Understanding and influencing exercise behavior in hematologic cancer survivors: An examination of the intention-behavior gap

by

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ABSTRACT

Background: Regular exercise participation improves health and quality of life (QoL) in hematologic cancer survivors (HCS), yet many are insufficiently active. Because few who intend to exercise actually translate their intention into behavior, examining the intention-behavior gap (I-B gap) in HCS is important. Furthermore, though supervised exercise interventions produce the largest improvements in patient-reported outcomes, telephone counselling (TC) may be a cost-effective alternative which still provides important participant interaction and a wider reach. Grounding TC interventions in a theoretical understanding of the I-B gap, as described in the multi-process action control framework (M-PAC), may further improve their effectiveness. **Purpose:** The purpose of this dissertation was to examine the exercise I-B gap in HCS, and to develop and assess a TC intervention aimed at improving aerobic exercise behavior in HCS. **Methods:** This dissertation comprised two studies. Study 1 was a cross-sectional survey which assessed aerobic and strength exercise behavior, M-PAC correlates, and demographic/medical variables in 606 HCS from Alberta, Canada. Study 2 was a randomized controlled trial which assessed the feasibility and preliminary efficacy of a 12-week M-PAC-based TC exercise intervention in a sample of 51 HCS. Participants were randomized to either a weekly telephone counselling exercise (TCE) group (n=26) or a self-directed exercise (SDE) group (n=25), and completed online measures of self-reported aerobic exercise behavior, QoL, fatigue, and program satisfaction at baseline and post-intervention (12 weeks). **Results:** Study 1 demonstrated a substantial I-B gap for aerobic and strength exercise in HCS, resulting in the majority of HCS being insufficiently active. Specifically, only about half of those with an intention to do either regular aerobic or strength exercise, translated their intention into meeting the respective exercise guideline. As such, overall 22% of HCS were meeting the aerobic guideline only, 10% the

strength guideline only, 22% both the aerobic and strength guideline combined, and 46% were meeting neither exercise guideline. M-PAC correlates were useful in explaining intention formation and translation in both aerobic and strength exercise contexts. Interestingly, HCS meeting the combined guidelines reported significantly stronger M-PAC correlates specific to both aerobic and strength exercise than those meeting either the aerobic-only or strength-only guideline. Study 2 revealed that a M-PAC based TC intervention was feasible in HCS, and produced large and meaningful improvements in aerobic exercise behavior. Specifically, adherence to the TC intervention was 93% and retention was 100%. Participants receiving TC increased their weekly aerobic exercise by 218 minutes compared to 93 minutes in the control group ($p < .001$, d = 2.19). Clinically meaningful mental health QoL improvements also favored the TC group (mean between-group differences > 0.33). Furthermore, the intervention yielded small-to-large between-group differences favoring the TC group in all M-PAC correlates (d = 0.20 to 1.11), and changes in coping planning, perceived opportunity, exercise identity, and habit partially mediated changes in aerobic exercise behavior. **Conclusions:** Few HCS are meeting the combined or individual exercise guidelines perhaps because substantial I-B gaps exist for both aerobic and strength exercise. The M-PAC-based TC intervention strengthened motivational, regulatory, and reflexive processes, which corresponded with increased aerobic exercise behavior and meaningful mental health improvements in HCS. Still, the absence of changes in physical health and fatigue is a common trend amongst remote exercise interventions and requires further investigation. Future phase III trials of M-PAC-based TC should look to demonstrate improvements in exercise behavior and patient-reported outcomes in HCS, other cancer survivor groups, and versus TPB-based TC.

Preface

This thesis is an original work by James R. Vallerand. Study 1 entitled "Correlates of aerobic and strength exercise in hematologic cancer survivors" received research ethics approval from the Health Research Ethics Board of Alberta – Cancer Committee (HREBA.CC-14-0097) on June 20, 2014. Study 2 entitled "Improving quality of life in hematologic cancer survivors by closing the exercise intention—behavior gap: a phase II randomized controlled trial of a theory-based, telephone-delivered exercise counselling intervention" received research ethics approval from the Health Research Ethics Board of Alberta – Cancer Committee (HREBA.CC-16-0775) on November 24, 2016.

Chapter 2 of this dissertation has been published as Vallerand, J.R., Rhodes, R.E., Walker, G.J., & Courneya, K.S. (2016). Understanding strength exercise intentions and behavior in hematologic cancer survivors: An analysis of the intention-behavior gap. *Journal of Cancer Survivorship*. doi: 10.1007/s11764-016-0540-9. I conceived and designed the study, collected and managed the data, analyzed and interpreted the data, and wrote the first draft of the manuscript. KS Courneya, RE Rhodes, and GJ Walker provided feedback on the study concept and design, data analyses and interpretation, and revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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CHAPTER 1: INTRODUCTION

1.1 CANADIAN CANCER SURVIVORS

One in two Canadians will develop cancer in their lifetime, and thanks to improvements in early detection and targeted therapies, approximately 60% will survive their diagnosis [1]. As such, of those diagnosed in the past 10 years, Canada currently hosts nearly 1.5 million cancer survivors. Despite yielding improvements in overall survival, cancer therapies still give rise to additional challenges that compromise other aspects survivors' health and quality of life (QoL) [2]. Thus, many survivors have long-term healthcare needs that extend beyond their cancer-specific management. For example, compared to those without a cancer history, survivors account for approximately 50% more healthcare costs going forward [3, 4], contributing towards the $3.8 billion in annual direct healthcare costs for managing cancer nationwide [5].

Hematologic cancer survivors (HCS) comprise a unique group of survivors. Hematologic cancers represent a cluster of cancers originating from blood forming tissue (i.e., leukemias) or cells of the immune system (i.e., lymphomas), that form either solid or non-solid tumors [6]. Of all cancers in Canada, non-Hodgkin lymphomas account for approximately 4%, leukemias for 3%, and Hodgkin lymphomas for 1% of the overall prevalence [1]. The natural history of hematologic cancers varies extensively, with some progressing indolently and sparsely requiring treatment. The goals for treating these cancers often center on non-curative for symptom management and the prevention of acute transformation to an accelerated form of their disease. Conversely, other hematologic cancers can be immediately life-threatening and require especially harsh acute treatments (e.g., high-dose chemotherapy, radiotherapy, immunotherapy, stem cell transplant); in part because some acute hematologic malignancies are curable in some patients and unfortunately the response to therapy in cases of disease relapse is generally quite

poor. Furthermore, these protocols are often so aggressive that patients require extensive stays in hospital as in-patients while receiving and recovering from their therapy.

Overall, however, the majority of hematologic malignancies have favorable prognostic outcomes and collectively account for only about 7% of all cancer-related deaths [1]. Furthermore, thanks to the integration of targeted immunotherapies (e.g., rituximab, imatinib), boast some of the largest improvements in five-year survival rates. There is no doubt that improving cancer survival is of upmost importance, especially considering the scale of potential years of life lost to hematologic cancers that affect younger populations [7]. Still, the physiological and psychological costs associated with aggressive treatments or long-term disease maintenance, leave many HCS with extended survivorship periods plagued by compromised health and worsening QoL [8, 9]. As such, evidently a timely need exists for developing effective strategies to improve the quality of HCS' survivorship [10].

1.2 EXERCISE AND CANCER

Regular exercise participation (both aerobic and strength-based) is effective in managing and reversing many physiological and psychosocial cancer-related ailments [11-13]. Furthermore, exercise is safe for survivors even immediately after having received high-dose chemotherapy [14], and doing so has been linked to improved life expectancies [15]. Perhaps the most unique contribution that exercise can offer is that in the light of important physician care, it can empower survivors to take control of improving their own health. Thus, exercise has the potential to shift much of the overall burden of disease management away from the Canadian health care system and into the able hands of survivors nationwide [16].

The primary challenge of promoting "exercise as medicine" [17] for HCS, however, is that the majority are insufficiently active to improve their own health. Specifically, it appears that

without external support, more than half of HCS are unable to meet the aerobic exercise guidelines [18, 19]. Furthermore, exercise guidelines also recommend that survivors participate in strength exercise at least twice per week [20, 21], but we currently have no indication of how many HCS are adhering to this recommendation. Perhaps because such low participation rates are found in breast, prostate, and colorectal cancer survivor groups, we should not expect that more than 30% of HCS would meet the strength exercise guideline [22-24]. Therefore, not only do we need a better understanding of the state of physical inactivity in HCS, but it appears that many HCS will require some form of behavioral support if they wish to improve their health and QoL through exercise.

Amongst all exercise interventions, supervised interventions yield the greatest health improvements [25-27]. Supervised exercise interventions, however, are extremely resource-intensive [28, 29], and typically focus on helping participants adhere to a set exercise program under highly-controlled settings, rather than supporting them to self-manage their own exercise behavior. Furthermore, even large multi-center trials may lack the reach to cater to underserved rural survivors. Conversely, evidence suggests that static distance-based interventions that rely on one-way communication (e.g, print-material or automated messaging) produce minimal or modest changes in exercise behavior and rarely improve QoL [30-34].

1.3 TELEPHONE COUNSELING

Telephone counselling has been proposed as a compromise cost-effective intervention modality that consists of dynamic interaction with participants and allows them to pursue their exercise in more realistic environments [29, 35, 36]. Still, a great deal of variability exists across the TC interventions in terms of supplementation and trial schedule, limiting the ability for the current evidence to properly inform the development of subsequent trials. For example, all trials

in cancer survivors supplemented their TC programs by integrating either print material, in-person counselling, or exercise videos, but the lack of contact-control limits our ability to extrapolate the level of influence exhibited by these supplementations. Meanwhile, some trials in healthy adult populations used TC exclusively for intervention delivery, but few yielded significant changes in exercise behavior [35]. In terms of variability in trial schedules, the majority of TC interventions in cancer survivors were longer interventions, ranging from 6-12 months in duration, while a few were between 3-4 months in duration. Call intervals also ranged from being scheduled weekly to once per month. Unfortunately, no obvious trends emerged in the combination of trial duration and call interval, as the majority of trials improved exercise behavior regardless.

Indeed, despite this heterogeneity in trial designs, TC interventions overall produced medium-to-large improvements in exercise behavior (d=0.47 to 0.93) in cancer survivors [29]. Still, the current state of evidence is heavily biased towards breast cancer survivors, as very few trials examined the efficacy of their trial in other cancer survivor groups [28, 29]. Thus, a need to look at how other cancer survivor groups, including HCS, respond to varying behavior change techniques exists. Furthermore, though TC appears effective in increasing exercise behavior in cancer survivors [37-48], its effects have only rarely translated into improved patient-reported outcomes [37, 39, 40, 44, 46]. As such, changes in QoL may depend on the magnitude of change in exercise behavior [25, 38, 49], and one possible explanation for the modest effects of previous TC interventions may be the theoretical focus of the counselling.

1.4 EXERCISE CORRELATES

Because exercise behavioral support interventions (BSIs) influence exercise behavior by elucidating change in its correlates [50], targeting the right correlates is of paramount

importance. To date, our current understanding of the psychosocial and behavioral correlates of exercise stems primarily from cross-sectional research, where they are typically organized in behavioral theories. In the context of studying exercise in cancer survivors, the theory of planned behavior [TPB; 51] has been one of the most frequently applied theoretical frameworks [52-59]. Briefly, the TPB proposes that intention is the primary determinant of exercise participation, and that an intention formed by attitudes, subjective norms, and perceived behavioral control [51]. Thus, interventions commonly target these intentional antecedents in the hope that forming an exercise intention will increase exercise behavior.

Not only is the TPB the most frequently applied theory in exercise oncology, it is also noted as one of the best for explaining variance in exercise behavior [60, 61]. Across applications in cancer survivors, the TPB explained between 10-40% of the variance in exercise behavior, and intention was consistently the strongest independent predictor with standardized regression coefficients ranging from .25 to .40 [52-58]. Thus, evidence from these cross-sectional explorations suggest that interventions based on the TPB might drive small-to-medium increases in exercise behavior. The main limitation in the application of the TPB however, is that many survivors likely already 'intend to do exercise,' especially if they view it as a somewhat beneficial, enjoyable and feasible behavior. Additionally, the majority of those who volunteer to participate in an exercise intervention by definition have already formed an exercise intention. Furthermore, researchers are beginning to recognize that a substantial gap between intention and behavior exists, and has sparked a line of criticism directed towards the TPB [62-65]. Evidently, one of the key arguments is that influencing individuals to "intend more strongly" may have limited applied utility, and would likely only perpetuate this intention-behavior gap (I-B gap). Rather, viewing an intention as a decisional process instead of a construct operating along a

spectrum of commitment [66], and applying a new line of theorizing that accounts for the I-B gap by focusing on both pre- and post- intentional/decisional processing, may be necessary.

1.5 THE INTENTION-BEHAVIOR GAP

Several theory-based models examine the I-B gap in adults [67], and on the whole, many share common elements. For example, Kuhl's action control model [68], Heckhausen & Gollwitzer's motivation/volition model [69], Schwarzer's health action process approach (HAPA) [70], and Rhodes' multi-process action control (M-PAC) framework [71] are all stage-based models that recognize intention as a decision-oriented construct. These stage-based models are especially useful for understanding exercise behavior as they allow for the I-B gap to be quantified by further subcategorizing those who intend to do exercise as either being successful intenders (those that translate their intention into exercise) or unsuccessful intenders (those that didn't follow-through on their exercise intention). Still, no direct comparisons between these frameworks exist, and thus the selection of which theory to follow hinges on choosing the framework with maximal descriptive value [65].

The M-PAC, for example, serves as an especially enticing framework for exercise oncology because of its relation to the TPB [66, 67, 72]. Specifically, similar to the TPB, the M-PAC proposes that initiating motivational processes (e.g., instrumental attitude, perceived capability) explain intention formation. The M-PAC expands upon the TPB by then postulating ongoing motivational processes (i.e., affective attitude and perceived opportunity) assume a dual role in influencing intention formation and translation, and that behavioral regulations (e.g., action planning, coping planning, self-monitoring, social support), and reflexive processes (e.g., habit, identity, obligation, anticipated regret, self-regulation of alternative activities) also aid with intention translation [73]. Though support for the M-PAC has been documented in the

context of family physical activity, daily dog walking, and adult gym-based exercise [74-78], it has yet to be applied in any cancer survivor group. As such, our understanding of the determinants of exercise behavior for cancer survivors may improve when studied through the lens of the M-PAC framework, which could ultimately improve the efficacy of exercise BSIs for HCS.

1.6 SUMMARY OF THE LITERATURE

To summarize this review of the literature, it firstly appears that HCS stand to greatly benefit from exercise because it improves their health, QoL, may extend their life, and currently very few are sufficiently active. Furthermore, despite supervised exercise interventions providing the best results in terms of heath and patient-reported outcomes, TC may prove to be an appealing alternative mode of intervention delivery. Specifically, TC has been shown to significantly increase exercise behavior in other cancer survivor groups, boasts low costs and wide reach, and supports survivors' exercise pursuits in more realistic conditions. Though we lack evidence on the optimal design of an exercise TC intervention, the proper trial schedule will likely depend on the amount of theory-based content needed to be covered. Furthermore, by following an appropriate theoretical framework, the need to further supplement TC with other intervention modalities likely diminishes. The M-PAC appears to be a particularly useful framework in the context of exercise oncology, as it leverages the rich existing evidence grounded within the TPB, and expands its reach to address the I-B gap. More specifically, following the M-PAC allows for the I-B gap to be quantified, and also provides an organized structure to examine the determinants of behavioral intentions, and its translation into behavior. As such, the M-PAC is uniquely suited to help expand the current understanding of the

determinants of exercise in HCS, as well as providing the framework for a TC exercise intervention.

1.7 OVERVIEW OF DISSERTATION

The purpose of this dissertation was to (a) understand and (b) influence exercise behavior in hematologic cancer survivors. To address both purposes, I conducted two studies in my dissertation. Study 1 was a cross-sectional survey of 606 HCS using the Alberta Cancer Registry, which yielded three papers examining the correlates of exercise behavior in HCS. Chapter 2 (Paper 1) documented the level of discordance between intention and behavior (i.e., the I-B gap) for strength exercise in HCS, and examined the key psychosocial and behavioral constructs that may help reduce this I-B gap. Continuing this line of inquiry, Chapter 3 (Paper 2) replicated this investigation for aerobic exercise. Chapter 4 (Paper 3) proposed a novel understanding of the I-B gap by considering that some HCS may actually be meeting the aerobic guideline only, the strength guideline only, both simultaneously, or neither. Together, these investigations informed the development of a BSI for HCS. Thus, Study 2 of my dissertation was a phase II randomized controlled trial which examined the feasibility and preliminary efficacy of a TC intervention for improving aerobic exercise behavior in HCS. Chapter 5 (Paper 4) reported the feasibility and results of the pilot study, comparing 12 weeks of TC versus self-directed exercise in terms of aerobic exercise behavior, quality of life, and fatigue. Chapter 6 (Paper 5) reported a comparison of changes in motivation, regulation, and reflexive processes resulting from the trial. Finally, Chapter 7 discussed the strengths and limitations of the dissertation, and provides insight into future research directions.

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CHAPTER 2: STUDY 1 – PAPER 1

Understanding strength exercise intentions and behavior in hematologic cancer survivors: An analysis of the intention-behavior gap

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2.1 INTRODUCTION

Strength exercise, or resistance training, improves physical functioning [1, 2], quality of life [3], and may even help cancer survivors live longer [4]. Few cancer survivors, however, are meeting the strength exercise guideline of at least 2 days per week of moderate-to-intense strength training of all the major muscle groups [5, 6]. The first study to estimate the prevalence of strength exercise found that only 26% of colorectal cancer survivors were meeting the guideline [7]. Similar estimates were reported for breast cancer survivors (24%) [8], and a mixed sample of breast, prostate, and colorectal cancer survivors (23%) [9]. Moreover, the few studies that have examined the correlates of strength exercise in cancer survivors have reported that survivors who were younger, highly educated, healthier, non-smokers, and not obese were more likely to do strength exercise [7-9]. Survivors were especially more likely to do strength exercise if they were also more motivated, had strong exercise self-efficacy, and developed a detailed plan for their exercise [8, 9].

To date, no study has estimated the prevalence or examined the correlates of strength exercise in hematologic cancer survivors (HCS). HCS are a unique cancer survivor group because their tumors are not solid, their disease is often widely disseminated at diagnosis, and they primarily receive intensive systemic treatments including stem cell transplantation [10]. Moreover, hematologic cancers are often managed as chronic diseases with multiple ongoing treatments over an extended period of time. These disease characteristics and treatment protocols may influence the prevalence and correlates of strength exercise [11].

Of the few population-based studies that have examined exercise in HCS, all have focused on the correlates of an aerobic exercise intention [12-14]. While intention is a critical psychological determinant of exercise behavior [15], it is clear that intention does not always

lead to exercise [16]. In fact, only about half of those who intend to do aerobic exercise, successfully translate their intention into meeting the exercise guideline [17]. To our knowledge, this gap between exercise intention and behavior (I-B gap) has never been examined for strength exercise, and has never been examined in cancer survivors.

The multi-process action control (M-PAC) was developed to specifically understand the I-B gap in exercise. Through an explicit focus on the correlates of both intention formation and translation [18], the M-PAC framework consists of motivational processes (i.e., attitude, perceived control) which influence the likelihood for an exercise intention to be formed. These motivational processes coupled with behavioral regulations (i.e., planning, and making financial investments into one's personal exercise), and reflexive processes (i.e., sense of obligation, anticipated regret, and the self-regulation of affinity towards alternative activities), help translate an exercise intention into exercise behavior [19, 20]. Understanding how intentions are formed and translated may facilitate the development of more effective exercise behavior change interventions for HCS.

The purpose of this study was to estimate the prevalence and examine the correlates of intention formation and translation for strength exercise in HCS using the M-PAC framework. We hypothesized that similar to aerobic exercise [13], more than 50% of survivors would intend to do strength exercise. Based on previous research in other cancer survivor populations, we hypothesized that about 25% of HCS would meet strength exercise guidelines [7-9]. Moreover, based on results in healthy adults [17], we hypothesized that less than 50% of HCS who intend to do strength exercise would translate that intention into behavior. We also hypothesized that based on the M-PAC model [18, 21], the motivational processes from the theory of planned behavior (TPB) would be strongly associated with intention formation, and that behavioral

regulations and reflexive processes would additionally be strongly associated with intention translation. Finally, we hypothesized that any cancer and demographic variables associated with intention formation and translation would be mediated by the M-PAC model.

2.2 METHODS

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. A population-based, stratified random sample of 2,100 HCS (700 each of leukemia, Hodgkin lymphoma, and non-Hodgkin lymphoma) were contacted by the Alberta cancer registry to participate in this cross-sectional study. Participants aged between 18 and 80 years, and diagnosed with hematologic cancer, were eligible. Three attempts to contact survivors were made [22]. Informed consent was obtained from all individual participants included in the study. Participants were asked to complete a self-report questionnaire and return it to the cancer registry via the provided pre-paid postage envelope. HCS were instructed that if they were uninterested in participating in the study, they could call the cancer registry personally or through a family member, return the questionnaire blank, or ignore our mailed requests.

Measures

Demographic and cancer-specific variables. All measures were assessed using self-report. Demographic variables included age (continuous), gender (male/female), marital status (never married/married/common law/separated/widowed/divorced), education level (some high school/completed high school/some university or college/completed university or college/some graduate school/completed graduate school), employment status (disability/retired/part time/homemaker/full time/temporarily unemployed), ethnicity

(White/Black/Hispanic/Asian/Aboriginal/Other), height (continuous), and weight (continuous). Cancer-specific variables included date of diagnosis (month, year), type of hematologic cancer (leukemia, Hodgkin lymphoma, non-Hodgkin lymphoma), disease stage (I/II/III/IV), previous treatments (surgery yes/no; radiation yes/no; chemotherapy yes/no; stem cell or marrow transplant yes/no), current treatment status (completed treatments for now/still receiving treatment), cancer recurrence (yes/no), and current cancer status (existing disease/disease-free). Cancer symptom burden was measured using 19-items from the MD Anderson Symptom Inventory [23], covering a range of symptoms such as nausea, lack of appetite, insomnia, pain, fatigue, and digestive function, and was rated on an 11-point scale (0-10).

Strength exercise. Strength exercise was measured using a modified Leisure Score Index from the Leisure Time Exercise Questionnaire [24]. While retaining the structure and template of the original Leisure Time Exercise Questionnaire, the modification entailed adding a separate section focused on strength exercise that asked participants to indicate the average frequency (days/week) and duration (minutes/session) of any moderate-to-intense strength exercise (i.e., "exercise that improves muscular strength such as weight lifting, resistance bands, sit-ups, push-ups") that they performed in a typical week over the past month [7, 9, 25]. To be consistent with prior research, strength exercise was dichotomized into meeting versus not meeting the strength exercise guideline for cancer survivors based on a frequency of at least two days per week [26], and the duration of weekly moderate-to-intense strength exercise was reported descriptively.

Motivational processes. All survey items were referenced to reflect meeting the strength exercise guideline of moderate-to-intense strength exercise at least two days per week. Fifteen standard TPB measures were used to assess survivors' exercise motivation using a 7-point bipolar scale [27]. Three items captured participants' instrumental attitude (e.g., useful-useless),

and three for affective attitude (e.g., enjoyable-unenjoyable). Three items assessed injunctive norm (e.g., "… people who are important to me will be…" encouraging-discouraging), and three for descriptive norm (e.g., "… people who are important to me will perform…" regular strength exercise-no strength exercise). Perceived control was measured using three items (e.g., "… regular strength exercise over the next month would be completely up to me …" strongly agree-disagree). In line with the theory proposed by M-PAC, the decision to form an exercise intention was measured using a single dichotomous item (i.e., "Do you intend to do regular strength exercise over the next month? (please circle): Yes/No") [28].

Regulatory behaviors. Exercise plans were assessed through five items using a 7-point bipolar scale (i.e., no plans – detailed plans) [29, 30]. Financial investments were measured using a 10-point scale (completely true for me - not at all true for me) on the following single item: "I have invested a lot of my own money into doing regular strength exercise…" [20, 31].

Reflexive processes. Anticipated regret was measured using two items (e.g., "If I do not engage in regular strength exercise over the next month, I will feel regret.") on an 11-point scale (i.e., definitely no – definitely yes) [32, 33]. Seven items on a 10-point scale (i.e., completely true for me - not at all true for me) measured participants' exercise obligation and regulation over alternative activities [20, 31]. Exercise obligation was measured using three items (e.g., "I feel obligated to do regular strength exercise over the next month...") and four items captured self-regulation over alternative competing activities (e.g., "Compared to doing regular strength exercise over the next month, there are other things I could do which would be more fun...").

Statistical analyses

To create an intention translation variable, intenders were divided as successful (meeting guidelines) or unsuccessful (not meeting guidelines). Descriptive frequency and percentage data

are reported for intention formation, strength exercise behavior, and intention translation. An exploratory factor analysis (EFA) with Varimax rotation ensured that constructs were distinct from one another [34]. Factor loading criteria for item aggregation was a primary loading of ≥.40, and a Cronbach alpha of ≥.70. Multivariate analyses of variances (MANOVAs) and chi-square analyses were used to examine differences in motive, behavioral, reflexive, demographic, and cancer variables (dependent variables), between intenders and non-intenders (fixed factor). This procedure was replicated to examine differences for intention translation (successful/unsuccessful intenders).

To determine the independent correlates of intention formation and translation, variables that approached significance in the MANOVAs/chi-squares ($p<0.10$) were included in hierarchical forward stepwise logistic regressions. Separate regressions were conducted for intention formation and translation. The stepwise variable entry threshold was $p=.05$, and $p=.10$ for removal [34]. Standardized Bartlett factor scores for each of the motive, behavioral, and reflexive variables were used to help guard against violations of multicollinearity [35]. The intention formation regression consisted of three hierarchical blocks. Block one included demographic variables, block two comprised the cancer-specific variables, and block three included motivational variables [36]. Behavioral and reflexive variables were not entered because theoretically, they are post-intention constructs [18]. Four hierarchical blocks were entered for the intention translation regression. The first three blocks mirrored the sequencing of the intention formation regression (demographics, cancer, and motivational variables), and the fourth block consisted of behavioral/reflexive variables.

