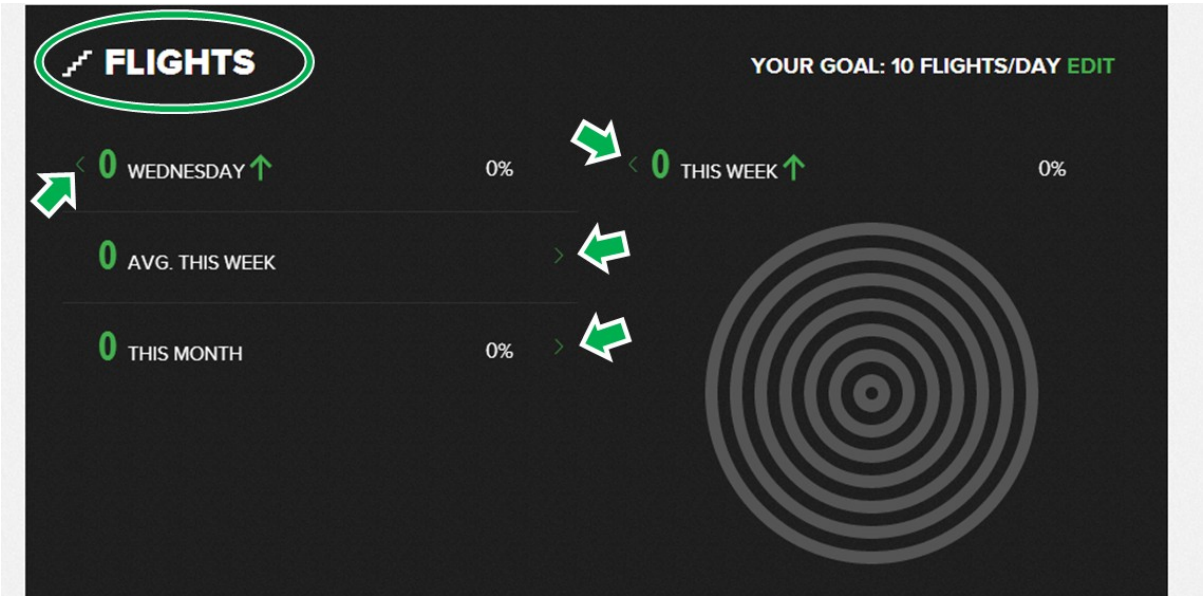
B. This will take you to a page where you can enter multiple days or types of activity. This page also shows you a summary table of past exercise
C. Here you will find the private Active Nova Scotia community that you are a member of currently under “My Communities”.
D. This takes you to your profile. Here you can sync an app or device like FitBit to the website. You can also change your profile information here.
E. If you want to add today’s activity, one type of activity at a time, use this button.



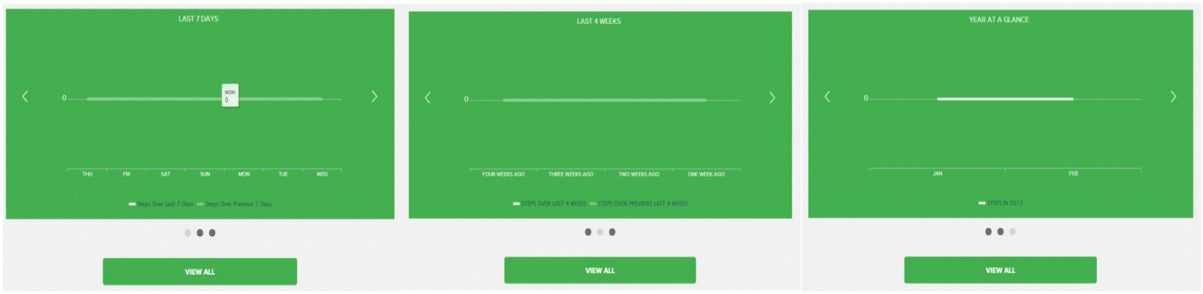
Also on your main home page, you will see summaries of your activity. The top summary shows you your stepping activity. To view data for the previous day, week, month, or year click the small arrows indicated in the picture.



The same method can be used to review the number of flights of stairs you have climbed.



Another type of summary you can view further down the dashboard page is a line graph of the last week, last 4 weeks or the previous whole year. Switch the view by pressing the little circles under the graph.