2.3 RESULTS

Participant flow through the study is presented in Figure 2-1. The survey resulted in a 29% completion rate (n = 606 / 2100) and a 32% response rate (n = 606 / 1921) after excluding deceased persons and return-to-senders. Based on limited medical and demographic data available in the registry, we found no significant differences between responders and non-responders on age, sex, disease stage, and time since diagnosis. Responders were more likely to have been diagnosed with non-Hodgkin lymphoma ($p < .001$) and to have received chemotherapy ($p = .017$). Participant demographic and medical information is presented in **Table 2-1**.

Overall, 58% (n = 353 / 606) of HCS intended to do strength exercise and 32% (n = 192 / 606) met the strength exercise guideline. Considering those who met the strength exercise guideline, 91% (n = 174 / 192) reported doing 30 minutes or more of weekly strength exercise. Furthermore, survivors meeting the guideline averaged 118 weekly minutes of strength exercise, versus 3 minutes for those not meeting the guideline ($p < .001$, d = 1.52). Of those who intended to do strength exercise, 51% (n = 181 / 353) actually did strength exercise. Of those without an intention to do strength exercise, 4% (n = 11 / 253) did strength exercise. Conversely, for those meeting guidelines, 94% had an exercise intention (n = 181 / 192), and 6% did not (n = 11 / 192). Our EFA resulted in an initial six factor model based on eigenvalue criteria of >1.0. After visual inspection of the scree plot, we accepted a seven-factor model (all eigenvalues >0.95, Cronbach alpha's >.90), which significantly improved the fit versus the initial six factor model (nested comparison: $x^2 = 852.24$, df = 24, $p < .001$) [34, 37]. The resulting factors were: planning, obligation/regret, attitude, self-regulation over competing activities, descriptive norm, injunctive norm, and perceived control (**Table 2-supplement**).

Univariate correlates of intention formation and translation

The univariate correlates of intention formation and translation are reported in **Tables 2-2** and **2-3**. Participants who were younger, not-retired, had completed university, had fewer than two comorbidities, currently disease free, and diagnosed with Hodgkin lymphoma were more likely to intend to do strength exercise (all *p*s < .01; see **Table 2-2**). Participants who were younger, had completed university, and reported no comorbidities, were more likely to translate their intention into strength exercise (all *p*s < .05; see **Table 2-2**). All motivational processes were significant univariate correlates of intention formation (all *p*s < .001; see **Table 2-3**). Attitude ($p < .001$), perceived control ($p = .002$), and all behavioral and reflexive processes were significant correlates of intention translation (all *p*s ≤ .001; see **Table 2-3**).

Multivariate correlates of intention formation and translation

The independent correlates of intention formation and translation are reported in **Table 2-4**. The independent correlates of intention formation were not being retired (OR = 1.56, $p = .001$), having graduated from university (OR = 1.32, $p = .001$), and a favorable attitude (OR = 1.56, $p < .001$), descriptive norm (OR = 1.38, $p = .006$), injunctive norm (OR = 1.45, $p = .004$), and perceived control (OR = 1.38, $p < .001$). The independent correlates of intention translation were having a detailed plan (OR = 1.86, $p < .001$), favorable attitude (OR = 1.68, $p = .001$), sense of obligation (OR = 1.38, $p = .010$), and self-regulated the affinity for competing activities (OR = 1.35, $p = .012$).

2.4 DISCUSSION

In our sample of over 600 HCS, almost 60% intended to do strength exercise. Few studies have estimated the prevalence of intentions for strength exercise in cancer survivors so direct comparisons with our sample are not possible. Nevertheless, the fact that the majority of

HCS intended to do strength exercise suggests that many are aware of the benefits of strength exercise. Moreover, about one-third of HCS report that they are currently meeting strength exercise guidelines which is slightly higher than the approximate 25% prevalence estimated across studies in breast, prostate, and colorectal survivors [7-9]. Nevertheless, two-thirds of HCS are not experiencing the significant benefits of strength exercise and interventions to promote strength exercise in this unique population are needed.

As hypothesized, about half of HCS were unsuccessful in translating their strength exercise intention into behavior. Our study provides the first examination of the I-B gap for strength exercise and thus no direct comparison is possible. Nevertheless, this finding indicates a large I-B gap for strength exercise in HCS, which is consistent with the I-B gap for aerobic exercise reported in healthy populations [17]. Thus, the act of simply forming an intention for strength exercise does not always translate into behavior. Still, forming a strength exercise intention does appear to be necessary for behavior, as almost no survivors reported participating in strength exercise unintentionally, thus making intention one of the strongest psychosocial predictors of behavior [38]. Overall, these data suggest that merely examining exercise intentions may not be the optimal way of understanding strength exercise. Rather, focusing on the I-B gap by using theories that examine the correlates of both phases: intention formation and translation, may lead to the most effective exercise behavior change interventions for HCS.

In terms of intention formation for strength exercise, the univariate results revealed that certain subgroups of HCS were less likely to form an intention. Specifically, non-Hodgkin lymphoma and leukemia survivors, and those who were older, retired, did not have a university degree, suffered from at least one comorbidity, or were not cured of their cancer were less likely to form an intention. Furthermore, intention formation was strongly related to motivational

processes, with all TPB-based constructs serving as significant independent correlates. When examining the magnitude of odds ratios, attitude was the only motivational variable to exhibit a meaningful effect size [39]. Attitude is the most stable determinant of intention across TPB applications [13], and mean attitude scores were especially discrepant between intenders and non-intenders (see **Table 2-2**).

Thus, to help HCS form a strength exercise intention, interventions should be designed with attitude as the primary intervention target. For example, interventionists can encourage HCS to find ways to make strength exercise fun (e.g., with music or a friend), and detail its specific benefits for HCS (e.g., reduce fatigue, improve health and quality of life) [40]. Interventionists are additionally encouraged to target other key constructs outlined within the TPB (i.e., perceived control, descriptive norm, injunctive norm), as they too emerged as significant correlates of intention formation but exhibited smaller effect sizes. Furthermore, not being retired was a significant unmediated correlate of intention formation that exhibited a meaningful effect size. This highlights that retirees are less likely to form an intention to do strength exercise but the reason is not explained by the TPB (i.e., attitude, norms, perceived control). This finding is surprising because conceptually, HCS' perceived control should have accounted for (and thus mediated) the influence of potential physical, environmental, and informational barriers of strength exercise (e.g., training equipment, space, and technique) [41]. Thus, future research is needed to explain why retired HCS are less likely to form a strength exercise intention.

In terms of intention translation for strength exercise, the univariate results highlighted that certain subgroups of HCS were less likely to translate their intention into regular strength exercise behavior. Specifically, those who were older, had not completed university degree, were retired, or reported one or more comorbidity were less likely to translate their intention into

exercise. In multivariate analyses, the influence of comorbidities and age were mediated by attitude, planning, obligation/regret, and self-regulation over competing activities, which were all, as hypothesized, significant correlates of intention translation. Having a detailed plan and favorable attitude, however, were the only variables with relationships to intention translation that exhibited meaningful effect sizes [39]. Forming a detailed exercise plan is thought to be especially important for participant groups who encounter numerous exercise-related barriers [42], such as cancer survivors. Furthermore, strength exercise requires the coordination of numerous participatory resources (e.g., equipment, space, knowledge). As such, it is likely that participation in strength exercise is rarely done spontaneously without prior planning. Thus, interventions focused on planning may be the most effective in helping HCS translate strength exercise intention into behavior. For example, an intervention strategy may be helping HCS form a detailed plan by guiding them to consider when, where, how, what type, and with whom they might exercise [30]. Furthermore, strategies that target planning may be especially effective for intention translation when supplemented by affect-based strategies, as having a favorable attitude was important for both intention formation and translation. Thus, attitude appears to act as a transitional variable [18, 21], where a favorable attitude will help form an exercise intention, but an especially favorable attitude is needed to help bridge the I-B gap (see mean values in **Table 2-2**).

The strengths of our study include being the first to examine the I-B gap for exercise in cancer survivors, the first to examine the I-B gap for strength exercise in any population, the first to test the M-PAC model for strength exercise in any population, one of the few to examine the correlates of exercise in HCS, the validated measures of motivation, the large population-based sample, and the comparison of responders and non-responders on some demographic and

medical variables. Limitations of this study include the modest response rate, the lack of a validated measure of strength exercise, the cross-sectional design, the use of self-report data, and the failure to explore additional variables from the M-PAC framework.

The modest response rate likely biased our sample and influenced our ability to provide an accurate estimate of the prevalence of strength exercise intentions and behavior. Nevertheless, the bias in our sample likely overestimates the number of HCS intending and performing strength exercise and the number of HCS able to translate strength exercise intentions into behavior. Consequently, the need for interventions is likely more pronounced than our data suggest. The lack of a validated strength exercise measure is also a limitation, however, no such measures currently exist. Strength exercise will be particularly difficult to capture by self-report because of the necessity to assess the frequency, intensity, number of sets, number of repetitions, and the number of muscle groups exercised. Our assessment included the frequency and intensity components and we were able to use duration as a surrogate for the number of sets, repetitions, and muscle groups covered. Still, great merit exists for researchers to develop a more detailed and validated self-report measure of strength exercise for use in population-based studies.

The cross-sectional design of this study does not allow for causal interpretations of results nor to assert temporal relationships between variables. Cross-sectional research, however, serves as the foundation of our understanding of motivated exercise behavior and remains as a critical first step towards informing the development of subsequent intervention-based research. Still, longitudinal designs are needed to explore the stability and reliability of relationships between motivation and behavior long-term, as well as to explore one's progression through the M-PAC model (i.e., shifting from motivational and regulation processes, to placing more emphasis on reflective processes for behavioral maintenance over-time). The reliance on self-

report data for medical variables is another limitation of this study. Despite our relative confidence in participants' ability to accurately recall their type of cancer, and treatments received, objective measures of medical data would be preferred.

This initial application of the M-PAC was also limited as we did not assess all possible variables that might influence intention and translation within the framework, and some theoretically important correlates, such as perceived control, were surprisingly not significantly related to intention translation. Thus, future research is needed to replicate our findings and additionally explore other motivational, behavioral, or reflexive processes. For example, given the need to coordinate numerous participatory resources and the strong influence of developing detailed plans for exercise, perhaps the habituation of exercise preparation may aid in translating an intention for strength exercise [21]. This investigation also followed a common approach within the exercise motivation literature, and only focused on one type of exercise modality (strength exercise), in one group of cancer survivors [43-45]. Research examining the I-B gap for other exercise modalities (e.g., aerobic exercise and sport participation) and in other cancer survivor groups is also needed.

This study has practical implications for informing future interventions. Specifically, based on the low and likely overestimated number of HCS intending to strength exercise and successfully translating that intention into behavior, interventions are needed that can address both intention formation and translation. Efforts that focus only on intention formation are less likely to result in successful behavior change. Moreover, interventions that help HCS develop a more favorable attitude, by making exercise fun and highlighting its benefits, and a detailed plan for exercise that focuses on "with whom, what type, where, and when," may be especially effective in aiding HCS to form and translate their intention into strength exercise. Furthermore,

additional attention and support might be required in order to help retirees form an intention for strength exercise, as they were significantly less likely to form an intention on their own. This initial discovery of what might help HCS translate exercise intentions (attitude and planning) does not however provide information on how these targets might be effectively manipulated. Thus, future research should look to assess the effectiveness of different intervention modalities that might help HCS improve their attitude for exercise and create more detailed exercise plans. For example, it is unclear if written materials with an exercise workbook will be sufficient to change their attitude, plan, and behavior, or whether more intensive counseling procedures will be required [30]. Furthermore, additional considerations relating to the amount of intervention time required to elicit a behavior change (e.g., 12-week intervention vs. 6-month intervention) and the optimal method of delivery (i.e., distance-based vs. face-to-face) remain to be determined.

2.5 CONCLUSIONS

In summary, few HCS are meeting strength exercise guidelines, despite the majority intending to exercise. Of HCS with an exercise intention, only about half were successful in translating their intention into behavior. HCS who were not retired, and had a favorable attitude towards exercise, were more likely to form a strength exercise intention. Furthermore, HCS who developed a detailed exercise plan, and had a favorable attitude, were more likely to have successfully translated their intention into strength exercise behavior. Interventions targeting both intention formation and translation may reduce the I-B gap and optimize strength exercise participation in HCS.

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Table 2-1. Demographic and medical characteristics of hematologic cancer survivors participating in this study.

Variable	Overall (n=606)	Leukemia (n=186)	Hodgkin lymphoma (n=187)	non-Hodgkin lymphoma (n=233)	*p* value
Age [M (SD)]	58.1 (16.4)	61.7 (14.2)	48.5 (17.7)	62.8 (13.4)	<.001
< 60 years	303 (50%)	76 (25%)	135 (45%)	92 (30%)	<.001
≥ 60 years	303 (50%)	110 (36%)	52 (17%)	141 (47%)	
Gender					.089
Female	341 (56%)	112 (34%)	93 (27%)	136 (40%)	
Male	265 (44%)	74 (28%)	94 (35%)	97 (37%)	
Body Mass Index [M (SD)]	27.7 (7.4)	27.1 (5.6)	28.0 (8.0)	27.9 (8.3)	.45
Normal weight	221 (37%)	67 (30%)	70 (32%)	84 (38%)	.81
Overweight	245 (40%)	81 (33%)	72 (29%)	92 (38%)	
Obese	140 (23%)	38 (27%)	45 (32%)	57 (41%)	
Marital status					.096
Not married	179 (29%)	53 (30%)	66 (37%)	60 (33%)	
Married	427 (71%)	133 (31%)	121 (28%)	173 (41%)	
Children living at home					.003
None	450 (74%)	148 (33%)	122 (27%)	180 (40%)	
One or more	156 (26%)	38 (24%)	65 (42%)	53 (34%)	
Education					.44
Did not complete University	295 (49%)	92 (31%)	84 (29%)	119 (40%)	
Completed University or more	311 (51%)	94 (30%)	103 (33%)	114 (37%)	
Employment status					<.001
Not retired	375 (62%)	106 (28%)	144 (38%)	125 (33%)	
Retired	231 (38%)	80 (35%)	43 (19%)	108 (47%)	
Ethnicity					.16
White	562 (93%)	178 (32%)	170 (30%)	214 (38%)	
Other	44 (7%)	8 (18%)	17 (39%)	19 (43%)	
Time since diagnosis					.99
< 2 years	116 (19%)	37 (32%)	36 (31%)	43 (37%)	
2-5 years	304 (50%)	93 (41%)	95 (31%)	116 (38%)	
> 5 years	186 (31%)	56 (30%)	56 (30%)	74 (40%)	
Radiotherapy					<.001
No	399 (66%)	152 (38%)	104 (26%)	143 (36%)	
Yes	207 (34%)	34 (16%)	83 (40%)	90 (44%)	
Chemotherapy					<.001
No	173 (28%)	95 (55%)	23 (13%)	55 (32%)	
Yes	433 (72%)	91 (21%)	164 (38%)	178 (41%)	
Stem cell transplant					.015
No	541 (89%)	156 (29%)	170 (31%)	215 (40%)	
Yes	65 (11%)	30 (46%)	17 (26%)	18 (28%)	
Treatment status					<.001
Receiving treatments	193 (32%)	113 (59%)	17 (9%)	63 (33%)	
Completed treatments	413 (68%)	73 (18%)	170 (41%)	170 (41%)	
Recurrence					.036
No	524 (87%)	165 (31%)	168 (32%)	191 (37%)	
Yes	82 (13%)	21 (26%)	19 (23%)	42 (51%)	
Current disease status					<.001
Disease free	372 (61%)	61 (16%)	164 (44%)	147 (40%)	
Existing disease	234 (39%)	125 (53%)	23 (10%)	86 (37%)	
Comorbidities					<.001
None	221 (36%)	49 (22%)	108 (49%)	64 (29%)	
One	151 (25%)	52 (34%)	41 (27%)	58 (38%)	
Two or more	234 (39%)	85 (36%)	38 (16%)	111 (47%)	
Symptom burden [M (SD)]	1.2 (1.5)	1.3 (1.5)	1.1 (1.5)	1.3 (1.4)	.29

Note. Symptom burden = the average on a 10-point scale derived from 19 items of the MD Anderson Symptom Inventory.

Table 2-2. Associations of demographic and cancer-specific variables with strength exercise intention formation and translation in hematologic cancer survivors.

Variable	Non-Intenders (n=253)	Intenders (n=353)	*p* value	Unsuccessful Intenders (n=172)	Successful Intenders (n=181)	*p* value
Age			**<.001**			**.010**
< 60 years	100 (33%)	203 (67%)		87 (43%)	116 (57%)	
≥ 60 years	153 (51%)	150 (49%)		85 (57%)	65 (43%)	
Gender			**.27**			**.16**
Female	149 (44%)	192 (56%)		87 (45%)	105 (55%)	
Male	104 (39%)	161 (61%)		85 (53%)	76 (47%)	
Body Mass Index			**.47**			**.54**
Normal weight	88 (40%)	133 (60%)		62 (47%)	71 (53%)	
Overweight/Obese	165 (43%)	220 (57%)		110 (50%)	110 (53%)	
Marital status			**.08**			**.42**
Not married	65 (36%)	114 (64%)		52 (46%)	62 (54%)	
Married	188 (44%)	239 (56%)		120 (50%)	119 (50%)	
Children living at home			**.33**			**.21**
None	193 (43%)	257 (57%)		120 (47%)	137 (53%)	
One or more	60 (38%)	96 (62%)		52 (54%)	44 (46%)	
Education			**.006**			**.025**
University not completed	140 (47%)	155 (53%)		86 (56%)	69 (44%)	
Completed university	113 (36%)	198 (64%)		86 (43%)	112 (57%)	
Employment status			**<.001**			**.016**
Not retired	130 (35%)	245 (65%)		109 (44%)	136 (56%)	
Retired	123 (53%)	108 (47%)		63 (58%)	45 (42%)	
Ethnicity			**.12**			**.34**
White	241 (43%)	321 (57%)		159 (49%)	162 (51%)	
Other	12 (27%)	32 (73%)		13 (41%)	19 (59%)	
Cancer type			**.006**			**.42**
Leukemia	85 (46%)	101 (54%)		51 (51%)	50 (49%)	
Hodgkin lymphoma	60 (32%)	127 (68%)		56 (44%)	71 (56%)	
non-Hodgkin lymphoma	108 (46%)	125 (54%)		65 (52%)	60 (48%)	
Time since diagnosis			**.21**			**.23**
< 2 years	42 (36%)	74 (64%)		34 (46%)	40 (54%)	
2-5 years	125 (41%)	179 (59%)		95 (53%)	84 (47%)	
> 5 years	86 (46%)	100 (54%)		43 (43%)	57 (57%)	
Radiation			**.44**			**.28**
No	171 (43%)	228 (57%)		116 (51%)	112 (49%)	
Yes	82 (40%)	125 (60%)		56 (45%)	69 (55%)	
Chemotherapy			**.49**			**.86**
No	76 (44%)	97 (56%)		48 (49%)	49 (51%)	
Yes	177 (40%)	256 (59%)		124 (48%)	132 (52%)	
Stem cell transplant			**.17**			**.11**
No	231 (43%)	310 (57%)		156 (50%)	154 (50%)	
Yes	22 (34%)	43 (66%)		16 (37%)	27 (63%)	
Treatment status			**.66**			**.37**
Receiving treatments	86 (45%)	107 (55%)		56 (52%)	51 (48%)	
Completed treatments	167 (40%)	246 (60%)		116 (47%)	130 (53%)	
Recurrence			**.34**			**.76**
No	151 (29%)	373 (71%)		152 (49%)	158 (51%)	
Yes	27 (33%)	55 (67%)		20 (46%)	23 (54%)	
Current disease status			**.024**			**.26**
Disease free	142 (38%)	230 (62%)		107 (46%)	123 (54%)	
Existing disease	111 (47%)	123 (53%)		65 (53%)	58 (47%)	
Comorbidities			**<.001**			**.001**
None	72 (33%)	149 (67%)		57 (38%)	92 (62%)	
One or more	181 (47%)	204 (53%)		115 (56%)	89 (44%)	
Symptom burden [M (SD)]	**1.3 (1.4)**	**1.2 (1.5)**	**.29**	**1.2 (1.3)**	**1.2 (1.6)**	**.77**

Note. Symptom burden = the average on a 10-point scale derived from 19 items of the MD Anderson Symptom Inventory.

Table 2-3. Associations of motive, behavioral, and reflexive variables with strength exercise intention formation and translation in hematologic cancer survivors.

Variable	Non-Intenders (n=253) M (SD)	Intenders (n=353) M (SD)	*p* value	*d*	Unsuccessful Intenders (n=172) M (SD)	Successful Intenders (n=181) M (SD)	*p* value	*d*
TPB variables								
Attitude	3.9 (1.4)	5.7 (0.8)	<.001	1.58	5.5 (0.9)	5.9 (0.8)	<.001	0.47
Injunctive norm	4.7 (1.7)	6.1 (0.9)	<.001	1.03	6.0 (0.8)	6.1 (0.9)	.74	0.12
Descriptive norm	3.2 (1.8)	4.4 (1.7)	<.001	0.69	4.4 (1.7)	4.3 (1.7)	.72	0.06
Perceived control	4.8 (2.0)	6.1 (1.0)	<.001	0.82	5.9 (1.1)	6.3 (0.9)	.002	0.40
Regulatory behaviors								
Planning	1.4 (0.9)	5.1 (1.7)	<.001	2.72	4.7 (1.8)	5.6 (1.6)	<.001	0.53
Reflexive processes								
Obligation/regret	2.4 (1.8)	7.5 (2.2)	<.001	2.54	7.0 (2.2)	7.9 (2.2)	<.001	0.41
Regulation of alternatives	3.6 (2.5)	5.8 (2.2)	<.001	0.93	5.4 (2.1)	6.1 (2.2)	.001	0.33

Note. TPB = theory of planned behavior; *d* = Cohen's effect size.

Table 2-4. Independent correlates of intention formation (n=606) and translation (n=428) from hierarchical forward stepwise logistic regressions

	Model 1			Model 2			Model 3			Model 4		
Variable	OR [95% CI]	*Wald*	*p* value	OR [95% CI]	*Wald*	*p* value	OR [95% CI]	*Wald*	*p* value	OR [95% CI]	*Wald*	*p* value
Intention Formation												
Education	1.42 [1.02-1.98]	4.23	.040	1.43 [1.02-1.99]	4.35	.037	1.32 [0.93-1.88]	2.36	.001			
Employment	2.03 [1.44-2.85]	16.63	<.001	1.78 [1.24-2.55]	9.68	.002	1.56 [1.06-2.30]	5.19	.001			
Comorbidities	--	--	--	1.48 [1.02-2.15]	4.30	.038	1.39 [0.94-2.06]	2.70	.051			
Attitude	--	--	--	--	--	--	1.56 [1.31-1.86]	24.65	<.001			
Descriptive norm	--	--	--	--	--	--	1.38 [1.16-1.64]	13.50	.006			
Injunctive norm	--	--	--	--	--	--	1.45 [1.21-1.74]	15.99	.004			
Perceived control	--	--	--	--	--	--	1.38 [1.16-1.65]	13.38	<.001			
	R^2=.053, F=24.47, p<.001			R^2=.062, F=28.79, p<.001			R^2=.187, F=90.61, p<.001					
Intention Translation												
Age	1.74 [1.14-2.67]	6.54	.011	1.33 [0.83-2.15]	1.38	.240	2.03 [1.36-3.04]	11.80	.001	1.31 [0.79-2.16]	1.08	.299
Comorbidities	--	--	--	1.83 [1.13-2.97]	6.12	.013	1.73 [1.06-2.83]	3.80	.051	1.54 [0.92-2.55]	2.73	.099
Attitude	--	--	--	--	--	--	1.43 [1.07-1.92]	5.86	.015	1.68 [1.23-2.31]	10.58	.001
Perceived control	--	--	--	--	--	--	1.36 [1.00-1.84]	3.95	.047	1.31 [0.96-1.79]	2.89	.089
Planning	--	--	--	--	--	--	--	--	--	1.86 [1.37-2.53]	15.89	<.001
Obligation/regret	--	--	--	--	--	--	--	--	--	1.38 [1.08-1.76]	6.60	.010
Regulation of alternatives	--	--	--	--	--	--	--	--	--	1.35 [1.07-1.71]	6.35	.012
	R^2=.025, F=6.60, p=.010			R^2=.047, F=12.77, p=.002			R^2=.077, F=21.08, p<.001			R^2=.155, F=43.68, p<.001		

Table 2-supplement. Primary loadings from the exploratory factor analysis revealing the independent motive/behavioral variables.

Survey Items	Factors						
	1	**2**	**3**	**4**	**5**	**6**	**7**
I have plans concerning 'where' I am going to exercise	.90						
I have plans concerning 'what' kind of exercise	.89						
Do you have plans for when, where, and what type of exercise	.88						
I have plans concerning 'when' I am going to engage in exercise	.87						
I have plans concerning 'how' I am going to get to a place to engage in exercise	.86						
I have invested a lot of my own money into doing regular aerobic exercise	.58						
Regular exercise over the next month would be: beneficial/harmful		.66					
Regular exercise over the next month would be: useful/useless		.65					
Regular exercise over the next month would be: important/unimportant		.64					
Regular exercise over the next month would be: enjoyable/unenjoyable		.64					
Regular exercise over the next month would be: pleasurable/painful		.61					
Regular exercise over the next month would be: fun/boring		.58					
There are other things I could do which would be more enjoyable…			.96				
There are other things I could do which would be more fun…			.94				
There are other things I would be happier doing…			.71				
There are other things I could do which would be more worthwhile…			.58				
Those important to me would be: encouraging/discouraging				.86			
Those important to me would be: supportive/unsupportive				.81			
Those important to me would be: approving/disapproving				.81			
If I do not engage in exercise over the next month, I will feel upset					.71		
I feel obligated to do exercise over the next month					.69		
If I do not engage in exercise over the next month, I will feel regret					.66		
I feel it is my duty to exercise over the next month					.64		
I feel it is necessary for me to exercise over the next month					.63		
Those important to me will participate in exercise: likely/unlikely						.93	
Those important to me will participate in exercise: agree/disagree						.93	
Those important to me will perform: regular exercise/no exercise						.86	
I have complete control over how much I engage in exercise: very much/ not at all							.89
Engaging in exercise would be completely up to me: agree/disagree							.83
The amount of control I would have to exercise: complete/very little							.66
Cronbach alpha	**.96**	**.94**	**.92**	**.97**	**.96**	**.96**	**.91**

Note. All items were prefaced to pertain to participating in regular aerobic exercise. Principal axis factoring with varimax rotation. Factor names are as follows: 1 = Planning; 2 = Attitude; 3 = Self-regulation over alternative activities; 4 = Injunctive norm; 5 = Obligation/regret; 6 = Descriptive norm; 7 = Perceived control.

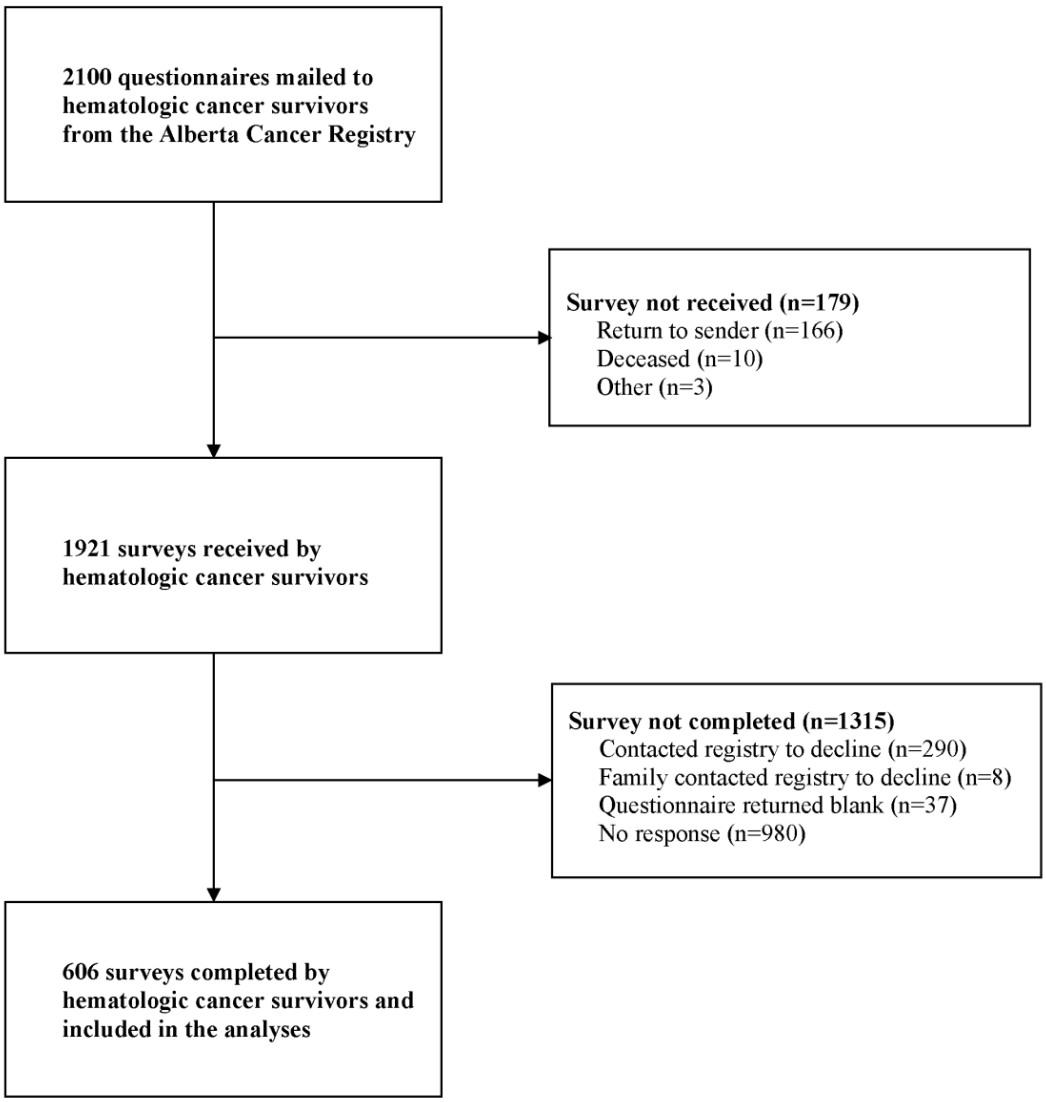

Figure 2-1. Flow of participants through the cross-sectional study of exercise in hematologic cancer survivors.

CHAPTER 3: STUDY 1 – PAPER 2

Magnitude and correlates of the aerobic exercise intention-behavior gap in hematologic cancer survivors: An application of the multi-process action control framework

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3.1 INTRODUCTION

Hematologic cancer survivors (HCS) who regularly participate in aerobic exercise have better health and quality of life [1-3], and may even live longer [4]. The most effective strategy for promoting exercise to cancer survivors, however, is unknown and the majority of HCS remain inactive [5, 6]. Prior efforts have primarily attempted to understand cancer survivors' exercise motivation by applying the theory of planned behavior (TPB) [7], and this approach has recently received substantial criticism [8]. Specifically, the TPB proposes that intentions (which are the product of attitudinal, normative, and controllability evaluations) are the primary cause of behavioral enactment. The TPB, however, provides little utility in explaining why individuals do not always behave in accordance with their intention, and thus does not address the intention-behavior (I-B) gap [9]. Nevertheless, intending to exercise appears to be necessary for behavior, as spontaneous engagements in complex behaviors (e.g., physical exercise) are rare. Thus, examinations of the I-B gap that focus on the determinants of both intention formation and its translation into behavior are of key importance for informing behavior change interventions. The multi-process action control framework (M-PAC) [10] extends beyond the TPB by explicitly focusing on the determinants of intention formation and translation, through a consideration of behavioral regulations and reflexive processes in addition to the TPB's motivational processes.

We previously conducted a population-based survey of over 600 Alberta HCS. Our initial report focused specifically on strength exercise in HCS and was the first study to examine the I-B gap in cancer survivors and for strength exercise [11]. Guided by the M-PAC, we quantified and determined the correlates of the I-B gap. We found that overall, 58% of HCS intended to do regular strength exercise (n = 353 / 606), and 32% met the public health guidelines for strength exercise (n = 192 / 606). Taken together, only 51% of HCS translated their intention into strength

exercise behavior (n = 181 / 353). Furthermore, our initial investigation supported the theoretical propositions of the M-PAC [11]. Specifically, we found that the motivational processes from the TPB (attitudes, injunctive and descriptive norms, and perceived control) were important for explaining intention formation. Furthermore, attitudes and perceived control were also significant correlates of intention translation, in addition to action planning, a sense of obligation, and self-regulation over alternative activities.

The purpose of the current investigation was to examine the magnitude and correlates of the I-B gap for aerobic exercise in HCS. Based on prior results in non-Hodgkin lymphoma survivors, we hypothesized that approximately 25% of survivors would report at least 150 minutes moderate-to-vigorous aerobic exercise per week [5, 6]. Furthermore, we hypothesized that more than 60% of survivors would intend to do regular aerobic exercise, and that 50% of HCS with an intention to exercise would successfully translate their intention into aerobic exercise behavior [9, 11]. We also hypothesized based on the M-PAC model that intention formation would be strongly associated with the motivational processes, and intention translation would be strongly associated with behavioral regulations, reflexive processes, attitude, and perceived control [10]. Finally, we hypothesized that any cancer and demographic variables associated with intention formation and translation would be mediated by the M-PAC model.

3.2 METHODS

The design and methods of our survey study have been detailed elsewhere [11]. Briefly, institutional ethical approval and informed consent was obtained for all procedures performed in the study. Self-report survey data for this cross-sectional study was collected over the course of five months, from September to January. The Alberta Cancer Registry generated a stratified random sample of 2,100 HCS (700 of each leukemia, Hodgkin lymphoma, and non-Hodgkin

lymphoma). Participants between 18 and 80 years old, and diagnosed with hematologic cancer were eligible. HCS were mailed a study package containing: an invitation letter from the cancer registry, a letter from the researchers detailing the study's objectives, a questionnaire, and a pre-paid return envelope.

Measures

Demographic and cancer-specific variables. All measures were assessed using self-report. Demographic variables included age, gender, marital status, education, employment status, ethnicity, height, and weight. Cancer-specific variables included date of diagnosis, type of cancer, disease stage, previous treatments, current treatment status, cancer recurrence, and current cancer status (existing disease versus disease-free). Cancer symptom burden was measured using 19-items from the MD Anderson Symptom Inventory [12], rated on a 10-point scale. These items covered a range of symptoms such as nausea, insomnia, pain, and fatigue.

Aerobic exercise and intention. The Godin Leisure Time Exercise Questionnaire was used to measure aerobic exercise [13]. Participants indicated their average frequency and duration of any moderate and vigorous aerobic exercise in a typical week over the past month. Weekly minutes were added together, with vigorous minutes double weighted, yielding a total value of moderate-to-vigorous aerobic exercise. Values were dichotomized according to meeting exercise guidelines (i.e., <150 minutes or ≥150 minutes) [14]. To measure whether participants intended to do aerobic exercise, participants were asked the following single dichotomous question: "Do you intend to do regular aerobic exercise over the next month? (yes/no)" [15].

Motivational processes. Survey items were prefaced with a definition of the aerobic exercise guidelines. Standard TPB measures assessed survivors' aerobic exercise motivation on a 7-point bipolar Likert scale [16]. Three items captured participants' instrumental attitude (e.g.,

useful-useless), and three for affective attitude (e.g., enjoyable-unenjoyable). Three items assessed injunctive norm (e.g., "… people who are important to me will be…" encouraging-discouraging), and three for descriptive norm (e.g., "… people who are important to me will perform…" regular aerobic exercise-no aerobic exercise). Perceived control was measured using three items (e.g., "… regular aerobic exercise over the next month would be completely up to me …" strongly agree-disagree).

Behavioral regulations. Exercise plans were assessed through five items using a 7-point bipolar scale (i.e., no plans – detailed plans) [17]. A sample item is: "Do you have plans for when, where, and what type of regular aerobic exercise you will do in the next month?" Reflexive processes. Anticipated regret was measured using two items (e.g., "If I do not engage in regular aerobic exercise over the next month, I will feel regret.") on an 11-point scale (i.e., definitely no – definitely yes) [18]. Seven items on a 10-point scale (i.e., completely true for me - not at all true for me) measured participants' exercise obligation and regulation over alternative activities [19]. Exercise obligation was measured using three items (e.g., "I feel obligated to do regular aerobic exercise over the next month...") and four items captured self-regulation over alternative competing activities (e.g., "Compared to doing regular aerobic exercise over the next month, there are other things I could do which would be more fun...").

Statistical analyses

To create a variable that captured "intention translation," intenders were categorized as successful (meeting guidelines) or unsuccessful (not meeting guidelines). Descriptive frequency and percentage data are reported for aerobic exercise behavior, intention formation, and intention translation. An exploratory factor analysis (EFA) with Varimax rotation was conducted (see **Table 3-supplement)** to ensure that all motivational processes, behavioral regulations, and

reflexive processes were distinct from one another and exhibited preliminary factorial validity [20]. Factor loading criteria for item aggregation was a primary loading of ≥ .40, and a Cronbach alpha of ≥ .70. To examine differences in motivational processes, behavioral regulations, reflexive processes, demographic, and cancer variables (dependent variables) between intenders and non-intenders (fixed factor), multivariate analyses of variances (MANOVAs) and chi-square analyses were used. This procedure was replicated to examine differences for intention translation (successful/unsuccessful intenders).

To determine the independent correlates of intention formation and translation, variables that approached significance in the MANOVAs/chi-squares (p<0.10) were included in hierarchical forward stepwise logistic regressions. Separate regressions were conducted for intention formation and translation (dependent variables). The stepwise variable entry threshold was p=.05, and p=.10 for removal [20]. Standardized Bartlett factor scores for each of the motive, behavioral, and reflexive variables were used to help guard against violations of multicollinearity [21]. The intention formation regression consisted of three hierarchical blocks. Block one included demographic variables, block two comprised the cancer-specific variables, and block three included motivational variables [22]. As the behavioral and reflexive variables serve as post-intentional constructs within the M-PAC framework [10], they were not entered in the regression model for intention formation in order to guard against model misspecification [23]. Four hierarchical blocks were entered for the intention translation regression. The first three blocks mirrored the sequencing of the intention formation regression (demographics, cancer, and motivational variables), and the fourth block consisted of behavioral/reflexive variables.

3.3 RESULTS

Participant flow through the study is presented elsewhere [11]. Briefly, 29% of survivors who were mailed a study package returned a completed survey (n = 606 / 2100), which resulted in a 32% response rate (n = 606 / 1921) when excluding the return-to-senders and deceased persons. Overall, 186 (31%) were leukemia survivors, 187 (31%) were Hodgkin lymphoma survivors, and 233 (38%) were non-Hodgkin lymphoma survivors. Furthermore, participants were on average age 58 years of age, 56% were female, 68% had completed all cancer treatments, and 50% were diagnosed between 2 to 5 years prior to their involvement in this study.

Aerobic exercise behavior and the intention-behavior gap

Overall, 44% (n = 267 / 606) of HCS met the aerobic exercise guideline and 71% (n = 428 / 606) intended to do aerobic exercise. In subgroup analyses, 60% of intenders (n = 256 / 428) and 6% (n = 11 / 178) of non-intenders met the aerobic exercise guideline.

Univariate correlates of intention formation and translation

Participants who were younger, not retired, had children at home, completed university, fewer than two comorbidities, and reported lower symptom burden were more likely to intend to do aerobic exercise (all *p*s < .05; see **Table 3-1**). Participants who were younger, female, not obese, diagnosed with non-Hodgkin lymphoma, currently disease free, had children at home, completed university, not retired, fewer than two comorbidities, and reported lower symptom burden, were more likely to translate their intention into aerobic exercise (all *p*s < .05; see **Table 3-1**).

Seven factors resulted from the EFA (planning, obligation/regret, attitude, self-regulation over competing activities, descriptive norm, injunctive norm, and perceived control; see Table 3-

4). All motivational processes were significantly different between intenders and non-intenders (all *p*s < .001; see **Table 3-2**). Attitude, perceived control, and all behavioral and reflexive processes were significantly different between successful and unsuccessful intenders (all *p*s < .001; see **Table 3-2**).

Independent correlates of intention formation and translation

In multivariate analyses, HCS with a favorable attitude (OR = 1.9, $p < .001$), perceived control (OR = 1.5, $p < .001$), younger age (OR = 2.0, $p = .001$), higher education (OR = 2.1, $p = .001$), descriptive norm (OR = 1.3, $p = .006$) and injunctive norm (OR = 1.3, $p = .004$), were significantly more likely to form an aerobic exercise intention (see **Table 3-3**). HCS with a sense of obligation/regret (OR = 2.8, $p < .001$), better able to self-regulate alternative activities (OR = 1.6, $p < .001$), a positive attitude (OR = 2.0, $p < .001$), higher perceived control (OR = 1.7, $p < .001$), detailed plan (OR = 1.7, $p < .001$), were female (OR = 2.0, $p = .004$), and younger (OR = 3.0; all $p < .001$) were more likely to have translated their intention to do regular aerobic exercise.

3.4 DISCUSSION

Overall, 44% of HCS reported meeting the aerobic exercise guideline, which is higher than reported in prior investigations in non-Hodgkin lymphoma survivors [5, 6], and our prior investigation in HCS for strength exercise [11]. Few studies have estimated the prevalence of aerobic exercise in Hodgkin lymphoma and adult leukemia survivors, thus limiting our ability to compare between investigations across cancer types. Nevertheless, Hodgkin lymphoma survivors in the current investigation appeared to be more likely to do aerobic exercise and thus may have influenced the overall prevalence. Indeed, 71% of HCS intended to meet the aerobic exercise guideline, which again is larger than hypothesized (60%) based on prior results [11, 24]. The

overall proportion of intentional HCS may also have been influenced by certain subgroups. Specifically, almost 80% of HCS who were younger, had children living at home, completed university, were not retired, or were free of comorbidities, reported intending to meet the guideline.

In terms of intention translation, 60% of HCS intending to do regular aerobic exercise met the guideline. This is slightly higher than hypothesized based on an average reported across 10 prospective studies in healthy young adults (54%) [9], and from our prior investigation in HCS for strength exercise (51%) [11]. It is possible, however, that a greater temporal congruency found within a cross-sectional study, versus prospective cohorts, may partially explain an inflated proportion of intention translation [25]. Furthermore, fewer resources are needed for aerobic exercise participation versus strength exercise and thus may facilitate aerobic exercise participation. Nevertheless, given that 40% of HCS who intended to meet the guideline were unable to do so, the overall I-B gap for aerobic exercise in HCS is still meaningful. This is especially true for specific subgroups of HCS who had particularly poor rates of intention translation and may require special attention. For example, less than 55% of HCS who were men, less educated, on treatment, had leukemia, or existing disease, reported translating their intention. This proportion of successful intention translation dropped to 50% for cases with multiple comorbidities, who were older, obese, or retired. This evidence supports the recent string of criticisms directed at health behavior change interventions [8, 26], suggesting that many may be ineffective because they focus exclusively on promoting exercise intention formation. This is especially striking when considering that as many HCS reported being unsuccessful in translating their intention into aerobic exercise (n=172) as reported having no intention to do aerobic exercise (n=178), yet very few interventions target unsuccessful intenders.

In accordance with the M-PAC framework and as hypothesized, all motivational processes were significant correlates of aerobic intention formation. Attitude and perceived control, however, were the only correlates to exhibit meaningful associations with intention formation. These are the most common determinants of exercise intentions across TPB applications in cancer survivors [24], and the consistency of findings with our prior investigation in strength exercise is encouraging [11]. As such, interventions that employ strategies to make HCS more aware of the unique benefits of aerobic exercise (e.g., treatment completion, symptom management, improved survival), and ways to make aerobic exercise more enjoyable (e.g., exercising with music or a friend), should increase the odds that HCS form an exercise intention by improving their attitude. Furthermore, interventions that target HCS' perceived control by helping them become more aware of basic exercise principles (e.g., target intensities, different aerobic exercise modalities) and of the many opportunities to engage in aerobic exercise (e.g., at fitness centres, in one's neighbourhood) should similarly benefit in increasing the odds that HCS form an exercise intention. As such, health care professionals and community organizations have a role in furthering survivors' perceived control by providing detailed exercise prescriptions that are feasible, enjoyable, and accessible. Added utility may also come from other key constructs outlined within the TPB (i.e., descriptive norm, injunctive norm) as they too emerged as significant correlates of intention formation but exhibited smaller effect sizes.

For intention translation, all behavioral regulations and reflexive processes, in addition to a favorable attitude and perceived control, showed significant and meaningful associations, thus supporting our hypothesis. Furthermore, these processes were also all significant correlates of intention translation in strength exercise, however, only attitudes and planning exhibited meaningful effect sizes [11]. Thus, these processes may be more relevant for translating an

aerobic exercise intention (i.e., all behavioral/reflexive processes) than a strength exercise intention (i.e., only planning and attitude). The utility of anticipated regret and self-regulation over competing activities for intention translation is supported in prior research [18, 27], linking to a sense of shame/guilt associated with not fulfilling the identified role of being an exerciser [28]. Thus, interventionists may be more effective if they derive strategies that encourage HCS to commit to their exercise goals rather than alternatives and reinforce HCS' identity as exercisers (e.g., goal contracts, rewards, decision balance, investing into one's exercise) [29].

Furthermore, encouraging HCS to develop detailed action plans that focus on considering when, where, how, what type, and with whom they might exercise may prove to be useful for implementing their intention, as well as for fostering greater behavioral habituation and subconscious responsiveness to environmental cues [30]. Supplementing these strategies with additional attitudinal and controllability considerations may be especially important, as these motivational constructs appear to operate as transitional variables [31], where a certain threshold is required for intention formation but an even greater threshold holds considerable influence over whether that intention is translated into exercise (as seen in **Table 3-3**). Interestingly, multivariate association with cancer symptoms were mediated by the M-PAC processes, yet age and gender maintained independent influence. Specifically, the independent influence of cancer symptoms was no longer significant when attitude and perceived control were entered into the multivariate model (see **Table 3-3**, model 3 for intention translation). As such, being all the more aware of the numerous health benefits specific to HCS that would result from exercise participation, and remaining confident in one's ability to exercise regularly may play key roles in helping symptomatic survivors translate their intention into exercise, despite their cancer symptoms. Furthermore, as age and gender exhibited independent influence on survivors' odds

of successful intention translation, additional research is needed to determine the unique needs of older survivors and male survivors to help them successfully translate their exercise intention. Moreover, other demographic and cancer-specific variables may emerge as potential moderators within different contexts (i.e., survivor groups, types of exercise), and thus a continued effort to consider such variables as correlates of exercise intention formation and translation seems important.

The strengths of our study include being the first to examine the aerobic exercise I-B gap in cancer survivors, one of the few to examine the correlates of exercise in HCS, the large population-based sample of HCS, and the validated measures of motivation and exercise. Limitations of this study include the cross-sectional design, a potential self-selection sample bias, the use of self-report measures of exercise, and the failure to explore additional variables from the M-PAC framework.

The cross-sectional design prevents us from examining the causal order among variables, and whether these variables would be malleable enough to prove useful in subsequent intervention-based applications. Furthermore, without a measure of participants' exercise history, we cannot make any conclusions on the nature of how survivors transition from exercise initiation to maintenance. Secondly, the sample may have been biased due to self-selection. Though the HCS who completed the survey were not significantly different than non-respondents in age, sex, disease stage, and time since diagnosis [11], they were likely more motivated to do aerobic exercise. This may have implications especially for our estimated prevalence of I-B gap, where HCS in general may have an even larger I-B gap for aerobic exercise. The self-report aerobic exercise measure is subject to some recall and reporting biases

[32]. Furthermore, additional sources of physical activity occurring outside of one's leisure-time may too hold potential for health benefits and merit exploration.

Given our particular interest in examining exercise initiation, we did not assess all possible reflexive intention translation variables within the M-PAC, and we did not compare motivational, regulatory, and reflexive profiles between exercise initiates and maintainers. The M-PAC additionally proposes that behavioral influence can stem from self-monitoring and exercise habituation [31], thus considering these concepts in future prospective studies may prove especially useful for understanding how survivors transition from exercise initiation to maintenance. Finally, we have reported on the I-B gap for aerobic and strength exercise separately, however, guidelines for cancer survivors recommend both aerobic and resistance exercise [14], and a simultaneous consideration of both forms of exercise may be informative.

3.5 CONCLUSIONS

In summary, 71% of HCS reported an intention to perform aerobic exercise and 60% successfully translated their intention into behavior. HCS who were younger, completed university, had a favorable attitude and perceived control were more likely to form an exercise intention. Furthermore, HCS who were younger, had a sense of obligation/regret, self-regulated over alternative activities, financially invested into personal exercise, and a favorable attitude and perceived control were more likely to successfully translate their intentions. Interventionists may use these results to develop health-promotion efforts for HCS that target both the determinants of exercise intentions and intention translation.

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Table 3-1. Associations of demographic and cancer-specific variables with aerobic exercise intention formation and translation in hematologic cancer survivors.