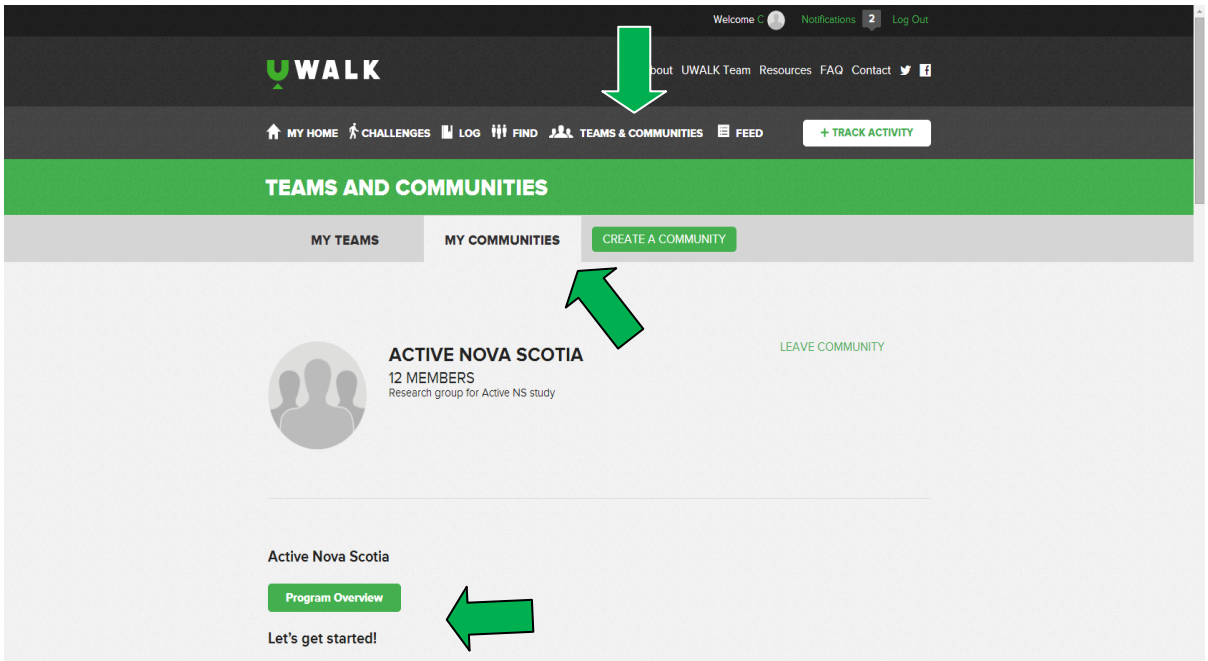


Log

On the Log page you will be able to enter steps, moderate and vigorous minutes of activity and flights for multiple days (up to one week at a time). If you missed previous weeks you can go back and enter those as well but clicking the green arrow beside the date.

You will also be able to see a summary of your activities here by scrolling down to the bottom of the page. Any days on which you have entered activity will show up here. If you have made a mistake entering your data, you can also edit the information by clicking on the date and selecting "edit."

Active Nova Scotia Community



Looking under “Teams & Communities” you will see the heading “My Communities”. This is where you will find the private Active Nova Scotia community that you are a part of. This group is only available to those taking part in this research study.

Bookmark the “Program Overview” page to help you reach the group fast and easy.

Feed

Your activity

This page will show you a newsfeed-style summary of your website activity. You will see updates like the steps or activity you logged.

Support Pages

The previous pages make up the majority of the main website but there are other sections you can visit. You can find some general information on why walking is so good for you and how UWALK can help you increase your steps on the About page.

If you would like to learn about the UWALK staff, visit the UWALK Team page where you will find their biographies.

The Resources page gives you information on our Library Loan Program (contact us for more details), downloadable material like tracking sheets and help guides and there are videos that you can watch!

A very helpful page is the Frequently Asked Questions (FAQ). We have compiled a list of questions people have asked us since we started and have answered them here. If you are wondering how to change your password, how to start a challenge or what kind of physical activity monitors you can use, this is the place to go!

Finally, on our contact page, you will be able to send us a message with a question or concern, a comment or request, or just to say hi! Fill out the form and we will get back to you!

If the person you are looking for does not have an account yet, you can send them an invite!

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