Variable	Non-Intenders (n=178)	Intenders (n=428)	*p* value	Unsuccessful Intenders (n=172)	Successful Intenders (n=256)	*p* value
Age			<.001			<.001
< 60 years	61 (20%)	242 (80%)		70 (29%)	172 (71%)	
≥ 60 years	117 (39%)	186 (61%)		102 (55%)	84 (45%)	
Gender			.92			.013
Female	101 (29%)	240 (71%)		84 (35%)	156 (65%)	
Male	77 (30%)	188 (70%)		88 (47%)	100 (53%)	
Body Mass Index			.59			.018
Normal weight	66 (30%)	155 (70%)		55 (35%)	100 (64%)	
Overweight	67 (27%)	178 (73%)		67 (38%)	111 (62%)	
Obese	45 (32%)	95 (68%)		50 (53%)	45 (47%)	
Marital status			.24			.96
Not married	59 (33%)	120 (67%)		48 (40%)	72 (60%)	
Married	119 (28%)	308 (72%)		124 (40%)	184 (60%)	
Children living at home			.011			.023
None	145 (32%)	305 (68%)		133 (44%)	172 (56%)	
One or more	33 (21%)	123 (79%)		39 (32%)	84 (68%)	
Education			<.001			.011
University not completed	115 (39%)	180 (61%)		85 (47%)	95 (53%)	
Completed university	63 (20%)	248 (80%)		87 (35%)	161 (65%)	
Employment status			<.001			<.001
Not retired	85 (23%)	290 (77%)		100 (35%)	190 (65%)	
Retired	93 (40%)	138 (60%)		72 (52%)	66 (48%)	
Ethnicity			.12			.60
White	170 (30%)	392 (70%)		159 (40%)	233 (60%)	
Other	8 (18%)	36 (82%)		13 (36%)	23 (64%)	
Cancer type			.16			.014
Leukemia	55 (30%)	131 (70%)		61 (47%)	70 (53%)	
Hodgkin lymphoma	46 (25%)	141 (75%)		43 (31%)	98 (69%)	
non-Hodgkin lymphoma	77 (33%)	156 (67%)		68 (44%)	88 (56%)	
Time since diagnosis			.96			.066
< 2 years	34 (29%)	82 (71%)		38 (46%)	44 (54%)	
2-5 years	88 (29%)	216 (71%)		75 (35%)	141 (65%)	
> 5 years	56 (30%)	130 (70%)		59 (45%)	71 (55%)	
Radiation			.20			.25
No	124 (31%)	275 (69%)		116 (42%)	159 (58%)	
Yes	54 (26%)	153 (74%)		56 (37%)	97 (63%)	
Chemotherapy			.58			.41
No	48 (28%)	125 (72%)		54 (43%)	71 (57%)	
Yes	130 (30%)	303 (70%)		118 (39%)	185 (61%)	
Stem cell transplant			.79			.18
No	158 (29%)	383 (71%)		158 (41%)	225 (59%)	
Yes	20 (31%)	45 (69%)		14 (31%)	31 (69%)	
Treatment status			.66			.052
Receiving treatments	59 (31%)	134 (69%)		63 (47%)	71 (53%)	
Completed treatments	119 (29%)	294 (71%)		109 (37%)	185 (63%)	
Recurrence			.45			.53
No	151 (29%)	373 (71%)		152 (41%)	221 (59%)	
Yes	27 (33%)	55 (67%)		20 (36%)	35 (64%)	
Current disease status			.06			.016
Disease free	99 (27%)	273 (73%)		98 (36%)	175 (64%)	
Existing disease	79 (34%)	155 (66%)		74 (48%)	81 (52%)	
Comorbidities			<.001			<.001
None	45 (20%)	176 (80%)		56 (32%)	120 (68%)	
One	39 (26%)	112 (74%)		36 (32%)	76 (68%)	
Two or more	94 (40%)	140 (60%)		80 (57%)	60 (43%)	
Symptom burden [M (SD)]	1.5 (1.5)	1.1 (1.4)	.001	1.3 (1.6)	1.0 (1.3)	.007

Note. Symptom burden = the average on a 10-point scale derived from 19 items of the MD Anderson Symptom Inventory.

Table 3-2. Associations of motive, behavioral, and reflexive variables with aerobic exercise intention formation and translation in hematologic cancer survivors.

Variable	Non-Intenders (n=178) M (SD)	Intenders (n=428) M (SD)	*P* value	*d*	Unsuccessful Intenders (n=172) M (SD)	Successful Intenders (n=256) M (SD)	*p* value	*d*
TPB variables								
Attitude	4.1 (1.5)	5.8 (0.8)	<.001	1.41	5.5 (0.8)	6.0 (0.7)	<.001	0.67
Injunctive norm	5.0 (1.6)	6.1 (0.9)	<.001	0.85	6.1 (0.8)	6.2 (0.9)	.32	0.12
Descriptive norm	3.7 (1.8)	4.9 (1.6)	<.001	0.70	4.8 (1.6)	5.0 (1.5)	.16	0.13
Perceived control	4.6 (1.9)	6.1 (1.0)	<.001	0.99	5.8 (1.1)	6.3 (0.9)	<.001	0.50
Regulatory behaviors								
Planning	1.9 (1.6)	4.1 (2.2)	<.001	1.14	3.5 (2.2)	4.5 (2.0)	<.001	0.48
Reflexive processes								
Obligation/regret	2.7 (2.0)	7.9 (2.1)	<.001	2.54	7.0 (2.3)	8.5 (1.7)	<.001	0.74
Regulation of alternatives	4.8 (2.2)	5.9 (3.0)	<.001	0.42	4.5 (2.2)	5.3 (1.9)	<.001	0.39

Note. TPB = theory of planned behavior; *d* = Cohen's effect size.

Table 3-3. Independent correlates of intention formation (n=606) and translation (n=428) from hierarchical forward stepwise logistic regressions

	Model 1			Model 2			Model 3			Model 4		
Variable	OR [95% CI]	*Wald*	*p* value	OR [95% CI]	*Wald*	*p* value	OR [95% CI]	*Wald*	*p* value	OR [95% CI]	*Wald*	*p* value
Intention Formation												
Age	2.24 [1.54-3.24]	18.05	<.001	2.24 [1.54-3.26]	17.82	<.001	2.03 [1.36-3.04]	11.80	.001			
Education	2.26 [1.56-3.27]	18.65	<.001	2.19 [1.51-3.18]	16.98	<.001	2.14 [1.43-3.19]	13.75	<.001			
Symptoms	--	--	--	1.20 [1.06-1.35]	8.66	.003	1.14 [1.00-1.30]	3.80	.051			
Attitude	--	--	--	--	--	--	1.86 [1.54-2.26]	40.03	<.001			
Descriptive norm	--	--	--	--	--	--	1.31 [1.08-1.59]	7.67	.006			
Injunctive norm	--	--	--	--	--	--	1.32 [1.09-1.59]	8.13	.004			
Perceived control	--	--	--	--	--	--	1.53 [1.28-1.84]	20.74	<.001			
	R^2=.101, χ^2=44.39, p<.001			R^2=.119, χ^2=52.97, p<.001			R^2=.271, χ^2=128.03, p<.001					
Intention Translation												
Age	2.98 [1.99-4.45]	28.58	<.001	3.12 [2.07-4.69]	29.58	<.001	3.48 [2.28-5.33]	33.04	<.001	3.03 [2.08-5.26]	25.53	<.001
Sex	1.77 [1.18-2.67]	7.56	.006	1.65 [1.09-2.50]	5.62	.018	1.75 [1.14-2.67]	6.64	.010	1.96 [1.23-3.12]	8.10	.004
Symptoms	--	--	--	1.18 [1.02-1.36]	4.96	.026	1.14 [0.98-1.32]	2.99	.084	1.09 [0.92-1.28]	1.01	.316
Attitude	--	--	--	--	--	--	1.43 [1.11-1.84]	7.60	.006	2.04 [1.51-2.75]	21.81	<.001
Perceived control	--	--	--	--	--	--	1.52 [1.17-1.96]	9.92	.002	1.73 [1.30-2.30]	14.21	<.001
Planning	--	--	--	--	--	--	--	--	--	1.67 [1.32-2.11]	18.30	<.001
Obligation/regret	--	--	--	--	--	--	--	--	--	2.81 [2.04-3.87]	40.27	<.001
Regulation of alternatives	--	--	--	--	--	--	--	--	--	1.59 [1.23-2.07]	12.28	<.001
	R^2=.112, χ^2=37.17, p<.001			R^2=.127, χ^2=42.22, p<.001			R^2=.172, χ^2=58.14, p<.001			R^2=.331, χ^2=120.48, p<.001		

Note. OR = odds ratio, CI = confidence interval. Intention formation regression consisted of three blocks. Intention translation regression consisted of four blocks.

Table 3-supplement. Primary loadings from the exploratory factor analysis revealing the independent motive/behavioral variables.

Survey Items	Factors						
	1	**2**	**3**	**4**	**5**	**6**	**7**
I have plans concerning 'where' I am going to exercise	.94						
I have plans concerning 'what' kind of exercise	.93						
Do you have plans for when, where, and what type of exercise	.93						
I have plans concerning 'when' I am going to engage in exercise	.92						
I have plans concerning 'how' I am going to get to a place to engage in exercise	.87						
I feel it is necessary for me to exercise over the next month		.78					
I feel obligated to do exercise over the next month		.77					
If I do not engage in exercise over the next month, I will feel upset		.76					
If I do not engage in exercise over the next month, I will feel regret		.76					
I feel it is my duty to exercise over the next month		.74					
Regular exercise over the next month would be: enjoyable/unenjoyable			.78				
Regular exercise over the next month would be: fun/boring			.72				
Regular exercise over the next month would be: pleasurable/painful			.65				
Regular exercise over the next month would be: useful/useless			.63				
Regular exercise over the next month would be: important/unimportant			.62				
Regular exercise over the next month would be: beneficial/harmful			.61				
There are other things I could do which would be more enjoyable…				.92			
There are other things I could do which would be more fun…				.91			
There are other things I would be happier doing…				.77			
There are other things I could do which would be more worthwhile…				.69			
Those important to me will participate in exercise: likely/unlikely					.92		
Those important to me will participate in exercise: agree/disagree					.91		
Those important to me will perform: regular exercise/no exercise					.81		
Those important to me would be: supportive/unsupportive						.80	
Those important to me would be: encouraging/discouraging						.79	
Those important to me would be: approving/disapproving						.74	
I have complete control over how much I engage in exercise: very much/ not at all							.87
Engaging in exercise would be completely up to me: agree/disagree							.77
The amount of control I would have to exercise: complete/very little							.61
I have invested a lot of my own money into doing regular aerobic exercise	.33	.38	.14	-.04	.12	.05	.09
Cronbach alpha	**.99**	**.95**	**.92**	**.90**	**.95**	**.95**	**.87**

Note. All items were prefaced to pertain to participating in regular aerobic exercise. Principal axis factoring with varimax rotation. Factor names are as follows: 1 = Planning; 2 = Obligation/regret; 3 = Attitude; 4 = Self-regulation over alternative activities; 5 = Descriptive norm; 6 = Injunctive norm; 7 = Perceived control. Financial investments remained independent from all other factors.

CHAPTER 4: STUDY 1 – PAPER 3

Correlates of meeting the combined and independent aerobic and strength exercise guidelines in hematologic cancer survivors

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4.1 INTRODUCTION

To improve cancer survivors' physical functioning and quality of life [1, 2], the American College of Sports Medicine (ACSM) recommends that survivors accumulate a weekly total of at least 150 minutes of moderate-to-vigorous aerobic exercise (aerobic guideline), and two weekly sessions of strength training that target the major muscle groups (strength guideline) [3]. Complying with this combined guideline serves as the optimal scenario for cancer survivors, as it affords them the unique benefits of both aerobic and strength exercise guidelines (e.g., cardiovascular health, body composition, physical functioning). Thus, understanding the determinants of the combined guideline is critical to the health of cancer survivors.

Previous research on the correlates of exercise has generally reported the correlates of "physical activity," with more recent efforts detailing the correlates separately for aerobic and strength exercise [4, 5]. Crawford and colleagues have recently argued that the correlates of meeting the combined guideline may be different than a single guideline, and different strategies may be needed to motivate individuals to perform the combined guideline if they already meet one guideline or neither [6]. To explore these concepts, researchers need to examine the correlates of aerobic and strength exercise simultaneously. In an important first step, Crawford and colleagues followed this approach using a dataset of demographic and clinical variables, but these variables did not meaningfully distinguish between survivors meeting the combined guideline versus either single guideline [6]; prompting them to suggest that exercise-specific social cognitive variables may better differentiate these groups.

The purpose of the present study is to examine the correlates of meeting the combined and independent exercise guidelines in a population-based sample of hematologic cancer survivors (HCS). In our recent population-based survey of over 600 Albertan HCS, we examined

their aerobic and strength exercise participation and motivations [7, 8], and focused our examination around a theoretical framework (the multi-process action control framework; M-PAC) which explicitly accounts for motivational (e.g., attitude, perceived control), regulatory (e.g., planning), and reflective (e.g., habit, identity) differences that characterize the gap existing between intention and behavior (known as the intention-behavior gap; I-B Gap) [9, 10]. A particular strength of our study was that we assessed M-PAC based variables separately for both aerobic and strength exercise. In line with previous research, however, we reported the prevalence and correlates of aerobic and strength exercise separately. We now believe that a more informative approach would be to consider the correlates of both guidelines simultaneously.

We organized our hypotheses into themes: "traditional" and "novel." Our traditional hypotheses involved comparing demographic, cancer, and M-PAC based variables (i.e., motivational processes, behavioral regulations, and reflective processes) of HCS meeting the three exercise guidelines (combined, aerobic-only, and strength-only) versus neither guideline. Our novel hypotheses involved comparing these same variables between each of the three exercise guidelines. Our traditional hypotheses were that key demographic and cancer-specific variables would differentiate HCS meeting either of the three exercise guidelines versus those meeting neither. Regarding the M-PAC based variables, we made the traditional hypotheses that compared to HCS meeting neither guideline, those meeting the combined or aerobic guidelines would have a more favorable aerobic-specific M-PAC profile, and those meeting the combined or strength guidelines would have a more favorable strength-specific M-PAC profile. In terms of novel hypotheses, we hypothesized that key demographic and cancer-specific variables would also differentiate HCS meeting the combined guidelines versus those meeting the aerobic-only

and strength-only guidelines, and may even distinguish those meeting aerobic-only versus strength-only. We also made the novel hypotheses that those meeting the combined guideline would have a more favorable strength-specific M-PAC profile versus those meeting the aerobic-only guideline, and a more favorable aerobic-specific M-PAC profile versus those meeting the strength-only guideline. Finally, we expected large differences in the aerobic and strength specific M-PAC profiles of those meeting the aerobic-only versus strength-only guideline.

4.2 METHODS

The design and methods of our survey study have been detailed elsewhere [7]. Briefly, ethical approval and informed consent were obtained for all procedures performed in the study. A stratified random sample of 2,100 adult HCS (700 of each leukemia, Hodgkin lymphoma, and non-Hodgkin lymphoma) was contacted by the Alberta Cancer Registry to participate in this study. Data was collected from self-report questionnaires, where participants completed surveys by hand and returned them via post.

Measures

Demographic and cancer-specific variables. Demographic variables included age, sex, marital status, education, employment status, ethnicity, height, and weight. Cancer-specific variables included cancer type, previous treatments, time-since-diagnosis, current treatment status, cancer recurrence, current cancer status (existing disease versus disease-free), comorbidities, and whether participants received an exercise recommendation by one of their healthcare professionals involved in their cancer treatment.

Aerobic and strength exercise behavior. A modified version of the Godin Leisure Time Exercise Questionnaire (GLTEQ) was used to measure exercise behavior [11]. As the original GLTEQ did not separate aerobic and strength exercise, we included separate aerobic and strength

questions. Participants were asked to first indicate the frequency and duration of any light, moderate, and vigorous aerobic exercise (i.e., exercise that improves the heart and lungs such as walking or running), they would have completed in a typical week over the past month. Participants were then asked to indicate the average frequency (days/week) and duration (minutes/session) of any moderate-to-intense strength exercise (i.e., exercise that improves muscular strength such as weight lifting, resistance bands, sit-ups, push-ups) that they performed in a typical week over the past month. Weekly moderate-to-vigorous aerobic minutes were totaled, with vigorous minutes double weighted. Exercise levels were then dichotomized according to their respective guideline (i.e., aerobic: < or ≥ 150 minutes; strength: < or ≥ 2 sessions per week) [3]. Based on this information, we created a composite exercise guideline variable which categorized each HCS as meeting one of the following guidelines: neither, aerobic-only, strength-only, or combined.

Aerobic and strength exercise intention. In line with the M-PAC, the decision to form an exercise intention was measured using two separate dichotomous items, one reflecting an intention to meet the aerobic guideline and the other to meet the strength guideline (i.e., "Do you intend to do regular aerobic/strength exercise over the next month? Yes/No") [12]. The term "regular exercise" was defined to reflect the levels of exercise that would constitute either the aerobic or strength guideline respectively (i.e., aerobic: ≥ 150 weekly minutes; strength: ≥ 2 weekly sessions). Again, we used this information to create another composite variable which categorized each HCS as either having an intention to meet the following guideline: neither, aerobic, strength, or combined.

Motivational processes. All of the following questionnaire items were first asked in relation to aerobic exercise and then repeated for strength exercise in a separate section of the

questionnaire. Standard measures from the theory of planned behavior (TPB) assessed survivors' exercise motivation on a 7-point bipolar Likert scale [13, 14]. Six items captured attitude (e.g., useful-useless, enjoyable-unenjoyable). Three items measured injunctive norm (e.g., "… people who are important to me will be…" encouraging-discouraging), and three items captured descriptive norm (e.g., "… people who are important to me will perform…" regular aerobic/strength exercise-no aerobic/strength exercise). Three items measured perceived control (e.g., "… regular aerobic/strength exercise over the next month would be completely up to me …" strongly agree-disagree).

Behavioral regulations. Five items assessed exercise plans (when, where, and what type) using a 7-point scale (i.e., no plans – detailed plans) [15].

Reflective processes. Two items measured anticipated regret (e.g., "If I do not engage in regular aerobic/strength exercise over the next month, I will feel regret.") on an 11-point scale (i.e., definitely no – definitely yes) [16]. Exercise obligation and regulation over alternative activities were assessed using seven items on a 10-point scale (i.e., completely true for me - not at all true for me) [17]. Three items assessed exercise obligation (e.g., "I feel obligated to do regular aerobic/strength exercise over the next month...") and four items measured self-regulation over alternative competing activities (e.g., "Compared to doing regular aerobic/strength exercise over the next month, there are other things I could do which would be more fun..."). Items for self-regulation over competing alternative activities were reverse scaled so that higher scores would reflect greater self-regulation over competing activities.

Statistical analyses

Factor structures for the motivational, regulatory, and reflective variables are presented elsewhere [7, 8]. Briefly, separate exploratory factor analyses yielded identical seven factor

structures for aerobic- and strength-specific M-PAC based variables (i.e., planning, obligation/regret, attitude, self-regulation over alternatives, descriptive norm, injunctive norm, and perceived control). Attitude, descriptive norm, injunctive norm, perceived control, and planning scores ranged from 1-7, self-regulation over alternatives ranged from 1-10, and obligation/regret scores ranged from 1-10.4 because this factor combined two anticipated regret items (measured on 1-11 scales) and 3 obligation items (measured from 1-10). Descriptive statistics were used to estimate the prevalence of guideline adherence and the magnitude of the I-B gap. Multivariate analyses of variances (MANOVA) and chi-square analyses were used to examine differences in demographic, cancer, and M-PAC based variables between the four levels of guideline adherence. Any demographic or cancer variables that emerged significant in chi-square analyses were entered into a multinomial logistic regression to assess post hoc differences among the four guideline groups. Post hoc pairwise comparisons were conducted to interpret significant between-group differences for the M-PAC based variables.

4.3 RESULTS

Participant flow through the study and characteristics are presented elsewhere [7]. Briefly, 29% of those contacted for this study returned a completed survey (606 / 2100). Excluding return-to-senders and deceased persons yielded a 32% response rate (606/1921). Overall, 186 (31%) participants were leukemia, 187 (31%) Hodgkin lymphoma, and 233 (38%) non-Hodgkin lymphoma survivors. Based on limited data from the cancer registry, responders did not significantly differ from non-responders on age, sex, disease stage, and time since diagnosis, but were more likely to be non-Hodgkin lymphoma survivors ($p < .001$) and to have received chemotherapy ($p = .017$).

Prevalence of HCS intending and meeting the exercise guidelines

Table 4-1 reports the prevalence of intending and meeting the combined and independent exercise guidelines, as well as the I-B gap. Overall, 22% (134 / 606) of HCS met the combined guideline, 22% (133 / 606) met aerobic-only, 10% (58 / 606) met strength-only, and 46% (281 / 606) met neither guideline. In terms of exercise intention, 51% (312 / 606) intended to meet the combined guideline, 19% (116 / 606) the aerobic-only, 7% (41 / 606) the strength-only, and 23% (137 / 606) neither guideline. In terms of the I-B gap, 40% (127 / 312) of HCS with an intention to meet the combined guideline, 44% (51 / 116) with an intention to meet the aerobic-only, 37% (15 / 41) with an intention to meet the strength-only, and 90% (124 / 137) with an intention to meet neither guideline, acted in accordance with their intention.

Correlates of meeting neither, aerobic, strength, or combined guidelines

Results from the chi-square analyses relating demographic and cancer variables to the four guideline categories are reported in **Tables 4-2** and **4-3**. Significant univariate associations emerged for age, education, employment status, number of children living at home, cancer type, cancer status, and comorbidities. When entered into a multinomial logistic regression, only the associations with age ($p = .008$), number of children living at home ($p = .010$), and education ($p < .001$) remained independently significant ($R^2 = .17$, $p < .001$). In terms of M-PAC profiles (**Table 4-4**), the MANOVA revealed significant main effects for each aerobic- and strength-specific motivational, regulatory, and reflective variable (all ps $< .001$).

Traditional comparisons between combined, aerobic, and strength versus neither guideline

The traditional post hoc comparisons of demographic and cancer variables from the multinomial regression are reported in **Table 4-5**. Compared to HCS meeting neither guideline, those meeting the combined guideline were younger and more highly educated; HCS meeting the

aerobic-only guideline were younger; and no demographic or cancer variables distinguished HCS meeting the strength-only guideline. The traditional post hoc comparisons of M-PAC based variables from the MANOVA are reported in **Table 4-6**. Compared to HCS meeting neither guideline, those meeting the combined guideline had significantly more favorable aerobic- and strength-specific M-PAC profile on all measured variables. Those meeting the strength-only guideline also reported significantly greater values on all strength-specific variables versus those meeting neither guideline. HCS meeting the aerobic-only guideline had significantly greater aerobic-specific motivations, regulations, and reflective processes on all variables except for regulation over alternatives.

Novel comparisons among combined, aerobic, and strength guidelines

Table 4-7 reports the novel post hoc comparisons of demographic and cancer variables between the different guidelines from the multinomial regression. HCS were more likely to meet the combined guideline over the aerobic-only guideline if they had no children living at home. They were also more likely to meet the combined guideline over both the aerobic and strength-only guidelines if they had completed university. HCS with no children living at home were more likely to meet the strength-only guideline over the aerobic-only guideline. **Table 4-8** reports the novel post hoc comparisons of M-PAC based variables between the different guidelines from the MANOVA. HCS meeting the combined guideline reported significantly more favorable strength-specific scores than those meeting the aerobic guideline, and more favorable aerobic-specific scores than those meeting the strength guideline, on all motivations, regulations, and reflective processes. Aerobic-specific attitude, perceived control, obligation/regret, and regulation over alternatives were favored by HCS meeting the aerobic versus strength-only guideline. Strength-specific attitude, planning, obligation/regret, and

regulation over alternatives were favored by HCS meeting the strength versus aerobic-only guideline. Finally, HCS meeting the combined guidelines reported significantly more favorable strength-specific perceived control, planning, and obligation/regret than those meeting the strength guideline, and more favorable aerobic-specific perceived control, planning, obligation/regret, and regulation over alternatives than those meeting the aerobic guideline.

4.4 DISCUSSION

The purpose of this investigation was to estimate how many HCS met the combined, aerobic-only, strength-only, and neither exercise guideline, and to examine what differentiates these four exercise groups. We previously reported in our two separate papers that 44% of HCS met the aerobic and 32% met the strength guideline [7, 8]. Our new results demonstrate that only 22% of HCS in our sample met the combined guidelines, 22% aerobic, 10% strength, and 46% neither guideline. These current results address a key limitation of our prior findings, and other studies examining aerobic and strength exercise separately, by accounting for the contamination that exists in a binary grouping scheme. For example, when examining the correlates of meeting the aerobic guideline separately, some of those categorized as meeting the aerobic guideline were in fact meeting the combined guideline, and some of those categorized as not meeting the aerobic guideline were in fact meeting the strength guideline. Thus, categorizing exercise guideline adherence into four categories avoids such confound, which also has implications for quantifying the I-B gap.

Specifically, the current investigation highlights that only about 40% of HCS who intended to meet either the aerobic, strength, or combined guideline followed-through on their intention, whereas our previous separate reports indicated that 60% of HCS successfully translated their aerobic exercise intention and 50% realized their strength exercise intention [7,

8]. Not only do we contend that the current results depict a more accurate illustration of the true I-B gap for HCS, but noting that almost no survivors (2%) met the combined guideline without an intention to do so, supports a common criticism of the intention construct: that an intention is necessary but rarely dictates behavior alone [18-20]. Furthermore, HCS who intended to meet the combined guideline, rather than just the aerobic or strength guideline, were more likely to meet at least one of these exercise guidelines. So, it appears that a necessary first step towards helping survivors meet the combined guideline is to aid their formation of an intention to do both regular aerobic and strength exercise. Examining this data further, we see that HCS were twice as likely to fall short of their goal to meet the combined guideline because they failed to do enough strength exercise (24%) versus failing to meet the aerobic requirement (12%).

As expected, our results provided overall support for the traditional hypotheses that HCS meeting the combined, aerobic, or strength guideline would differ on key demographic, cancer, and M-PAC based variables, versus those meeting neither guideline. As commonly found in the general literature, age and education were important correlates of exercise versus no exercise [21]. Specifically, age and education status differentiated HCS meeting the combined guideline from those meeting neither, and education differentiated HCS meeting the aerobic-only guideline from those meeting neither. Interestingly, no demographic or cancer variables distinguished HCS meeting the strength guideline from those meeting neither guideline, which may suggest that M-PAC based variables may be of greater importance for driving strength exercise behavior [7]. In terms of M-PAC profile differences, compared to HCS meeting neither guideline, those meeting the combined guideline had more favorable aerobic- and strength-specific M-PAC profiles, and those meeting the strength guidelines reported an overall more favorable strength-specific profile. Interestingly, HCS meeting the aerobic guideline reported a similar trend for aerobic-

specific M-PAC based variables, however, their reported level self-regulation over alternative activities did not differ significantly from those meeting neither guideline. We speculate that this may reflect a unique facet of aerobic exercise which allows individuals to multi-task while participating. So, sacrificing one's involvement in competing activities (e.g., television watching) in order to exercise may not be required if multiple aims can be pursued simultaneously [22].

Our novel hypotheses compared HCS meeting the combined guideline, the aerobic-only guideline, and the strength-only guideline. HCS who completed university were twice as likely to meet the combined guideline over the aerobic-only guideline and three times as likely over the strength-only guideline. Thus, completing university may be associated with a greater awareness of the benefits of doing both regular aerobic and strength exercise, or may relate to better access to necessary resources (i.e., equipment, facilities) [21, 23]. Furthermore, HCS with no children living at home were significantly more likely to meet the combined guideline (two times) and strength-only guideline (three times) than the aerobic-only guideline. Exercise correlates research suggests that not having to care for dependents at home may alleviate some exercise-related time constraints [24, 25], but why this is more important for doing strength exercise over aerobic is unclear, especially when considering that the strength guideline can be satisfied in less overall time than the aerobic guideline.

As hypothesized, HCS meeting the combined guideline reported more favorable ratings on all strength-specific M-PAC based variables than those meeting the aerobic-only guideline, and the same was true when comparing all aerobic-specific variables versus those meeting the strength guideline. The most intriguing finding from our novel comparisons, however, is that HCS meeting the combined guidelines reported significantly greater aerobic-specific ratings of

perceived control, planning, and obligation/regret than those meeting the aerobic-only guideline. Furthermore, this identical trend resulted for strength-specific¬ ratings versus those meeting the strength-only guideline. Thus, these results suggest that efforts targeted towards helping HCS meet the combined guideline when already adhering to one guideline should focus on promoting both exercise modalities and not just the one in which they are deficient. For example, significant improvements in aerobic-specific perceived control, regulations, and reflective processes may help HCS meet the combined guideline, even if they already meet the aerobic guideline. Thus, we may need to reconsider the intuitive approach of only promoting the motivations, regulations, and reflective processes for the "deficient guideline," and consider the additional need to promote (or "top-up") the currently "performed guideline." Altogether, these results speak to the overall benefit of using action control models (such as the M-PAC) [26], as the majority of the differentiating features between HCS meeting the combined guideline versus either singular guideline were behavioral regulations and reflective processes that are not typically captured in more traditional models (such as the TPB) [27].

Our study has important strengths and limitations. The strengths of our study include being one of the few to quantify adherence to the four categories of the exercise guidelines, the first to examine the I-B gap and M-PAC correlates in such a context, one of the few to examine the correlates of exercise in HCS, the large population-based sample of HCS, and the validated measures for social cognitive variables specific to both aerobic and strength exercise. The limitations of this study include a potential self-selection sample bias, the use of self-report measures of exercise, the cross-sectional design, and not measuring additional potentially important variables.

Our sample may have been biased due to self-selection. Though the HCS who completed the survey were not significantly different than non-respondents in age, sex, disease stage, and time since diagnosis, they likely had more favorable exercise-specific M-PAC profiles, as well as higher rates of exercise intention and participation. These biases may not only have affected our estimates of the prevalence of exercise intentions and behavior but also their associations with the correlates of meeting the exercise guidelines. Therefore, it is unclear if our findings generalize to the broader population of less motivated and active HCS. The use of self-reported measures could be influenced by recall and reporting biases which may have prompted participants to over-report their actual levels of exercise participation and motivation. Furthermore, to date, no validated or sufficiently detailed self-report measure of strength exercise exists, and we are therefore unable to comment on the quality of participants' strength training programs. By employing a cross-sectional design, we were unable to examine the causal sequencing or hierarchy of variables in relation to participants' exercise levels. Finally, our survey did not assess other potentially important variables such as participants' knowledge of the exercise guidelines, their exercise history before diagnosis, and exercise habits. These variables could influence the likelihood of HCS meeting the exercise guidelines and could have been used to additionally discern whether survivors were recent exercise adopters or long-term maintainers.

4.5 CONCLUSIONS

In conclusion, we took a novel approach to examining the correlates of exercise behavior by simultaneously analyzing the aerobic and strength exercise guidelines. Our results revealed that 22% of HCS met the combined exercise guideline, 22% aerobic-only, 10% strength-only, and 46% met neither guideline. Having no children living at home and more formal education emerged as important correlates of meeting the combined over the aerobic- or strength-only

guideline. HCS meeting the combined guideline also reported more favorable ratings on all strength-specific M-PAC based variables than those meeting the aerobic-only guideline, and all aerobic-specific variables than those meeting the strength guideline. To help HCS meet the combined guidelines, it appears important to promote increased motivations, regulations, and reflective processes for both types of exercise including the exercise guideline that they are already meeting. These results may be helpful for designing health-promotion interventions aimed at helping HCS meet the aerobic and strength guidelines, thereby optimizing health outcomes.

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Table 4-1. The intention-behavior relationship for meeting neither, aerobic-only, strength-only, or combined exercise guidelines.

	Behavior			
Intention	Neither (n=281)	Aerobic (n=133)	Strength (n=58)	Combined (n=134)
Neither (n=137)	124 (90%)	8 (6%)	4 (3%)	1 (1%)
Aerobic-only (n=116)	59 (51%)	51 (44%)	2 (2%)	4 (3%)
Strength-only (n=41)	24 (58%)	0 (0%)	15 (37%)	2 (5%)
Combined (n=312)	74 (24%)	74 (24%)	37 (12%)	127 (40%)

Table 4-2. Demographic profile of survivors meeting neither, aerobic-only, strength-only, or combined exercise guidelines.

Variable	Neither (n=281)	Aerobic (n=133)	Strength (n=58)	Combined (n=134)	*p* value
Age					<.001
< 60 years	99 (33%)	84 (28%)	28 (9%)	92 (30%)	
≥ 60 years	182 (60%)	49 (16%)	30 (10%)	42 (14%)	
Gender					.22
Female	147 (43%)	81 (24%)	31 (9%)	82 (24%)	
Male	134 (51%)	52 (20%)	27 (10%)	52 (20%)	
Body Mass Index					.14
Normal weight	96 (43%)	50 (23%)	19 (9%)	56 (25%)	
Overweight	106 (43%)	57 (23%)	25 (10%)	57 (23%)	
Obese	79 (56%)	26 (19%)	14 (10%)	21 (15%)	
Marital status					.46
Not married	80 (45%)	36 (20%)	22 (12%)	41 (23%)	
Married	201 (47%)	97 (23%)	36 (8%)	93 (22%)	
Children living at home					<.001
None	222 (49%)	82 (18%)	49 (11%)	97 (22%)	
One or more	59 (38%)	51 (33%)	9 (6%)	37 (24%)	
Education					<.001
University not completed	159 (54%)	60 (20%)	36 (12%)	40 (14%)	
Completed university	122 (39%)	73 (24%)	22 (7%)	94 (30%)	
Employment status					<.001
Not retired	144 (38%)	91 (24%)	35 (9%)	105 (28%)	
Retired	137 (59%)	42 (18%)	23 (10%)	29 (13%)	
Ethnicity					.14
White	267 (48%)	123 (22%)	53 (9%)	119 (21%)	
Other	14 (32%)	10 (23%)	5 (11%)	15 (34%)	

Table 4-3. Cancer-specific profile of survivors meeting neither, aerobic-only, strength-only, or combined exercise guidelines.

Variable	Neither (n=281)	Aerobic (n=133)	Strength (n=58)	Combined (n=134)	*p* value
Cancer type					.008
Leukemia	96 (52%)	37 (20%)	17 (9%)	36 (19%)	
Hodgkin lymphoma	64 (34%)	47 (25%)	21 (11%)	55 (29%)	
non-Hodgkin lymphoma	121 (52%)	49 (21%)	20 (9%)	43 (19%)	
Time since diagnosis					.11
< 2 years	53 (46%)	19 (16%)	17 (15%)	27 (23%)	
2-5 years	137 (45%)	78 (26%)	21 (7%)	68 (22%)	
> 5 years	91 (49%)	36 (19%)	20 (11%)	39 (21%)	
Radiation					.27
No	196 (49%)	83 (21%)	38 (9%)	82 (21%)	
Yes	85 (41%)	50 (24%)	20 (10%)	52 (25%)	
Chemotherapy					.64
No	81 (47%)	38 (22%)	20 (12%)	34 (20%)	
Yes	200 (46%)	95 (22%)	38 (9%)	100 (23%)	
Stem cell transplant					.35
No	255 (47%)	121 (22%)	50 (9%)	115 (21%)	
Yes	26 (40%)	12 (19%)	8 (12%)	19 (29%)	
Treatment status					.13
Receiving treatments	99 (51%)	38 (20%)	22 (11%)	34 (18%)	
Completed treatments	182 (44%)	95 (23%)	36 (9%)	100 (24%)	
Recurrence					.88
No	242 (46%)	113 (22%)	54 (10%)	118 (23%)	
Yes	39 (48%)	20 (24%)	7 (9%)	16 (20%)	
Current cancer status					.007
Disease free	156 (42%)	88 (24%)	32 (9%)	96 (26%)	
Existing disease	125 (53%)	45 (19%)	26 (11%)	38 (16%)	
Comorbidities					<.001
None	72 (33%)	56 (25%)	25 (11%)	68 (31%)	
One	61 (40%)	42 (28%)	12 (8%)	36 (24%)	
Two or more	148 (63%)	35 (15%)	21 (9%)	30 (13%)	
Exercise recommendation					.07
No	185 (49%)	86 (23%)	36 (10%)	69 (18%)	
Yes	96 (42%)	47 (20%)	22 (10%)	65 (28%)	

Table 4-4. Motivations, regulations, and reflective processes of survivors meeting neither, aerobic-only, strength-only, or combined exercise guidelines.

Variable	Neither (n=281)	Aerobic (n=133)	Strength (n=58)	Combined (n=134)
Motivational Processes				
Attitude				
Aerobic	4.8 (1.4)	5.8 (0.8)	5.1 (1.3)	6.1 (0.7)
Strength	4.4 (1.5)	5.0 (1.2)	5.6 (1.1)	6.0 (0.7)
Injunctive norm				
Aerobic	5.5 (1.4)	6.1 (1.1)	5.7 (1.3)	6.3 (0.7)
Strength	5.2 (1.6)	5.5 (1.4)	5.7 (1.4)	6.1 (0.9)
Descriptive norm				
Aerobic	4.2 (1.8)	4.9 (1.5)	4.6 (1.8)	5.1 (1.5)
Strength	3.6 (1.8)	3.9 (1.9)	4.3 (1.8)	4.3 (1.7)
Perceived Control				
Aerobic	5.1 (1.8)	6.0 (1.1)	5.5 (1.4)	6.5 (0.6)
Strength	5.1 (1.9)	5.7 (1.5)	5.8 (1.2)	6.3 (0.9)
Behavioral Regulations				
Planning				
Aerobic	2.3 (1.9)	3.4 (2.2)	4.5 (1.9)	5.4 (1.5)
Strength	2.4 (1.9)	3.5 (2.3)	4.7 (2.1)	5.6 (1.6)
Reflective Processes				
Obligation/Regret				
Aerobic	4.6 (3.0)	7.9 (2.1)	5.5 (3.0)	8.7 (1.7)
Strength	3.9 (3.0)	5.0 (3.0)	6.8 (2.7)	8.0 (2.3)
Regulation of alternatives				
Aerobic	5.5 (2.6)	6.0 (2.4)	5.1 (2.2)	6.8 (2.3)
Strength	4.4 (2.6)	4.2 (2.4)	5.7 (2.0)	6.2 (2.4)

Note. Standard deviations are presented in brackets. Post hoc comparisons are made between meeting the different guidelines. Attitudes, injunctive norms, descriptive norms, perceived control, and planning ranged from 1-7, obligation/regret ranged from 1-10.4, and regulation of alternatives ranged from 1-10.

Table 4-5. Multinomial regression of demographic and cancer-specific correlates comparing combined, aerobic-only, and strength-only guidelines versus neither.

	Combined vs Neither		Aerobic vs Neither		Strength vs Neither	
Variable	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Age						
< 60 years vs ≥ 60 years	2.3 (1.2 – 4.4)	.010	2.6 (1.4 – 4.9)	.004	1.5 (0.7 – 3.4)	.35
Children living at home						
None vs. One or more	1.5 (0.9 – 2.7)	.12	0.7 (0.4 – 1.2)	.17	2.1 (0.9 - 4.9)	.07
Education						
University completed vs. not completed	2.8 (1.7 – 4.4)	<.001	1.4 (0.9 – 2.1)	.16	0.8 (0.4 – 1.5)	.46
Employment status						
Not retired vs. Retired	1.4 (0.7 – 2.7)	.30	0.8 (0.4 – 1.5)	.49	1.1 (0.5 – 2.4)	.82
Cancer type						
Leukemia & non-Hodgkin lymphoma vs. Hodgkin lymphoma	1.4 (0.8 – 2.3)	.22	1.3 (0.8 – 2.1)	.38	1.8 (0.9 – 3.6)	.09
Current cancer status						
Disease free vs. Existing disease	1.2 (0.7 – 2.0)	.44	1.1 (0.7 – 1.8)	.62	0.7 (0.4 – 1.3)	.22
Comorbidities						
None vs. one or more	1.8 (1.1 – 2.9)	.028	1.3 (0.8 – 2.1)	.33	2.0 (0.9 – 3.8)	.05

Note. OR = odds ratio, CI = confidence interval. All comparisons are in reference to the second listed group in each dyad.

Table 4-6. Pairwise comparisons of exercise-specific motivations, regulations, and reflective processes versus neither guideline.

Variable	Combined vs Neither	Aerobic vs Neither	Strength vs Neither
Motivational Processes			
Attitude			
Aerobic	***p* < .001, *d* = 1.17**	***p* < .001, d = 0.88**	*p* = .026, *d* = 0.22
Strength	***p* < .001, d = 1.37**	*p* < .001, *d* = 0.44	***p* < .001, *d* = 0.91**
Injunctive norm			
Aerobic	***p* < .001, *d* = 0.72**	***p* < .001, d = 0.48**	*p* = .27, *d* = 0.15
Strength	***p* < .001, d = 0.69**	*p* = .05, *d* = 0.20	***p* = .012, *d* = 0.33**
Descriptive norm			
Aerobic	***p* < .001, *d* = 0.54**	***p* < .001, d = 0.42**	*p* = .11, *d* = 0.22
Strength	***p* < .001, d = 0. 40**	*p* = .08, *d* = 0.16	***p* = .006, *d* = 0.39**
Perceived Control			
Aerobic	***p* < .001, *d* = 1.04**	***p* < .001, d = 0.60**	*p* = .07, *d* = 0.24
Strength	***p* < .001, d = 0.81**	*p* < .001, *d* = 0.35	***p* = .001, *d* = 0.44**
Behavioral Regulations			
Planning			
Aerobic	***p* < .001, *d* = 1.81**	***p* < .001, d = 0.54**	*p* < .001, *d* = 1.16
Strength	***p* < .001, d = 1.82**	*p* < .001, *d* = 0.52	***p* < .001, *d* = 1.15**
Reflective Processes			
Obligation/Regret			
Aerobic	***p* < .001, *d* = 1.68**	***p* < .001, d = 1.27**	*p* = .021, *d* = 0.30
Strength	***p* < .001, d = 1.53**	*p* < .001, *d* = 0.37	***p* < .001, *d* = 1.02**
Regulation of alternatives			
Aerobic	***p* < .001, *d* = 0.53**	***p* = .07, d = 0.20**	*p* = .19, *d* = 0.17
Strength	***p* < .001, d = 0.72**	*p* = .29, *d* = 0.08	***p* < .001, *d* = 0.56**

Note. Hypothesized comparisons are bolded.

Table 4-7. Multinomial regression comparing the demographic and cancer-specific correlates between the combined, aerobic-only, and strength-only guidelines.

	Combined vs Aerobic		Combined vs Strength		Strength vs Aerobic	
Variable	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Age						
< 60 years vs ≥ 60 years	0.8 (0.4 – 1.9)	.79	1.6 (0.6 - 3.9)	.35	0.6 (0.2 – 1.5)	.25
Children living at home						
None vs. One or more	2.2 (1.2 - 3.9)	.006	0.7 (0.3 – 1.7)	.46	3.1 (1.3 – 7.2)	.010
Education						
University completed vs. not completed	2.0 (1.2 – 3.4)	.008	3.4 (1.7 – 6.6)	<.001	0.6 (0.3 – 1.1)	.11
Employment status						
Not retired vs. Retired	1.7 (0.8 – 3.8)	.16	1.3 (0.5 – 3.2)	.60	1.4 (0.6 – 3.4)	.50
Cancer type						
Leukemia & non-Hodgkin lymphoma vs. Hodgkin lymphoma	1.1 (0.6 – 1.9)	.74	0.8 (0.4 – 1.6)	.47	1.4 (0.7 – 3.0)	.33
Current cancer status						
Disease free vs. Existing disease	1.1 (0.6 – 1.9)	.78	1.8 (0.9 – 3.8)	.10	0.6 (0.3 – 1.2)	.15
Comorbidities						
None vs. one or more	1.4 (0.8 – 2.4)	.27	0.9 (0.4 -1.9)	.78	1.5 (0.7 – 3.1)	.26

Note. OR = odds ratio, CI = confidence interval. All comparisons are in reference to the second listed group in each dyad.

Table 4-8. Pairwise comparisons of exercise-specific motivations, regulations, and reflective processes, between combined, aerobic-only, and strength-only guidelines.

Variable	Combined vs Aerobic	Combined vs Strength	Aerobic vs Strength
Motivational Processes			
Attitude			
Aerobic	$p = .07$, $d = 0.35$	**$p < .001$, d = 0.90**	**$p < .001$, $d = 0.63$**[a]
Strength	**$p < .001$, d = 0.98**	$p = .05$, $d = 0.41$	**$p = .004$, $d = 0.50$**[b]
Injunctive norm			
Aerobic	$p = .15$, $d = 0.24$	**$p = .002$, d = 0.57**	**$p = .05$, $d = 0.32$**[a]
Strength	**$p < .001$, d = 0.53**	$p = .07$, $d = 0.35$	**$p = .31$, $d = 0.16$**[b]
Descriptive norm			
Aerobic	$p = .25$, $d = 0.16$	**$p = .042$, d = 0.32**	**$p = .26$, $d = 0.18$**[a]
Strength	**$p = .05$, d = 0. 24**	$p = .89$, $d = 0.02$	**$p = .17$, $d = 0.21$**[b]
Perceived Control			
Aerobic	$p = .010$, $d = 0.50$	**$p < .001$, d = 0.92**	**$p = .012$, $d = 0.44$**[a]
Strength	**$p < .001$, d = 0.56**	$p = .042$, $d = 0.49$	**$p = .48$, $d = 0.13$**[b]
Behavioral Regulations			
Planning			
Aerobic	$p < .001$, $d = 1.02$	**$p = .005$, d = 0.49**	**$p < .001$, $d = 0.52$**[b]
Strength	**$p < .001$, d = 1.06**	$p = .003$, $d = 0.50$	**$p < .001$, $d = 0.54$**[b]
Reflective Processes			
Obligation/Regret			
Aerobic	$p = .013$, $d = 0.42$	**$p < .001$, d = 1.30**	**$p < .001$, $d = 0.93$**[a]
Strength	**$p < .001$, d = 1.10**	$p = .011$, $d = 0.45$	**$p < .001$, $d = 0.62$**[b]
Regulation of alternatives			
Aerobic	$p = .012$, $d = 0.33$	**$p < .001$, d = 0.75**	**$p = .016$, $d = 0.40$**[a]
Strength	**$p < .001$, d = 0.86**	$p = .18$, $d = 0.23$	**$p < .001$, $d = 0.70$**[b]

Note. [a] = comparisons favoring the aerobic-only guideline group, [b] = comparisons favoring the strength-only group. Hypothesized comparisons are bolded.

CHAPTER 5: STUDY 2 – PAPER 4

Feasibility and preliminary efficacy of an exercise telephone counselling intervention for hematologic cancer survivors: A phase II randomized controlled trial

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5.1 INTRODUCTION

Aerobic exercise improves physical functioning, quality of life (QoL), fatigue, and possibly even survival for many cancer survivor groups including hematologic cancer survivors (HCS) [1-3]. Many HCS, however, are not sufficiently active to gain these benefits [4-6]. For example, population-based studies in non-Hodgkin lymphoma survivors have estimated that about one in four (25%) non-Hodgkin lymphoma survivors meet the aerobic exercise guideline [4, 5]. A more recent population-based survey which assessed both aerobic and strength exercise, revealed that 22% of HCS met the combined exercise guideline, 22% met aerobic-only, 10% met strength-only, and 46% met neither exercise guideline [6]. Although supervised exercise interventions produce the best health outcomes [7-9], their scalability has been questioned [10-12]. Conversely, evidence suggests that static modes of intervention delivery that rely on one-way communication (e.g., print-material or automated messaging) produce minimal or modest changes in exercise behavior and rarely improve QoL [13-17].

Telephone counselling has been proposed as a compromise intervention modality that is cost-effective but still allows for important program tailoring through dynamic interaction with participants [18-20]. To date, telephone counselling has been effective in increasing exercise behavior in cancer survivors [12, 19], however, its effects have been modest and have rarely translated into improved patient-reported outcomes [21-31]. One possible explanation for the modest effects of previous telephone counselling exercise (TCE) interventions may be the theoretical focus of the counselling.

Behavioral support interventions (BSIs) usually aim to influence exercise behavior by promoting changes in theory-based psychosocial and behavioral constructs [32-35]. Many theoretical models, however, emphasize constructs that are primarily focused on intention

formation [36]. Though necessary, exercise intentions alone are often insufficient to produce exercise behavior change, as only about half of those who intend to exercise actually follow through [6, 37]. Moreover, the utility of intention-focused interventions is even further questioned for passive recruitment interventions, where virtually all participants coming forward for the intervention have probably already formed an intention to exercise [38]. Thus, focusing on psychosocial and behavioral constructs proposed to reduce the intention-behavior gap (I-B gap) may be a more effective strategy for increasing behavior [39].

Compared to many intention-focused theories, the multi-process action control (M-PAC) framework recognizes the I-B gap, and hinges its theoretical postulations on the determinants of intention formation and its translation into behavior [40]. Specifically, the M-PAC notes that initiating motivational processes (i.e., instrumental attitude and perceived capability) influence the development of behavioral intentions, and that ongoing motivational processes (i.e., affective attitude and perceived opportunity), behavioral regulations (action planning, coping planning, self-monitoring, social support), and reflexive processes (habit, identity, obligation/anticipated regret, regulation of alternatives) help translate intentions into behavior. Though support for the M-PAC had been documented in the context of family physical activity, daily dog walking, and adult gym-based exercise [41-45], the utility of the M-PAC for quantifying and explaining exercise I-B gap in cancer survivors had yet to be explored.

Our recent survey-based study of 606 HCS was the first formal examination of the exercise I-B gap in cancer survivors [6, 46, 47]. Guided by the M-PAC, our results showed that 56% of HCS were not meeting aerobic exercise guidelines despite 70% reporting an intention to do so [6]. As such, 40% of those with an intention to do aerobic exercise failed to translate it into behavior [47]. Results suggested that having a favourable attitude and perceived control

(motivational processes) aided survivors in forming an exercise intention, whereas having an especially favorable attitude and perceived control, a detailed plan (behavioral regulation), sense of obligation/anticipated regret, and being able to self-regulate the attractiveness of other competing activities (reflexive processes), helped significantly improve intention translation into exercise behavior. This investigation suggested the potential utility of these psychosocial and behavioral variables in helping HCS form and translate an exercise intention into behavior.

The primary objectives of this pilot study were to assess the feasibility and preliminary efficacy of a TCE intervention based on the M-PAC model for increasing aerobic exercise behavior in HCS. We hypothesized that the intervention would result in a significant increase in exercise behavior compared to a self-directed exercise (SDE) group. A secondary purpose was to examine the effects of the intervention on QoL and fatigue. We hypothesized that the change in exercise behavior in the intervention group would be substantial enough to improve QoL and fatigue and would mediate the effects of the intervention on these patient-reported outcomes.

5.2 METHODS

This study was a phase II, two-armed randomized controlled trial assessing the feasibility and preliminary efficacy of TCE compared to SDE for increasing aerobic exercise behavior, QoL, and fatigue in HCS.

Participants

We recruited from a sample of 407 Albertan HCS who previously participated in a survey study and indicated interest in future research participation [46]. Recruitment efforts were carried out via post, email, and telephone. Survivors who had a histologically confirmed hematologic cancer (leukemia, non-Hodgkin lymphoma, Hodgkin lymphoma), were between 18-80 years of age, living in Alberta, could speak and comprehend English, and were willing to

participate in a 12-week exercise telephone counselling intervention were eligible. Potential participants were excluded if they suffered from any chronic medical condition that would preclude them from increasing their aerobic exercise, were planning on being away from home for more than 2 weeks during the intervention, or reported baseline exercise levels of ≥240 weekly minutes of aerobic exercise (calculated as moderate minutes + 2 times vigorous minutes). We selected this exercise behavior cut point for eligibility because the behavioral goal of our intervention was for HCS to increase their aerobic exercise by ≥60 minutes/week which would take them to the optimal exercise dose of 300 weekly minutes beyond which there may be few additional benefits but higher risks of injury and drop-out [48, 49].

Randomization and blinding

After baseline assessments, eligible participants were randomized in a 1:1 ratio to either the TCE or the SDE group by a research assistant not otherwise involved in the trial, using a computer-generated allocation sequence. Randomization occurred via rolling variable blocks of 4-6 and was stratified based on baseline exercise levels (< or ≥ 150 weekly aerobic minutes). Participants were notified of their group allocation via email and phone.

Control condition

Participants in both groups received a copy of Canada's Physical Activity Guideline [50] and were provided the goal of increasing their aerobic exercise levels by at least 60 minutes/week up to a maximum recommendation of 300 minutes of weekly moderate-to-vigorous aerobic exercise. Participants randomized to the SDE group received no other intervention.

Intervention condition

In addition to receiving the same information and instructions (i.e., physical activity guide + exercise goal) as those in the SDE group, participants randomized to the TCE group received 12 weekly telephone counselling sessions. These calls occurred in two phases, where the first 8 calls focused on specific topics (see **Table 5-supplement**) derived from our prior work in HCS that was guided by the M-PAC [6, 47] and the exercise behavior change intervention from the CHALLENGE Trial [51-53]. Two of these sessions targeted M-PAC's motivational processes (perceived capability/opportunity, instrumental/affective attitudes), three sessions targeted behavioral regulations (action planning, coping planning, self-monitoring), and three sessions targeted reflexive processing (obligation/regret, self-regulation over alternatives, habit). Specifically, perceived capability and opportunity were targeted by providing examples of how to progress their exercise safely (i.e., when, how, and by how much to increase) and by brainstorming different avenues available for increasing their weekly aerobic exercise (e.g., walking, group fitness). Instrumental and affective attitudes were targeted by discussing the pertinent benefits of exercise to HCS (e.g., improve fitness, energy, relieve stress) and by eliciting different means of making exercise fun (e.g., with friends, listen to music, add variety). A session on creating detailed action plans had participants consider the "what, where, how, when, and with whom" relating to their exercise for each day of the week. Participants were sent a copy of their action plan via email after the session for their own record. Coping planning was targeted by discussing potential exercise barriers (e.g., fatigue, time, motivation) and strategies for overcoming each. To promote self-monitoring, participants received a session on how to use exercise logs to effectively track their own exercise on a daily basis. A template exercise log was sent to participants via email prior to this session to facilitate the discussion on effective exercise

monitoring. Exercise obligation was targeted through a goal-setting session where participants set challenging exercise goals and were encouraged to make these goals publicly known and to consider potential self-rewards for their accomplishments. Participants were sent a copy of their exercise goals via email after the session for their own record. Fostering self-regulation over alternative activities was targeted by having participants list the pros and cons of participating in exercise versus competing activities, and ranking these activities by priority, through a "decision-balance" activity. To help participants form exercise habits we provided a session on the utility of cue-based reminders and importance for streamlining their exercise, which discussed strategies to make their exercise preparation easier, quicker, and more routinized (e.g., keep a gym bag packed and visible, schedule phone reminders, schedule exercise around regularly occurring activities such as meals). The last 4 sessions (i.e., phase 2) served as "booster sessions," where participants were free to raise any challenges to their exercise at that time or to revisit any pertinent exercise topics previously discussed. We did not counsel on psychosocial issues, symptom management, or life goals in the TCE sessions. We anticipated that each call would take between 15-30 minutes, and recognized that the 4 booster sessions could be shorter in duration if participants were meeting their exercise goal that week. Each TCE session was administered in a semi-structured fashion in order to maintain a participant-oriented approach, and was led by a single research coordinator with experience in providing these behavioral counselling sessions in cancer survivors.

Measures

Online assessments were conducted for all participants at baseline (week 0) and post-intervention (week 13). Weekly TCE sessions for participants in the intervention group occurred during weeks 1-12.

Demographic and cancer-specific variables. All measures were self-reported. Demographic variables included age, gender, marital status, education, employment status, ethnicity, height, and weight. Cancer-specific variables included date of diagnosis, type of cancer, disease stage, previous treatments, current treatment status, cancer recurrence, and current cancer status (existing disease/not cured of their disease versus disease-free/no cancer).

Feasibility metrics. Feasibility was determined via recruitment, adherence, adverse-events, retention, follow-up, and acceptability metrics. Trial recruitment was assessed by the number of HCS who responded to our invitation to participate in the current trial, and by the number of these interested HCS who met the eligibility criteria. Intervention adherence was based on the number of TCE sessions each participant received (out of a possible 12 sessions). Trial retention was determined by the proportion of participants who completed the full 12-week intervention and did not withdraw from the trial. Follow-up was determined by the proportion of participants completing both pre- and post-intervention questionnaires. Intervention acceptability was assessed by TCE participants through a program satisfaction questionnaire.

Program satisfaction. Participants in the TCE group were asked to report their overall satisfaction with the intervention on 6 survey items on a 7-point scale (absolutely satisfied-unsatisfied). One additional item asked participants to rate the extent to which the information they received from the intervention was new to them, and this was rated on a 4-point scale (not at all – quite a bit yes). Eight additional items rated on a 7-point scale (absolutely useful-useless) allowed participants to rate the utility all specific topics covered in the TCE program. Finally, four questions asked participants to comment on their preferences for the duration of the intervention, frequency of calls, duration of calls, and mode of intervention delivery.

Exercise behavior. The primary efficacy outcome was self-reported minutes of moderate-to-vigorous aerobic exercise assessed by a modified version of the Leisure Score Index from the Godin Leisure Time Exercise Questionnaire (GLTEQ) [54]. The GLTEQ is one of the most commonly applied exercise measures [55, 56] and has shown acceptable convergent validity when compared to accelerometer based activity measures [56]. 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 aerobic exercise they performed in a typical week over the past month. To calculate "exercise minutes" in line with physical activity guidelines for cancer survivors [48, 49], vigorous intensity aerobic exercise minutes were double weighted and added to moderate intensity aerobic exercise minutes.

Quality of life. QoL was assessed via the Short-Form 36 (SF-36) questionnaire [57]. The SF-36 contains eight, multi-item, subscales that reflect constructs on physical functioning, health-related role limitations, bodily pain, general health perceptions, vitality, social functioning, emotional-related role limitations, and mental health. These subscales are translated into a scoring scheme that ranges from 0-100, and are then used to create norm-based scores centered around a mean of 50 and standard deviation of 10. The physical and mental health component summary scores were computed using factor score weighting of the physical functioning, role physical, bodily pain, general health vitality, social functioning, role emotional, and mental health subscales [57].

Fatigue. Self-reported fatigue was assessed via the FACT-F questionnaire [58]. This 13-item scale asked participants to report their level of tiredness and fatigue on a 5-point scale, ranging from "4 / not at all," to "0 / very much." Items are prefaced for participants to recall and

reflect on the past seven days. Two sample items are: “I feel fatigued,” and “I have trouble finishing things because I am tired.” Items are summed and total scores range from 0 to 52, where higher scores correspond to a lower burden of fatigue.

Statistical analyses

To examine the self-selection bias for study participation, we used chi-square analyses to compare demographic, cancer, and behavioral data collected in 2014 as part of our prior investigation in HCS [46] for participants who were not interested in future research participation, those who were interested in future research but declined participating in the current trial, and those who agreed to participate in the current trial. The intervention effect on exercise behavior was assessed using an analysis of covariance (ANCOVA), where the dependent variable was post-intervention exercise behavior, the independent variable was their group assignment (i.e., TCE versus SDE), and baseline exercise behavior was a covariate. Age, sex, education, BMI, and cancer type have demonstrated important prognostic value in prior research [6, 46, 47] and were also entered as covariates. This analytic approach was replicated to determine the intervention-effects on our secondary exercise outcomes (e.g., moderate minutes, vigorous minutes, percentage meeting exercise guidelines) and patient-reported outcomes (QoL and fatigue) wherein post-intervention values of these outcomes were entered into separate ANCOVAs as dependent variables, their pre-study values were entered as covariates, and group assignment served as the independent variable. Again, age, sex, education, BMI, and cancer type were entered as additional covariates due to their prognostic value. All analyses were conducted based on an intention-to-treat basis. Results are described in terms of mean-adjusted between-group differences (MBGDadj), standardized effect size (d), and relative risk (RR).

The study was powered to detect a between-group difference in change in aerobic exercise behavior equal to 100 minutes using an ANCOVA [59], and assuming a standard deviation of 155 minutes and influence from six covariates (i.e., baseline MVPA, age, sex, education, BMI, cancer type) equal to R2=0.36 [26, 60, 61]. It was determined that a sample of 25 participants per group would provide 80% with two-tailed alpha equal to 0.05. This power was deemed likely insufficient for detecting potentially clinically meaningful differences in our secondary patient-reported outcomes (QoL and fatigue) which typically range from 0.33 to 0.50 [62]. As this phase II trial was meant to inform a more definitive phase III trial, secondary patient reported outcomes were also interpreted for their clinical significance. Changes in the SF-36 QoL scales and fatigue scale of 3 points or greater were considered clinically meaningful [57, 62, 63].

5.3 RESULTS

Participant flow through the study is reported in Figure 1. Of the 407 HCS who had initially expressed interest in participating in a future study and were invited to participate in the current study, 269 did not respond (66%) and 19 declined participation (5%). Of the 89 who responded to our invitation (22%), 51 (57%) were eligible and randomized. In terms of self-selection bias (see **Table 5-1**), compared to the 555 HCS who participated in our prior survey study [46] but declined participating in this trial, the 51 HCS who agreed to participate in the current study were more likely to be Hodgkin lymphoma survivors, below the age of 60, female, not retired, to have completed a university degree, have received chemotherapy, and received radiation therapy.

Of the 51 participants, 26 were randomized to the intervention arm and 25 were randomized to the control condition. **Table 5-2** details the demographic, medical, and behavioral

information of participants. The majority of participants were female (61%), married (77%), and had completed university (67%). Furthermore, most participants were either leukemia (39%) or Hodgkin lymphoma (41%) survivors, were more than 5 years from their cancer diagnosis (84%), received chemotherapy (84%), had fully completed their cancer treatments (86%), and were currently disease free (69%). Lastly, very few participants were meeting the aerobic exercise guideline at baseline (16%).

Intervention adherence

In terms of intervention delivery, participants completed an average of 11.1 of the 12 TCE sessions over the 12-week period (93%), with an average duration for each call being 17.3 minutes (± 3.9minutes). Of the 8 topic-focused TCE sessions, participants received an average of 7.3 sessions (91%), each lasting an average of 19.7 minutes (± 4.0 minutes). Of the 4 booster sessions, participants received an average of 3.8 sessions (95%), each lasting an average of 12.9 minutes (± 4.9 minutes). Two participants missed more than two calls (< 80% adherence), however, any missed topic-based TCE session was made-up by having two topics covered in the subsequent session. Therefore, all 8 evidence-based topics were covered with all intervention participants. We lost no participants to follow-up and no participant, thus all 51 participants (100%) completed all post-intervention assessments. No participants withdrew from the study and no adverse events occurred during the study.

Intervention program satisfaction

Participant satisfaction with the TCE program is reported in **Table 5-3**. Generally, participants were highly satisfied (M=6.8/7, SD=0.4, Mdn=7/7, IQR=1.0) with the intervention. More specifically, participants were highly satisfied with the utility of the program, how interesting the sessions were, their clarity, the topics covered, and would likely recommend this

intervention to other HCS (all M > 6/7, Mdn ≥ 6). In terms of the utility of specific topics covered in TC sessions, all where at least somewhat to absolutely useful to participants (M > 5/7, Mdn > 6/7). Participants rated the goal setting, self-monitoring, exercise planning, overcoming barriers, and attitudes as the most useful sessions (M > 6/7). In terms of intervention preferences, 24 of 26 (92%) participants indicated that telephone-based counselling was their preferred method of receiving the intervention, whereas two participants each suggested a preference for either email-based or in-person counselling. Almost all (25/26; 96%) were satisfied with the duration of the telephone calls and with the 12-week duration of the intervention, with one participant suggesting the potential utility of a longer 24-week intervention. In terms of call frequency, 24 of 26 (92%) participants indicated that receiving weekly calls was their preferred call interval, whereas two participants both suggested that calls could have been scheduled less frequently on a bi-weekly basis.

Effects of the intervention on exercise behavior and patient-reported outcomes

Changes in exercise behavior are presented in **Table 5-4**. The TCE group increased their weekly aerobic exercise by 218 minutes (95%CI=163 to 274) compared to 93 minutes (95%CI = 43 to 143) in the SDE group (adjusted mean between group difference [MBGDadj] = 139, 95%CI = 65 to 213, p < .001, d = 2.19). Participants in the TCE group also reported significantly greater increases in moderate intensity minutes (MBGDadj = 56, 95%CI = 16 to 97, p = .007, d = 1.23) and vigorous intensity minutes (MBGDadj = 39, 95%CI = 13 to 65, p = .004, d = 1.86) compared to those in the SDE group. Furthermore, 92% of participants who received the TCE intervention achieved the recommended goal of increasing their weekly aerobic exercise by at least 60 minutes compared to 48% in the SDE group (p = .001, RR = 1.9).

Changes in QoL subscales and fatigue are reported in **Table 5-5**. No statistically significant adjusted between-group differences were observed between the TCE and SDE groups on any QoL subscales or fatigue scale. Adjusted between group differences reached a clinically meaningful value in favor of the TCE group on the mental health subscale MBGDadj = 3.7, 95%CI = -0.4 to 7.9, p = .08, d = 0.42), the mental health component score (MBGDadj = 3.6, 95%CI = -0.8 to 8.1, p = .10, d = 0.35), and approached this threshold on the vitality (MBGDadj = 2.5, 95%CI = -1.9 to 6.9, p = .26, d = 0.25) and role emotional (MBGDadj = 2.5, 95%CI = -1.8 to 6.8, p = .25, d = 0.25) subscales.

5.4 DISCUSSION

The primary purpose of this study was to assess the feasibility and preliminary efficacy of a telephone counselling intervention based on the M-PAC model to increase aerobic exercise behavior in HCS. We were also interested in the effects of the intervention on QoL and fatigue. Based on a high trial adherence, the perfect trial retention and follow-up, the absence of adverse events, and favorable program satisfaction, we deemed the intervention as feasible for HCS. The TCE intervention demonstrated efficacy in significantly improving weekly exercise minutes, weekly moderate minutes, and weekly vigorous minutes for the TCE group versus the SDE group. Although not statistically significant, clinically meaningful differences in mental health and mental component scores also favoured the TCE group.

Overall, the TCE program increased weekly aerobic exercise by 218 minutes compared to 93 minutes in the SDE group, resulting in a very large between group difference of 139 minutes (d=2.19). This magnitude of effect exceeds similar TCE interventions in cancer survivors that reported between group differences of 28 to 40 minutes [25, 28, 64]. Conversely, our results are consistent with the larger effects reported by Pinto et al. [26, 60] of approximately

115 minutes/week. It is important to note, however, that both of the Pinto et al. trials supplemented their TCE programs with an initial face-to-face counselling session. An interesting commonality among these highly successful interventions is that they were framed around the Transtheoretical Model (TTM) [65] and M-PAC [40], both of which consider pre- and post-intentional determinants of behavior. Thus, grounding BSIs in theories that focus on the mechanisms involved in translating intentions into actions, like the TTM and the M-PAC, may be a useful guiding framework for optimizing behavior change.

Another possible explanation for the large improvement in exercise behavior in our trial may relate to our high adherence to the TCE sessions. On average, participants received 93% of their planned weekly telephone sessions, which is superior to many other similar TCE trials which typically range between 70-85% adherence [21, 23, 25, 27, 28, 30, 61, 64], and is in line with the most adherent trials (i.e., 95%) in the literature [26, 60, 66]. Our adherence results are even more impressive considering all TCE participants were able to receive 100% of the content from all the behavior change topics, and only two participants missed more than two sessions (i.e., < 80% adherence) over the 12-week intervention. Therefore, it appears that participants were highly motivated to comply with the TCE program and maximize their potential benefit from the study. As such, our findings may not generalize to less motivated samples of HCS. Still, our trial adherence may highlight the importance of accounting for much needed program flexibility when developing and implementing an exercise BSI. Specifically, we encouraged all TCE participants to establish a routine with the TC sessions from week-to-week, and prompted participants to schedule the following week's call at the end of each session. Further, participants had the opportunity to receive their calls at any time of day or evening, during the week or weekend, and were able to receive two topic-based TCE sessions in a given week if one had been

missed the week prior. Ultimately, we accommodated any changes to the schedule as needed to maximize the likelihood that all participants would receive all 12 TCE sessions.

Despite these large changes in exercise behavior favoring the intervention group, no statistically significant intervention effects were noted on any of the QoL or fatigue scales. This is a common finding in unsupervised/home-based exercise interventions that produce significant improvements in self-reported exercise behavior with limited concomitant changes in patient-reported outcomes [21-31]. Conversely, supervised exercise trials are able to produce significant improvements in patient-reported outcomes in a similar timeframe [7], possibly because of more demanding exercise prescriptions (e.g., high-intensity interval training versus walking), progression of the exercise prescription (e.g., rapid increases in duration or intensity versus a stagnant prescription), better adherence, and social interaction with the trainer and other study participants [7, 67]. Moreover, unsupervised trials typically rely on self-report indices of exercise behavior, where participants may over-report their activity levels and, therefore, the magnitude of exercise behavior change may be exaggerated in these trials [56]. Though few studies have quantified the discrepancy between self-report and objective exercise behavior, some suggest that self-report can account for upwards of 30%-50% of over-report [68, 69]. These comparisons were, however, made in relatively inactive cancer survivor groups, and the congruency between self-report and objective exercise appears to increase in more active samples [26]. Still, additional TCE studies with objective measures of exercise and fitness are needed. Finally, supervised exercise trials often ask control participants not to change their current exercise levels, whereas unsupervised trials typically at least recommend exercise behavior change to control participants [32]. This difference often results in smaller between group differences in

unsupervised trials because of contamination stemming from increases in the control group which, in our trial, was over 90 minutes/week.

It is also worth noting that our trial was not powered to statistically detect meaningful between-group differences in the patient-reported outcomes. Still, between group differences in mental health and mental health component QoL subscales met a clinically meaningful threshold favoring the TCE group, and vitality and role emotional subscales approached this threshold [57, 70]. Interestingly, these trends all relate to improvements in mental health aspects of QoL, which may be indicative of a gain in sense of accomplishment from realizing their exercise goals, the benefit of receiving regular exercise-induced endorphin release, or the social interaction with the exercise counselor. Improvements in physical QoL and fatigue on the other hand, may be more dependent on changes in VO2peak [2, 71], thus, it is possible that our intervention did not produce sufficient changes in exercise intensity and progression to improve VO2peak [9]. Furthermore, the study could have been additionally hampered by potential ceiling effects in patient-reported outcomes, where baseline QoL values were in line with population norms and thus potentially less sensitive to change [25, 57]. Altogether, determining how to effectively augment physical fitness and physical components of QoL via unsupervised exercise interventions requires more careful consideration.

This study was the first TCE intervention in HCS and the first to be guided by the M-PAC to reduce the I-B gap in cancer survivors. Strengths of our study include documentation of self-selection bias, the randomized controlled trial design, the self-directed exercise comparison group, excellent adherence to the telephone intervention, 100% follow-up of post-intervention assessments, and large and meaningful improvements in exercise behavior. Limitations of our study include the unrepresentative sample, the small sample size, the use of a self-reported

exercise measure, the lack of fitness and physical health measures, the lack of a contact-control group, the relatively short intervention duration, and the lack of any long-term follow-up.

Based on our sample characteristics, it is uncertain whether these results can be generalized to the greater HCS population or to other cancer survivor groups. Furthermore, the sample was already somewhat active and reported generally favorable QoL indices at baseline, and thus potential ceiling effects could have stunted the intervention effects. The small sample size may have contributed to an inability to detect statistical significance on potentially meaningful between-group difference in QoL subscales. The use of self-report for measuring exercise behavior is subject to recall and reporting biases, and to participants changes in awareness of their exercise behavior over the course of the intervention, which altogether may have led participants to over-report their actual exercise behavior either at baseline, post-intervention, or both. Without a contact-control group, we cannot isolate the influence of telephone-counselling alone versus the effects of the M-PAC-based content. Lastly, in the absence of a long-term follow-up, our interpretation of the effectiveness of the intervention is limited to the three-month mark and therefore cannot comment on any long-lasting effects on aerobic exercise behavior or patient-reported outcomes.

5.5 CONCLUSION

In conclusion, we developed a novel TCE intervention for HCS based on the M-PAC framework which produced statistically significant and large increases in self-report exercise behavior, and clinically meaningful improvements in some mental health QoL scores. The program was also rated positively in terms of participant satisfaction, showing a strong degree of acceptability in this cancer survivor population. These results may be helpful for developing a more definitive phase III exercise telephone counselling intervention in HCS and other cancer

survivor groups. If improvements in mental and physical aspects of health can be documented, TCE may provide a less costly and more scalable alternative to supervised exercise interventions in cancer survivors.

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Table 5-1. Differences in demographic, medical, and behavioral characteristics of hematologic cancer survivors (N=606) who participated in our prior survey study in 2014, by interest in future study participation and current study participation.

Variable	Not interested (n=199)	Interested but did not participate (n=356)	Participated (n=51)	*p* value
Age [M (SD)]	**64.1 (14.9)**	**55.5 (16.6)**	**52.6 (13.7)**	**<.001**
< 60 years	70 (35%)	200 (56%)	33 (65%)	<.001
≥ 60 years	129 (65%)	156 (44%)	18 (35%)	
Sex				.009
Female	75 (38%)	162 (45%)	31 (61%)	
Male	124 (62%)	194 (55%)	20 (39%)	
Body mass index [M (SD)]	**27.5 (8.3)**	**27.7 (6.9)**	**27.8 (7.5)**	**.93**
Average weight	73 (37%)	127 (36%)	21 (41%)	.75
Overweight & Obese	126 (63%)	229 (64%)	30 (59%)	
Marital status				.32
Not married	54 (27%)	113 (32%)	12 (24%)	
Married	145 (73%)	243 (68%)	39 (76%)	
Children living at home				.07
None	159 (80%)	256 (72%)	35 (69%)	
One or more	40 (20%)	100 (28%)	16 (31%)	
Education				.002
University not completed	116 (58%)	160 (45%)	19 (37%)	
Completed university	83 (42%)	196 (55%)	32 (63%)	
Employment status				<.001
Not retired	94 (47%)	240 (67%)	41 (80%)	
Retired	105 (53%)	116 (33%)	10 (20%)	
Cancer type				.003
Leukemia	67 (34%)	100 (28%)	19 (37%)	
Hodgkin lymphoma	45 (23%)	120 (34%)	22 (43%)	
non-Hodgkin lymphoma	87 (44%)	136 (38%)	10 (20%)	
Time since diagnosis [M (SD)]	**4.3 (3.2)**	**4.6 (3.8)**	**4.4 (3.9)**	**.70**
≤ 5 years	147 (74%)	240 (67%)	33 (65%)	.22
> 5 years	52 (26%)	116 (33%)	18 (35%)	
Radiation				.035
No	142 (71%)	230 (65%)	27 (53%)	
Yes	57 (29%)	126 (35%)	24 (47%)	
Chemotherapy				.039
No	68 (34%)	96 (27%)	9 (18%)	
Yes	131 (66%)	260 (73%)	42 (82%)	
Stem cell/marrow transplant				.75
No	179 (90%)	318 (89%)	44 (86%)	
Yes	20 (10%)	38 (11%)	7 (14%)	
Current cancer status				.009
Disease free	105 (53%)	234 (66%)	33 (65%)	
Existing disease	94 (47%)	122 (34%)	18 (35%)	
Aerobic exercise behavior [M (SD)]	**185 (337)**	**336 (449)**	**194 (278)**	**<.001**
Previously meeting guideline	135 (68%)	173 (49%)	31 (61%)	<.001
Not meeting guideline	64 (32%)	183 (51%)	20 (39%)	

Note: Meeting aerobic exercise guidelines = at least 150 weekly exercise minutes calculated as moderate minutes + 2x the vigorous minutes.

Table 5-2. Baseline demographic, medical, and behavioral characteristics of hematologic cancer survivors in 2017 participating in the current study (N=51).

Variable	Overall[1] (N=51)	Telephone counselling group (n=26)	Self-directed group (n=25)
Age [M (SD)]	**56.2 (13.7)**	**50.1 (12.7)**	**59.3 (13.6)**
< 60 years	27 (53%)	18 (69%)	9 (36%)
≥ 60 years	24 (47%)	8 (31%)	16 (64%)
Sex			
Female	31 (61%)	16 (61%)	15 (60%)
Male	20 (39%)	10 (39%)	10 (40%)
Body mass index [M (SD)]	**27.1 (4.5)**	**28.3 (5.1)**	**25.4 (3.3)**
Normal weight	22 (43%)	9 (34%)	13 (52%)
Overweight & Obese	29 (57%)	17 (65%)	12 (48%)
Marital status			
Not married	12 (23%)	6 (23%)	6 (24%)
Married	39 (77%)	20 (77%)	19 (76%)
Education			
University not completed	17 (33%)	7 (27%)	10 (40%)
Completed university	34 (67%)	19 (73%)	15 (60%)
Employment status			
Not retired	29 (57%)	16 (61%)	13 (52%)
Retired	22 (43%)	10 (39%)	12 (48%)
Cancer type			
Leukemia	20 (39%)	10 (38%)	10 (40%)
Hodgkin lymphoma	21 (41%)	9 (35%)	12 (48%)
non-Hodgkin lymphoma	10 (20%)	7 (27%)	3 (12%)
Time since diagnosis [M (SD)]	**7.3 (3.8)**	**6.9 (3.0)**	**8.2 (4.7)**
< 5 years	11 (22%)	7 (27%)	4 (16%)
≥ 5 years	40 (78%)	19 (73%)	21 (84%)
Radiation			
No	27 (53%)	14 (54%)	13 (52%)
Yes	24 (47%)	12 (46%)	12 (48%)
Chemotherapy			
No	8 (16%)	4 (15%)	4 (16%)
Yes	43 (84%)	22 (85%)	21 (84%)
Stem cell/marrow transplant			
No	44 (86%)	22 (85%)	22 (88%)
Yes	7 (14%)	4 (15%)	3 (12%)
Treatment status			
Receiving treatments	7 (14%)	3 (12%)	4 (16%)
Completed treatments	44 (86%)	23 (88%)	21 (84%)
Recurrence			
No	42 (82%)	19 (73%)	23 (92%)
Yes	9 (18%)	7 (27%)	2 (8%)
Current cancer status			
Disease free	35 (69%)	17 (65%)	18 (72%)
Existing disease	16 (31%)	9 (35%)	7 (28%)
Aerobic exercise behavior [M (SD)]	**70 (63)**	**70 (67)**	**70 (61)**
Meeting guideline	8 (16%)	4 (15%)	4 (16%)
Not meeting guideline	43 (84%)	22 (85%)	21 (84%)

Note: Data from table 5-2 describing our randomized sample may not align with data from table 5-1 because changes over time stemming from the 3-year time gap between studies (e.g., age, body weight, treatments received, etc.). Meeting aerobic exercise guidelines= at least 150 weekly exercise minutes calculated as moderate minutes + 2x the vigorous minutes.

Table 5-3. Satisfaction with the telephone counselling program and sessions from participants receiving the intervention (n=26).

Intervention Satisfaction	**M (SD)**	**Mdn (IQR)**
Overall satisfaction	6.8 (0.4)	7.0 (1.0)
Intervention was useful	6.7 (0.7)	7.0 (0.0)
Would recommend this intervention to another HCS	6.5 (0.7)	7.0 (1.0)
Information was new to me[a]	3.5 (0.9)	4.0 (1.0)
Sessions were interesting	6.1 (0.8)	6.0 (1.0)
Sessions were clear	6.6 (0.8)	7.0 (1.0)
Satisfied with topics covered	6.4 (0.8)	7.0 (1.0)
Affective & instrumental attitudes	6.1 (0.8)	6.0 (1.0)
Action planning	6.4 (0.6)	6.0 (1.0)
Coping planning	6.3 (0.6)	6.0 (1.0)
Self-monitoring	6.4 (0.8)	7.0 (1.0)
Obligation	6.5 (0.7)	7.0 (1.0)
Regulation of alternatives	5.9 (1.5)	6.0 (2.0)
Habit	5.8 (1.4)	6.0 (2.0)
Booster sessions	5.3 (2.1)	6.0 (2.0)

Note: [a]Participants were asked to rate the extent to which the information covered in the telephone counselling was new to them on a 5-point scale from 1-5. All other items were rated on a 7-point scale from 1-7.

Table 5-4. Effects of telephone counselling on changes in aerobic exercise behavior in hematologic cancer survivors

Variable	Baseline M (SD)	Post Intervention M (SD)	Within group change M (95% CI)	Between group difference[a] M (95% CI)	*p* value	Effect size
Weekly exercise (mins)[b]						
Telephone counselling group	70 (67)	288 (134)	218 (163 to 274)	139 (65 to 213)	<.001	*d*=2.19
Self-directed group	69 (60)	162 (102)	93 (43 to 143)			
Weekly vigorous intensity exercise (mins)						
Telephone counselling group	17 (20)	76 (58)	59 (39 to 79)	39 (13 to 65)	.004	*d*=1.86
Self-directed group	10 (22)	38 (38)	28 (12 to 44)			
Weekly moderate intensity exercise (mins)						
Telephone counselling group	36 (39)	136 (69)	100 (65 to 135)	56 (16 to 97)	.007	*d*=1.23
Self-directed group	49 (52)	86 (64)	37 (3 to 72)			
Weekly light intensity exercise (mins)						
Telephone counselling group	72 (91)	95 (114)	22 (-40 to 85)	0 (-72 to 72)	.99	*d*=0.00
Self-directed group	177 (209)	111 (110)	-66 (-147 to 15)			
Meeting aerobic exercise guidelines (%)[c]						
Telephone counselling group	15% (36%)	88% (32%)	73%(45%)	29% (-2% to 60%)	.06	RR=1.6
Self-directed group	16% (37%)	60%(50%)	44% (65%)			
Increased exercise by at least 60 minutes (%)						
Telephone counselling group			92% (27%)	44% (21% to 67%)	.001	RR=1.9
Self-directed group			48% (51%)			

Note: [a]Between group differences were adjusted for baseline value, age, sex, education, cancer type, and BMI. [b]Weekly exercise minutes were computed as moderate intensity exercise minutes plus 2 times the vigorous intensity exercise minutes. [c]Meeting the aerobic exercise guideline was defined as at least 150 weekly exercise minutes. d = Cohen's effect size, RR= relative risk.

Table 5-5. Effects of telephone counselling on changes in quality of life and fatigue in hematologic cancer survivors

Variable	Baseline M (SD)	Post Intervention M (SD)	Mean change M (95% CI)	Between group difference[a] M (95% CI)	*p* value	Cohen's *d*
Physical Functioning						
Telephone counselling group	51.4 (6.9)	51.7 (5.5)	0.3 (-1.5 to 2.1)	-0.4 (-2.8 to 1.9)	.70	-.06
Self-directed group	51.5 (7.3)	52.3 (5.2)	0.7 (-1.4 to 2.9)			
Role Physical						
Telephone counselling group	49.6 (8.5)	50.0 (8.1)	0.3 (-2.9 to 3.7)	-1.5 (-6.6 to 3.4)	.52	-.18
Self-directed group	49.4 (8.3)	50.5 (8.5)	1.1 (-3.1 to 5.4)			
Bodily Pain						
Telephone counselling group	49.8 (8.7)	51.6 (7.6)	1.7 (-0.8 to 4.3)	1.1 (-2.8 to 5.1)	.57	.14
Self-directed group	53.0 (6.8)	51.6 (6.8)	-1.3 (-5.0 to 2.2)			
General Health						
Telephone counselling group	45.0 (6.9)	46.1 (6.7)	1.1 (-1.1 to 3.2)	0.4 (-2.2 to 3.2)	.72	.06
Self-directed group	44.0 (6.4)	45.4 (5.7)	1.3 (-0.2 to 2.9)			
Vitality						
Telephone counselling group	48.7 (10.3)	53.8 (8.4)	5.1 (2.1 to 8.1)	2.5 (-1.9 to 6.9)	.26	.25
Self-directed group	51.2 (9.9)	52.7 (9.5)	1.5 (-2.2 to 5.2)			
Social Functioning						
Telephone counselling group	48.2 (11.4)	50.9 (9.3)	2.7 (-1.8 to 7.2)	0.9 (-4.7 to 6.6)	.73	.09
Self-directed group	49.4 (8.6)	50.5 (9.2)	1.1 (-3.4 to 5.5)			
Role Emotional						
Telephone counselling group	50.6 (7.8)	51.9 (6.1)	1.3 (-2.1 to 4.8)	2.5 (-1.8 to 6.8)	.25	.25
Self-directed group	47.4 (11.9)	49.3 (9.3)	1.8 (-1.9 to 5.6)			
Mental Health						
Telephone counselling group	51.9 (9.2)	55.8 (6.8)	3.8 (0.1 to 7.7)	3.7 (-0.4 to 7.9)	.08	.42
Self-directed group	51.0 (8.4)	52.5 (9.0)	1.5 (-0.6 to 3.7)			
Physical Health Component						
Telephone counselling group	48.6 (7.7)	48.7 (6.7)	0.1 (-1.9 to 2.1)	-0.9 (-4.1 to 2.2)	.55	-.12
Self-directed group	50.2 (7.0)	50.2 (6.8)	0.0 (-2.5 to 2.4)			
Mental Health Component						
Telephone counselling group	50.2 (9.5)	54.3 (6.8)	4.1 (0.2 to 7.9)	3.6 (-0.8 to 8.1)	.10	.35
Self-directed group	49.0 (11.0)	51.0 (10.3)	2.0 (-1.0 to 5.0)			
Fatigue						
Telephone counselling group	38.6 (10.8)	42.8 (10.1)	4.2 (1.0 to 7.4)	1.4 (-2.6 to 5.6)	.48	.12
Self-directed group	39.5 (11.1)	41.7 (6.6)	2.2 (-1.5 to 5.9)			

Note: [a]Between group differences were adjusted for baseline value, age, sex, education, cancer type, and BMI

Table 5-supplement. Overview of content discussed in telephone counselling sessions with participants in the intervention arm based on the multi-process action control (M-PAC) framework.

M-PAC target	Telephone counselling session guide

Introductory/ Perceived capability & opportunity	• This was the first telephone counselling session delivered and thus also served as an introduction to the trial
	• Discuss exercise intensities (moderate: carry conversation but not sing, vigorous: unable to carry conversation)
	• Describe exercise progression (when to increase, how, and by how much)
	  o Challenge yourself in your next workout after each successful bout
	  o Can increase frequency, duration, or intensity
	• Brainstorm what types of aerobic exercise available at to participant at start of the trial

Instrumental & affective attitudes	• Discuss specific exercise benefits (e.g., improve fitness, energy level, relieve stress) • Brainstorm ways to make exercise fun (e.g., music, TV, friends, variety)
Action planning*	• Go through a 7-day plan for their exercise activities • Determine when, where, and with whom, they will exercise • Encourage the participant to note their plan and share with family/friends
Coping planning	• Discuss pertinent barriers to exercise (e.g., fatigue, time, motivation) • Develop strategies to overcome all barriers discussed (e.g., shorten bouts, exercise when less fatigued, add variety, set new goals) • Develop a contingency plan for missed exercise bouts to ensure weekly goals are still met (e.g., catch-up on another day, exercise at a different time that same day)
Self-monitoring*	• Explain the importance of self-monitoring for exercise adherence and progression • Assist participants with creating a strategy to track exercise on a daily basis
Obligation*	• Explain the importance of setting exercise goals for adherence and progression • Explain the SMART goal principle (specific, measureable, attainable, realistic, timely) • Set long- and short-term health and behavioral goals • Encourage participants to note their goals and share with family/friends • Discuss the potential of incorporating internal and external rewards to encourage goal-pursuit
Self-regulation of alternatives	• Guide the participant to make a list of all possible activities that could be pursued instead of doing exercise • Assist participants with listing the pros and cons for each activity • Encourage the participant to rank the activities in terms of their personal priority
Habit	• Discuss how streamlining and routinizing exercise can benefit long-term adherence • Provide examples of exercise reminders and preparatory aids (e.g., keep a gym bag packed and visible, schedule phone alerts/reminders, schedule exercise around regularly occurring activities such as meals)
Booster sessions	• Troubleshoot any barriers or issues with participant's exercise that week • Revisit any previously discussed topics if pertinent • Develop action and coping plans for the following week

Note: * represents three TC sessions that were supplemented with email correspondence. For self-monitoring, a template exercise log was sent to participants to support the discussion. For action planning and obligation sessions, an email was sent to provide a copy of the goal or plan that the participant developed in the session.

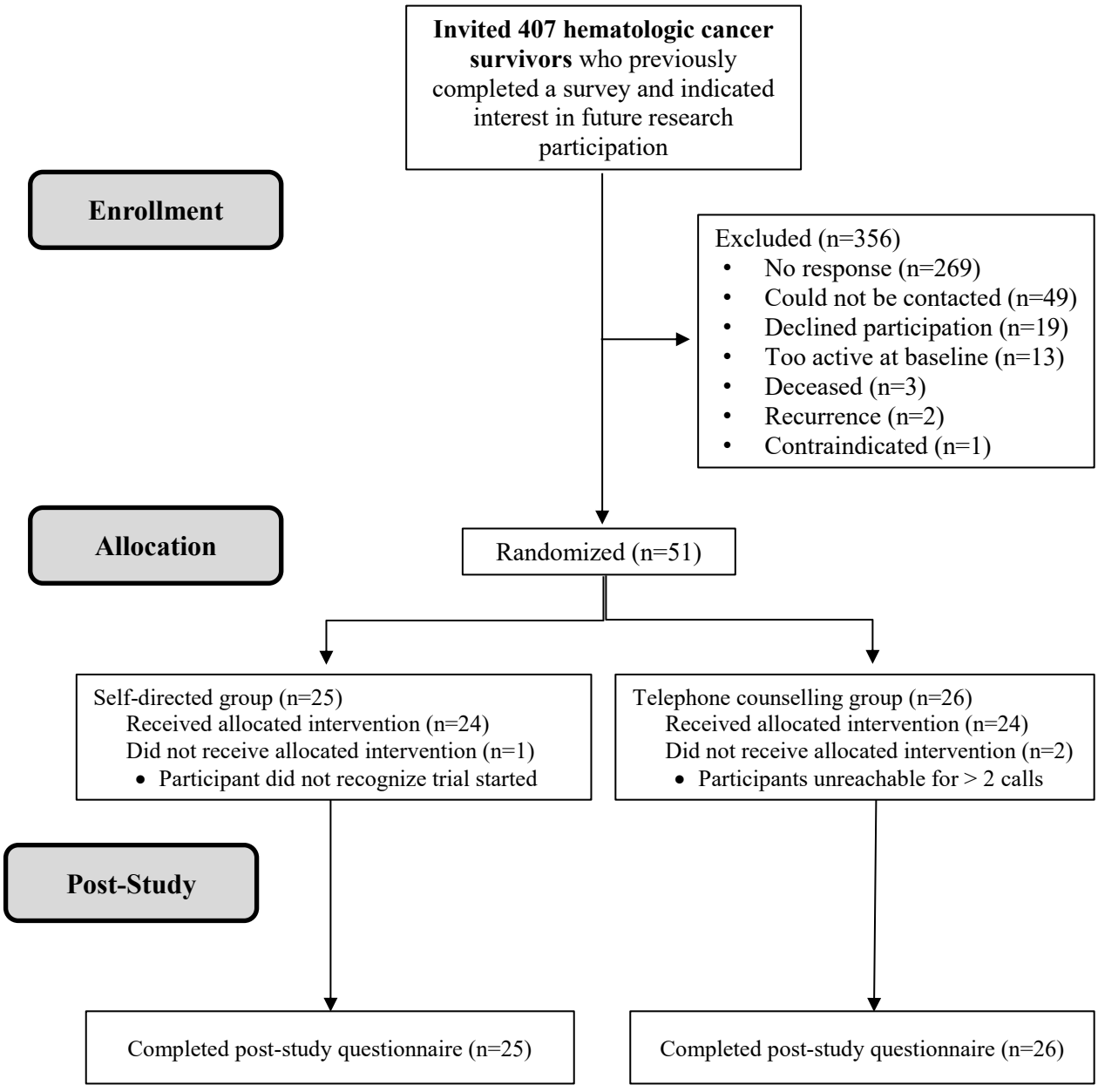

Figure 5-1. Participant flow through the exercise telephone counselling study in hematologic cancer survivors.

CHAPTER 6: STUDY 2 – Paper 5

Social cognitive effects and mediators of a pilot telephone counselling intervention to increase aerobic exercise in hematologic cancer survivors

6.1 BACKGROUND

By doing regular weekly aerobic exercise at a moderate-to-vigorous intensity, hematologic cancer survivors (HCS) improve their health, quality of life, and may even extend survival [1-3]. Despite the majority of HCS having good intentions to do regular aerobic exercise, few meet the recommended 150 minutes of weekly aerobic exercise [4, 5]. Thus, promoting exercise behavior in HCS is an important cancer survivorship goal.

Behavioral support interventions (BSIs) target key theoretically grounded correlates of exercise behavior in order to promote greater exercise behavior [6]. Supervised exercise interventions are the gold standard for improving health outcomes in cancer survivors [7, 8] but are labor- and resource-intensive [9, 10]. Furthermore, supervised interventions typically focus on helping participants adhere to a set exercise behavior target in a highly-controlled setting, rather than supporting participants to self-manage their own exercise behavior. As such, researchers propose that telephone counselling (TC) may serve as a suitable cost-effective means for exercise BSI delivery that maintains important participant-counsellor interaction, while allowing participants to pursue their exercise in more realistic environments [10, 11].

As such, we conducted a 12-week exercise telephone counselling BSI in HCS where we compared TC to a self-directed exercise (SDE) program [12]. We found a significant and very large difference in exercise behavior, and clinically meaningful differences in mental aspects of quality of life favoring the telephone counselling exercise (TCE) group versus the SDE control group. We proposed that in addition to benefiting from the interactive platform permitted within TC, the intervention's success was also likely attributed to the theoretical grounding. Our intervention was specifically guided by the multi-process action control framework [M-PAC; 13], and thus was uniquely tailored to address the exercise intention-behavior (I-B) gap.

Like the theory of planned behavior (TPB) [14], the M-PAC suggests that motivational processes help form behavioral intentions. The M-PAC deviates from the TPB by recognizing that despite best efforts, not all good intentions translate into behavior (i.e., the I-B gap). As such, according to the M-PAC, initiating motivational processes (i.e., instrumental attitude and perceived capability) are largely responsible for forming a behavioral intention, while ongoing motivational processes (i.e., affective attitude and perceived opportunity) assume a dual role in influencing intention formation and translation into initial behavior change. Further influencing intention translation, behavioral regulations (i.e., action planning, coping planning, and social support) are thought to help initial behavior change, while the development of reflexive processes over time (i.e., habit, identity, obligation, anticipated regret, and regulation of the attractiveness of alternative activities) are important for behavioral maintenance.

The purpose of this paper was to assess the effects of our telephone counselling intervention on the motivational, regulatory, and reflexive processes highlighted in the M-PAC model. We hypothesized that participants in the TCE group would report more favorable exercise-related motivational, regulatory, and reflexive ratings than those in the SDE group. More specifically, because participants would largely be initiating exercise behavior change in a 12-week exercise intervention, we expected that the largest between-group differences would stem from behavioral regulations and ongoing motivational processes, while smaller differences exist for the reflex and initiating motivational processes. We were secondarily interested in exploring whether changes in motivational, regulatory, and reflexive processes mediated changes in aerobic exercise behavior. We again hypothesized that at this early stage of behavior change, mediating effects would be larger for behavioral regulations and ongoing motivational processes than reflexive processes and initiating motivational processes.

6.2 METHODS

The methods of this study have been detailed elsewhere [12]. Briefly, we assessed the preliminary efficacy of a telephone-based exercise counselling program for increasing aerobic exercise behavior, quality of life, and fatigue in HCS. We recruited a sample of N=51 to this trial from a larger sample of N=606 who previously participated in a survey study, and randomly allocated them to either the TCE group (n=26) or the SDE (control) group (n=25). All participants were advised to increase their weekly aerobic exercise by at least an additional 60 weekly minutes of moderate-to-vigorous aerobic exercise and received a copy of Canada's Physical Activity Guideline. Participants in the TCE group received 12-weekly telephone counselling sessions. These calls were divided into two phases. The first eight calls focused on specific M-PAC based topics: two sessions on motivational processes (perceived capability/opportunity, instrumental/affective attitudes), three sessions on behavioral regulations (action planning, coping planning, self-monitoring), and three sessions on reflexive processing (obligation/regret, regulation of alternatives, habit/cues). The last four sessions were unscripted to allow participants to revisit any previously covered topics or raise any challenges with their exercise at that time.

Measures

Participants completed self-report surveys at baseline survey (week 0) and post-intervention (week 13) online or via post. All questionnaire items asked participants at baseline to project their feelings towards increasing their exercise over the next three months (e.g., "I think that for me, trying to increase my aerobic exercise over the next three months will be…"), whereas the post-study questionnaire asked them to recall their motivations while trying to increase their exercise over the past three months (e.g., "I think that for me, trying to increase my

aerobic exercise over the past three months was…"). All motivational, regulatory, and reflexive variables were assessed on a 7-point bipolar Likert scale (strongly agree - disagree), except for the 10 items measuring social support which were measured on a 5-point scale (very often - never).

Motivational processes. Attitudes were assessed using six items, capturing instrumental attitudes (e.g., useful-useless), and affective attitudes (e.g., enjoyable-unenjoyable) [15]. Perceived capability was measured using two items (e.g., "I possess the skills to increase my weekly aerobic exercise). Two additional items assessed participants' perceived opportunity (e.g., "I have the opportunity to increase my weekly aerobic exercise...").

Behavioral regulations. Exercise action and coping plans were captured through 10 items, using the stem: "I have a detailed plan to increase my weekly aerobic exercise over the next/past three months regarding:" [16]. A sample item for action planning is "when I would engage in aerobic exercise," and a sample coping planning item is "what to do if something interferes with my plans." Social support was measured using 10 items measured on a 5-point scale (never – very often) [17, 18]. A sample item is "while trying to increase my weekly aerobic exercise…, people in my life: exercised with me." We did not discriminate different possible sources of social support (i.e., friends versus family), and all 10 items were summed to create a single factor reflecting support for exercise participation. Higher scores refer to greater perceived support.

Reflexive processes. Anticipated regret was measured using two items (e.g., "I would feel regret if I did not increase my weekly aerobic exercise…") [19, 20]. Four items assessed exercise automaticity/habit (e.g., aerobic exercise is something I do automatically) [21]. Three items measured participants' exercise identity (e.g., I consider myself an exerciser) [Wilson &

Muon, 22]. Exercise obligation was measured using three items (e.g., "I feel obligated to increase my weekly aerobic exercise..."). Regulation of the attractiveness of alternative activities (a.k.a., regulation of alternatives) were measured using four items (e.g., "Compared to increasing my aerobic exercise over the next/past three months, there are other things I could do which would be more fun...") [Wilson et al., 23]. These items were then reverse scored so that higher scores would reflect greater regulation of alternatives.

Exercise behavior. Self-reported minutes of moderate-to-vigorous aerobic exercise behavior was assessed by a modified version of the Leisure Score Index from the Godin Leisure Time Exercise Questionnaire (GLTEQ) [24]. To calculate moderate-to-vigorous minutes consistent with the guidelines established for cancer survivors [25, 26], the time spent participating in vigorous exercise was doubled and added to the duration of moderately intense exercise to determine "aerobic exercise minutes".

Statistical analyses

Baseline comparisons from the N=606 who previously participated in our research, to determine sample biases on motivational processes, behavioral regulations, and reflexive processes were assessed using a multivariate analysis of variance (MANOVA) with post hoc pairwise comparisons. The intervention-effect on exercise motivational processes, behavioral regulations, and reflexive processes were assessed using separate analyses of covariance (ANCOVA) with adjustment for baseline value, age, sex, education, BMI, and cancer type [4, 5, 27]. As our trial was powered to detect large differences in our primary outcome of exercise behavior [12], we were underpowered to detect smaller but potentially meaningful differences in psychosocial constructs. Therefore, we also interpreted differences corresponding to at least a small standardized effect size (d=0.20) [28]. We also performed simple mediation models using

ordinary least squares path analyses [29] to explore whether intervention effects on participants' motivational, regulatory, and reflexive constructs mediated increases in aerobic exercise behavior. Again, as we were likely underpowered and with the absence of well-established benchmarks of magnitude constituting potentially meaningful indirect effects for aerobic exercise, we also interpret indirect effects that account for an absolute increase of at least 10 minutes of moderate-to-vigorous aerobic exercise (i.e., unstandardized regression coefficient, $b > 10.00$) as potentially meaningful.

6.3 RESULTS

Participant flow through the study is reported elsewhere [12]. Of the 407 HCS invited to participate in this study, 89 responded to our invitation, of which 51 (57%) were eligible to participate. HCS who participated in this trial were more likely to have significantly greater ratings of instrumental and affective attitudes, injunctive norm, perceived control, anticipated regret, and exercise obligation compared to those who were not interested in future research participation (**Table 6-1**).

Trial adherence and primary outcome

As reported previously, no participants were lost to follow-up, no adverse events occurred, adherence to telephone counseling was 93%, and the TCE group increased their aerobic exercise behavior by 218 minutes compared to 93 minutes in the SDE group (adjusted mean between-group difference [MBGDadj] = 139, 95%CI = 65 to 213, $p < .001$, $d = 2.19$) [12].

Effects of the intervention on social cognitive processes

Changes in exercise social cognitive processes are presented in **Table 6-2**. Pertaining to ongoing motivational processes, medium-sized between-group differences were noted for affective attitude (MBGDadj = 0.6, 95%CI = 0.1 to 1.2, $d = 0.71$) and perceived opportunity

(MBGDadj = 0.4, 95%CI = -0.3 to 1.2, d = 0.50). In terms of initiating motivational processes, a large between-group difference was noted for instrumental attitude (MBGDadj = 0.5, 95%CI = 0.1 to 1.0, d = 1.11), while a small difference was noted for perceived capability (MBGDadj = 0.2, 95%CI = -0.2 to 0.7, d = 0.22). With regards to changes in regulatory processes, a large between-group difference favoring the TCE group was noted for coping planning (MBGDadj = 1.4, 95%CI = 0.7 to 2.2, d = 1.04), and small between-group differences favoring the TCE group were noted for action planning (MBGDadj = 0.3, 95%CI = -0.2 to 0.8, d = 0.24) and social support (MBGDadj = 1.9, 95%CI = -2.1 to 6.0, d = 0.21). In terms of changes in reflexive processes, small-to-medium between-group differences in favor of the TCE group were noted for regulation of alternatives (MBGDadj = 0.5, 95%CI = -0.1 to 1.1, d = 0.45), exercise identity (MBGDadj = 0.6, 95%CI = -0.1 to 1.3, d = 0.32), and habit (MBGDadj = 0.4, 95%CI = -0.4 to 1.2, d = 0.32). Small between-group differences in favor of the TCE group were noted for anticipated regret (MBGDadj = 0.2, 95%CI = -0.2 to 0.7, d = 0.20) and obligation (MBGDadj = 0.2, 95%CI = -0.4 to 0.9, d = 0.20).

Mediators of aerobic exercise behavior

All motivational, regulatory, and reflexive variables were explored as potential mediators of the intervention effect on aerobic exercise behavior in simple mediation path analyses [30]. Using bias corrected bootstrapping to establish 95% confidence intervals based on 5000 bootstrap samples, we found potentially meaningful mediation of the intervention effect on aerobic exercise behavior through key regulatory, reflexive, and motivational processes (see **Table 6-3**). In terms of behavioral regulations, coping planning accounted for a notable indirect effect (b = 24.98, β = 0.18, 95%CI = -0.03 to 0.56). For reflexive processes, exercise identity (b = 17.43, β = 0.12, 95%CI = -0.05 to 0.41), habit (b = 14.64, β = 0.10, 95%CI = -0.01 to 0.42),

and obligation (b = 12.25, β = 0.09, 95%CI = -0. 11 to 0.34) appeared to be potentially meaningful mediators. For ongoing motivational processes, perceived opportunity (b = 17.95, β = 0.13, 95%CI = 0.01 to 0.36) and affective attitude (b = 12.85, β = 0.09, 95%CI = -0.01 to 0.30) accounted for potentially meaningful indirect effects on aerobic exercise. In terms of the initiating motivational process, perceived capability (b = 10.52, β = 0.07, 95%CI = -0.02 to 0.28) may have contributed meaningful mediation of aerobic exercise behavior.

6.4 DISCUSSION

The purpose of this paper was to assess the effectiveness of our telephone counselling intervention in eliciting changes in social cognitive processes highlighted in the M-PAC model, and explore whether these changes mediated changes in aerobic exercise behavior. In terms of behavioral regulations, improvements in coping planning emerged as one of the largest between-group differences overall and as one of the most important in terms of mediating the intervention effect on aerobic exercise behavior. Specifically, our mediation analyses revealed that each one-point increase in coping planning was associated with an average increase of 14.39 minutes of aerobic exercise behavior, and thus the TCE intervention accounted for an increase in 24.98 minutes of weekly aerobic exercise through coping planning. Highlighting its importance for behavior change, many successful exercise BSIs also note meaningful increases in coping planning [31-35]. Coping planning refers to the ability to create if-then contingency plans to overcome foreseeable barriers to exercise, and thus represents an amalgamation of numerous behavior change techniques such as dynamic problem solving, time management, barrier control, and goal setting. As such, coping planning was a common theme across numerous TC sessions (i.e., goal setting, self-monitoring, decision balance), but was most thoroughly targeted in a session on personal barriers to exercise, where participants were coached to create detailed

contingency plans to overcome barriers. Overall, coping planning is a complex and dynamic process which likely promotes a level of resiliency needed for moments where the I-B gap is widened by exercise barriers that may otherwise derail exercise pursuits.

Ongoing motivational processes were also theorized as being critically important for initial behavior change because unlike initiating motivational processes that are thought to primarily influence intention formation, ongoing motivational processes influence both intention formation and translation [13]. In support of this postulation, larger between-group differences were noted for the ongoing than the initiating motivational processes, with the exception of a large-between-group difference for instrumental attitude. In terms of mediating the intervention effect on aerobic exercise behavior, affective attitude and perceived opportunity accounted for larger indirect effects than instrumental attitude and perceived capability. Specifically, each one-point increase in affective attitude and perceived opportunity was related to an increase in 27.20 minutes and 29.70 minutes of aerobic exercise respectively, versus 11.91 minutes and 37.45 minutes for instrumental attitude and perceived capability respectively. Therefore, the TCE intervention accounted for increases in aerobic exercise by 12.85 minutes through affective attitude, 17.95 minutes through perceived opportunity, 5.99 minutes through instrumental attitude, and 10.52 minutes through perceived capability.

Interestingly, motivational differences largely stemmed from decreases in the SDE group versus stabilization or slight increases in the TCE group. This relatively common finding in exercise trials highlights the importance of stabilizing participants' motivation while they try to increase their exercise [36-38]. For example, perhaps motivation naturally peaks with optimism at baseline and unless acted upon, will inevitably decline through the realization that exercise behavior change may be more difficult, less enjoyable, or less immediately beneficial than

unrealistically expected [39]. In the absence of motivational stabilization, negative effects on exercise behavior are noted [40, 41], and even momentary fluxes in affect can be important for the I-B gap [42]. As such, we targeted the M-PAC's motivational processes in two TC sessions. First, we targeted participants' perceived capability by providing participants with information on training principles (e.g., exercise modalities, intensities, and progression), and their perceived opportunity by brainstorming different options and resources available for aerobic exercise. Another TC session targeted instrumental attitude by reviewing and eliciting participants to consider pertinent exercise benefits (e.g., improve health, relieve stress, increase energy), and affective attitude by having participants develop strategies to ensure that their aerobic exercise would be enjoyable (e.g., listen to music, exercise with friends, variety in one's routine).

Small between-group differences favoring the TCE group were noted across the reflexive processes, with the largest differences in regulation of alternatives, exercise identity, and habit. In terms of their influence on aerobic exercise behavior, exercise identity, habit, and obligation accounted for potentially meaningful mediation effects. Specifically, each one-point increase in exercise identity, habit, and obligation corresponded to an average increase in 21.48 minutes, 25.06 minutes, and 48.84 minutes of aerobic exercise respectively. As such, the effects of TCE on aerobic exercise through exercise identity was an increase of 17.43 minutes, 14.64 minutes through habit, and 12.25 minutes through obligation. Exercise identity is a complex reflexive process that appears to be associated with elements of affect, commitment, regulation, and ability [43]. We believed that participants' exercise identity would develop collectively as a result of the TCE sessions on attitudes (i.e., affective), regulations (i.e., action and coping planning), and setting a goal contract (i.e., publicizing their exercise goals). We also proposed that participants' exercise identity would be bolstered throughout the trial via weekly praise of their

accomplishments which may have then been internalized as an indicator of a heightened sense of exercise ability [43]. Non-conscious processes, especially the habituation of exercise preparation, appear to be important regulators of exercise behavior [44-46]. Habit was targeted via a TC session aimed to help reduce the effort required to initiate their exercise. Participants were guided to develop cue-based exercise prompts (e.g., using reminders, placing equipment in visible areas) and means of streamlining their exercise (e.g., preparing for exercise the night before, establishing consistent routines for exercise). Because the relationship between commitment and exercise behavior seems to hinge on the development of a "want-to" versus a "have-to" commitment [47], we were careful to promote participants' autonomy when developing goal contracts and detailed exercise plans. Participants were encouraged to bolster their commitment by posting their goals and plans visibly at home or sharing them verbally with significant others. Furthermore, participants were routinely praised for their efforts and accomplishments throughout the trial, and were encouraged to consider incentivizing their good behavior regularly.

Our study has notable strengths and limitations. The strengths include being the first randomized controlled trial to examine the theoretical mechanisms of exercise behavior change in HCS using TC, the first randomized trial to examine changes in M-PAC processes, the high intervention adherence rate, and no loss to follow-up. The limitations of this study include the small sample size, the inclusion of a highly-motivated sample, and measuring aerobic exercise behavior via self-report.

6.5 CONCLUSIONS

In conclusion, the TC intervention produced the hypothesized meaningful changes in motivational, regulatory, and reflexive processes favoring the TCE over the SDE group.

Specifically, the largest differences were noted for coping planning, affective attitude, perceived opportunity, and instrumental attitude. Changes in coping planning, perceived opportunity, exercise identity, habit, affective attitude, obligation, perceived capability all appeared to exhibit potentially meaningful mediating influence on the intervention effect on aerobic exercise behavior. The M-PAC appears to an important theoretical framework to guide and understand the mechanisms of exercise behavior change in HCS through TC. Larger trials testing the utility of the M-PAC for guiding exercise behavior change interventions in cancer survivors are warranted.

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Table 6-1. Differences in motivational, regulatory, and reflexive characteristics of hematologic cancer survivors (N=606) who participated in our prior survey study in 2014 by interest in future study participation and current study participation.

Variable	Not interested (N=199)	Interested but declined (n=356)	Participated (n=51)	*p* value	Post hoc
Motivational Processes					
Instrumental attitude	5.2 (1.7)	6.1 (1.1)	6.1 (1.2)	<.001	P & ID > NI
Affective attitude	4.4 (1.6)	5.0 (1.3)	5.1 (1.3)	<.001	P & ID > NI
Injunctive norm	5.5 (1.5)	6.0 (1.1)	6.1 (1.1)	<.001	P & ID > NI
Descriptive norm	4.4 (1.8)	4.7 (1.6)	4.5 (1.7)	.11	
Perceived Control	5.3 (1.7)	5.9 (1.3)	5.6 (1.5)	<.001	ID > NI
Behavioral Regulations					
Planning	2.7 (2.2)	3.9 (2.2)	3.3 (2.2)	<.001	ID > NI
Reflexive Processes					
Anticipated regret	5.4 (3.6)	7.4 (3.2)	7.1 (3.4)	<.001	P & ID > NI
Obligation	4.9 (3.3)	6.7 (2.9)	6.6 (2.8)	<.001	P & ID > NI
Regulation of alternatives	5.8 (2.7)	6.0 (2.4)	5.2 (2.2)	.11	

Note: P = participated, ID = interested but declined, NI = not interested. Motivational processes and behavioral regulations were rated on a 7-point scale, anticipated regret was measured on an 11-point scale, and obligation and regulation of alternatives were rated on a 10-point scale.

Table 6-2. Effects of telephone counselling on changes in exercise motivation in hematologic cancer survivors (N=51).

Variable	Baseline M (SD)	Post Study M (SD)	Mean change M (95% CI)	Between-group difference M (95% CI)	*p* value	Cohen's *d*
Motivational Processes						
Instrumental attitude						
TCE group	6.2 (0.4)	6.2 (0.7)	0.0 (-0.3 to 0.3)	0.5 (0.1 to 1.0)	.021	1.11
SDE group	6.3 (0.5)	5.8 (0.9)	-0.5 (-0.8 to -0.1)			
Perceived capability						
TCE group	6.3 (0.8)	6.5 (0.5)	0.2 (-0.0 to 0.5)	0.2 (-0.2 to 0.7)	.29	.22
SDE group	6.1 (1.0)	6.1 (1.1)	0.0 (-0.4 to 0.5)			
Affective attitude						
TCE group	5.4 (0.7)	5.6 (0.8)	0.2 (-0.1 to 0.5)	0.6 (0.1 to 1.2)	.021	.71
SDE group	5.4 (1.0)	5.2 (1.1)	-0.2 (-0.7 to 0.2)			
Perceived opportunity						
TCE group	6.3 (1.0)	6.4 (0.7)	0.1 (-0.3 to 0.6)	0.4 (-0.3 to 1.2)	.24	.50
SDE group	6.5 (0.5)	5.9 (1.6)	-0.6 (-1.2 to 0.0)			
Behavioral Regulation						
Action planning						
TCE group	5.3 (1.1)	6.0 (0.9)	0.7 (-0.2 to 1.2)	0.3 (-0.2 to 0.8)	.28	.24
SDE group	4.8 (1.4)	5.5 (1.0)	0.7 (0.1 to 1.2)			
Coping planning						
TCE group	4.9 (1.2)	5.9 (1.1)	1.0 (0.4 to 1.7)	1.4 (0.7 to 2.2)	<.001	1.04
SDE group	4.2 (1.5)	3.9 (1.8)	-0.3 (-0.9 to 0.3)			
Social support						
TCE group	29.2 (8.9)	25.2 (9.4)	-3.9 (-7.1 to -0.8)	1.9 (-2.1 to 6.0)	.33	.21
SDE group	29.6 (8.8)	23.3 (7.4)	-6.2 (-8.9 to -3.5)			
Reflexive Processes						
Exercise identity						
TCE group	3.5 (2.0)	4.6 (1.7)	1.1 (0.5 to 1.7)	0.6 (-0.1 to 1.3)	.09	.32
SDE group	4.2 (1.8)	4.3 (1.9)	0.1 (-0.2 to 0.5)			
Habit						
TCE group	3.1 (1.7)	3.8 (1.7)	0.7 (0.1 to 1.4)	0.4 (-0.4 to 1.2)	.32	.23
SDE group	3.5 (1.7)	3.5 (1.7)	0.0 (-0.5 to 0.5)			
Obligation						
TCE group	5.9 (0.7)	5.7 (1.0)	-0.2 (-0.6 to 0.2)	0.2 (-0.4 to 0.9)	.41	.20
SDE group	5.6 (1.2)	5.3 (1.3)	-0.3 (-0.7 to 0.2)			
Anticipated Regret						
TCE group	5.6 (0.8)	5.7 (0.9)	0.1 (-0.2 to 0.4)	0.2 (-0.2 to 0.7)	.35	.20
SDE group	5.7 (1.1)	5.6 (1.1)	-0.1 (-0.5 to 0.3)			
Regulation of alternatives						
TCE group	4.3 (1.2)	5.0 (1.1)	0.7 (0.1 to 1.2)	0.5 (-0.1 to 1.1)	.14	.45
SDE group	4.6 (1.0)	4.5 (1.0)	-0.1 (-0.6 to 0.4)			

Note: TCE = telephone counselling exercise group, SDE = self-directed exercise group. Between-group differences were adjusted for baseline values, age, sex, education, BMI, and cancer type.

Table 6-3. Path analyses of simple mediation models exploring psychosocial variables as mediators of intervention effects on aerobic exercise behavior.

	Path *a*				Path *b*				Path *c'*				Path *ab*			
Mediator variable	b	β	SE	95%CI	b	β	SE	95%CI	b	β	SE	95%CI	b	β	SE	95%CI
Instrumental attitude	0.50	0.59	0.26	0.06 to 1.11	11.91	0.07	0.14	-0.21 to 0.36	122.95	0.91	0.26	0.37 to 1.45	5.99	0.04	0.07	-0.07 to 0.26
Perceived capability	0.28	0.32	0.25	-0.19 to 0.84	37.45	0.24	0.13	-0.06 to 0.46	112.35	0.83	0.24	0.33 to 1.33	10.52	0.07	0.07	-0.02 to 0.28
Affective attitude	0.47	0.46	0.25	-0.05 to 0.99	27.20	0.20	0.13	-0.06 to 0.46	112.86	0.84	0.24	0.35 to 1.32	12.85	0.09	0.07	-0.01 to 0.30
Perceived opportunity	0.60	0.47	0.27	-0.08 to 1.03	29.70	0.28	0.12	0.02 to 0.53	112.61	0.83	0.25	0.33 to 1.34	17.95	0.13	0.08	0.01 to 0.36
Action planning	0.41	0.40	0.25	-0.11 to 0.92	20.07	0.15	0.14	-0.13 to 0.43	105.64	0.78	0.25	0.26 to 1.30	8.34	0.06	0.08	-0.02 to 0.34
Coping planning	1.73	0.96	0.22	0.51 to 1.40	14.39	0.19	0.15	-0.12 to 0.51	82.86	0.61	0.28	0.03 to 1.19	24.98	0.18	0.15	-0.03 to 0.56
Social support	2.15	0.25	0.20	-0.16 to 0.67	-2.08	-0.13	0.15	-0.45 to 0.18	132.81	0.98	0.23	0.52 to 1.45	-4.50	-0.03	0.06	-0.25 to 0.04
Exercise identity	0.81	0.45	0.17	0.10 to 0.80	21.48	0.28	0.18	-0.09 to 0.66	132.20	0.98	0.24	0.50 to 1.46	17.43	0.12	0.11	-0.05 to 0.41
Habit	0.58	0.33	0.22	-0.11 to 0.78	25.06	0.32	0.14	0.02 to 0.61	123.84	0.92	0.23	0.45 to 1.39	14.64	0.10	0.10	-0.01 to 0.42
Obligation	0.25	0.20	0.25	-0.31 to 0.72	48.84	0.43	0.13	0.17 to 0.69	109.05	0.81	0.23	0.34 to 1.28	12.25	0.09	0.25	-0.11 to 0.34
Regret	0.18	0.18	0.24	-0.30 to 0.67	25.62	0.19	0.14	-0.09 to 0.48	126.34	0.94	0.24	0.44 to 1.43	4.84	0.03	0.06	-0.03 to 0.26
Regulation of alternatives	0.63	0.55	0.26	0.02 to 1.09	6.61	0.05	0.13	-0.21 to 0.33	128.96	0.96	0.25	0.43 to 1.48	4.21	0.03	0.10	-0.12 to 0.29

Note. Path *a* refers to the effect of the intervention condition on the mediator variable. Path *b* refers to the effect of the mediator on aerobic exercise behavior. Path *c'* refers to the effect of the intervention condition on aerobic exercise behavior while controlling for the indirect effect of the mediator. Baseline values of aerobic exercise behavior and the mediator variable were controlled for in all paths. b = unstandardized regression coefficient, β = standardized regression coefficient, SE = standard error and CI = confidence intervals. 95%CIs for all paths are standardized and CIs for path *ab,* are bias corrected based on 5000 bootstrap samples.

CHAPTER 7: Discussion

7.1 OVERVIEW

The purpose of this dissertation was to understand and influence exercise behavior in HCS. Chapter 2 revealed that despite the majority of HCS holding an intention to do regular strength exercise, only 51% of those with an intention would translate it into meeting the strength exercise guideline. Furthermore, Chapter 2 provided support for the M-PAC framework in the context of strength exercise, where motivational processes were important for intention formation, while additional motivational, regulatory, and reflexive processes were important for translating intentions into strength exercise behavior. Chapter 3 provided similar support for the M-PAC in the context of aerobic exercise and found that up to 60% of those intending to do regular aerobic exercise were successful in translating their intention into meeting the aerobic guideline. Chapter 4 examined the possibility that some HCS who were meeting the strength guideline in Chapter 2 may also be meeting the aerobic guideline in Chapter 3, and as such revealed that overall, less than ¼ HCS were meeting both the aerobic and strength guideline combined, while ½ were not meeting either guideline. As expected, those meeting the combined guideline had a more favorable strength-specific M-PAC profile than those meeting the aerobic-only guideline, and a more favorable aerobic-specific M-PAC profile than those meeting the strength-only guideline, but surprisingly they also reported significantly more favorable aerobic-specific behavioral regulations and reflexive processes than those meeting the aerobic-only guideline, and more favorable strength-specific behavioral regulations and reflexive processes than those meeting the strength-only guideline. Chapter 5 demonstrated that a TC intervention based on the M-PAC can be feasible, efficacious in increasing aerobic exercise behavior, and may improve mental health aspects of QoL in HCS. Finally, Chapter 6 revealed that this TC intervention produced favorable effects on M-PAC variables, and that improvements in key

behavioral regulations and reflexive processes may mediate improvements in aerobic exercise behavior.

7.2 STRENGTHS AND LIMITATIONS

This dissertation has several important strengths and limitations that are discussed in detail in Chapters 2-6 as they pertain to each unique paper. In terms of novelty, Study 1 was the first to examine the I-B gap for any form of exercise in cancer survivors, the first to examine the I-B gap for strength exercise in any population, one of the few to quantify adherence to the four categories of the exercise guidelines, the first to examine the I-B gap and M-PAC correlates in such a context, and one of the few to examine the correlates of exercise in HCS. In terms of quality, Study 1 comprised of a large population-based sample of HCS, used validated psychosocial measures of exercise correlates, and assessed some level of self-selection bias by comparing responders and non-responders on demographic and medical variables. Study 2 demonstrated novelty as it was the first exercise intervention to use TC in HCS, the first to be guided by the M-PAC to reduce the I-B gap in cancer survivors, the first randomized controlled trial to examine the theoretical mechanisms of exercise behavior change in HCS using TC, and the first randomized trial to examine changes in M-PAC processes. Study 2 was also a high-quality trial based on its randomized controlled design, its use of self-directed exercise as a comparison group, an excellent adherence to the telephone intervention, 100% follow-up of post-intervention assessments, and documentation of self-selection bias.

Both studies were limited by the use of self-report measures which, especially for exercise behavior, can be subject to recall and reporting biases [1, 2]. Study 1 was also limited by the cross-sectional design. Ideally for the study of the I-B gap, participants would begin the study prior to having formed a behavioral intention, and be followed longitudinally for a reasonable

period of time to see if their intention translated into behavior. Further, the cross-sectional design limits the ability for causal inferences to be made between exercise correlates and exercise behavior. Another limitation of Study 1 is that not all variables within the M-PAC framework were assessed. Notably, measures of coping planning, habit, and identity were lacking in part because we were only beginning to discover prominent exercise correlates within the framework. Furthermore, by attempting to preliminarily validate our questionnaire for aerobic and strength exercise contexts via exploratory factor analyses (EFA), we lost some descriptive value in our measures of attitude and perceived control. A more appropriate test of how these questionnaire items align with the M-PAC framework would be a confirmatory factor analysis, which could have also been useful in circumventing the issue of subjectivity in the number of factors extracted from the EFAs using the scree test. Lastly, though we compared participants and non-participants on basic demographic and cancer variables, we did not have data on exercise and psychosocial variables for non-participants, and thus could not fully assess the representativeness of our sample to the greater HCS population. Admittedly, participants were likely more interested in exercise, active, and motivated than non-participants, and thus it is not clear whether results from Study 1 may be generalizable to all HCS or to other cancer survivor groups.

Study 2 was limited by its sole focus on aerobic exercise only and had no strength exercise component despite its recommendation within the combined exercise guideline. Unfortunately, the task of teaching novice exercisers proper strength training technique through TC appeared too potentially hazardous without sound prior evidence of a structured approach. Thus, we still do not know whether a TC intervention based on the M-PAC can influence strength exercise behavior. Furthermore, the lack of contact-control means that the effects of the TC intervention cannot be isolated to the utility of the M-PAC-based content or if simply

communicating to someone generally about exercise via telephone on a weekly influences aerobic exercise behavior. Similarly, the notable absence of an intention-focused comparator group (i.e., one targeting TPB constructs), does not allow for conclusions as to whether the focus on constructs targeting the I-B gap within the M-PAC framework served as an improvement over more traditional intention-focused interventions. Thus, multiple simple mediation analyses were needed to suggest the added value of the M-PAC framework on an exploratory level. The short intervention duration and lack of long-term follow-up means that any sustained effects of the intervention are unknown, and meant that the tenets of the M-PAC's understanding of behavioral maintenance went largely untested. Finally, the small and highly motivated sample hindered the ability to detect significant differences in secondary patient-reported outcomes and may limit the generalizability of results to HCS overall.

7.3 PRACTICAL IMPLICATIONS

Some of the notable strengths of this dissertation have practical implications to HCS and the field of exercise oncology. By quantifying the prevalence of exercise guideline adherence and the I-B gap in HCS, this dissertation highlights a need to support HCS improve their exercise behavior. Seeing that HCS have arduous cancer experiences from having to go through extreme acute treatments or long-term disease management [3], their compromised health status results in a large demand placed on the Canadian health care system [4-6]. Fortunately, prior evidence has demonstrated the feasibility and efficacy for regular exercise participation in improving health and QoL in HCS [7-10], but the potential for leveraging exercise as an important modifiable health behavior for HCS remained largely incomplete. For example, if it was revealed that the majority of HCS were already physically active, the further promotion of improving exercise behavior would likely yield minimal additional benefit to HCS. This dissertation now documents

that that few HCS were sufficiently active as established by the exercise guidelines for cancer survivors to reap associated health and QoL benefits, thus further emphasizing the role for exercise as a potential mechanism for health-promotion in HCS.

Furthermore, applying the M-PAC framework to the study of exercise correlates allowed for the quantification and a better understanding of the I-B gap. This may have implications for the exercise oncology field and more specifically to the study of exercise correlates, which has been largely centered around the TPB as the grounding theory of focus [11-18]. Though the TPB is excellent in framing the determinants of exercise intention formation, its utility in the face of substantial I-B gaps has been critiqued extensively [19-22], and reflects a limitation of the current understanding of psychosocial exercise correlates in cancer survivors. By demonstrating support for the tenets of the M-PAC framework and the level of the I-B discordance in Chapters 2-4 (i.e., Papers 1-3), perhaps researchers will be convinced of the importance of similarly examining the determinants of both intention formation and translation. Furthermore, Chapter 4 (Paper 3) provides an additional framework for examining exercise correlates as they pertain to the guidelines for cancer survivors which recommends that survivors do both regular aerobic and strength exercise [23, 24]. Despite tradition pushing researchers to examine correlates separately for aerobic and strength exercise, only one prior study considered that some survivors who meet one guideline might also be meeting the other [25]. This prior study however did not capture important psychosocial correlates, and only focused on demographic and medical correlates which may be less specific and sensitive in their influence on exercise behavior. Overall, using the M-PAC to study exercise correlates for aerobic exercise, strength exercise, or both simultaneously, appears to be quite useful for guiding the development of exercise interventions

by structuring an approach to help participants first form an intention and then secondly translate this intention into behavior.

Study 2 effectively demonstrated that a TC intervention based on the M-PAC model can improve aerobic exercise behavior in HCS, exercise motivation, behavioral regulations, and reflexive processes, as well as perhaps improving their mental health. This study had direct practical implications for HCS who participated in the trial and were able to increase their aerobic exercise behavior and improve their QoL. This study may also have practical implications for informing future Phase III trials because this type of intervention delivery can be cost-saving, wider-reaching, and more time-efficient for participants versus supervised exercise, and still effective in terms of influencing exercise behavior. Furthermore, because few trials to-date have applied the M-PAC, by demonstrating changes in M-PAC processes, this study adds preliminary evidence that these constructs can be malleable and influence subsequent changes in exercise behavior, thus serving as useful intervention targets.

7.4 FUTURE RESEARCH DIRECTIONS

Though this dissertation adds to the field of exercise oncology, advances can be made by addressing some of the notable limitations of this dissertation. For example, a fair critique of this work is its reliance of self-report measures of exercise. Though self-report is a reasonable indicator of actual exercise behavior [26], it is subject to recall and reporting biases which hampers its accuracy [1, 2]. There is no doubt that the integration of objective measures of exercise behavior would add rigor to future exercise correlates studies or exercise behavior change. Still, some challenges with the collection of objective exercise data exists, most notably the lack of consensus on the optimal means of collecting objective strength exercise data, and the added influence of the Hawthorne effect (i.e., observer bias). Perhaps the recent emergence of

improved fitness tracking devices and applications brings us closer to being able to validly track strength exercise behavior at a distance, as the use of accelerometers and exercise logs have become more ubiquitous than ever before. With such technology, perhaps researchers could gain access to objective exercise data recalled from prior to the study's initiation (thus removing the influence of observer bias) but issues with participant compliance and the standardization across apps and devices remain. Thus, an important step would necessitate the development of algorithms to standardize the interpretation of aerobic and strength exercise data across devices and apps for use in future research [27-30].

Thoughtful consideration of appropriate control conditions for exercise interventions may improve our understanding of the effectiveness of behavior change techniques. Common amongst exercise behavior change trials, control conditions entail usual care, which often provides no overt recommendation to increase exercise behavior [31-33]. Study 2 of this dissertation improved on this norm by challenging all participants to increase their exercise behavior, including those in the control group who were self-directed with their exercise. This arguably serves as a more realistic control condition which adds incremental value to the evaluation of the TC intervention. Still, without providing adequate contact-control to those who were self-directed with their exercise meant that effects from TC could not be isolated to the influence placed on theory-based exercise correlates. Thus, it seems important to assess whether a M-PAC-based TC intervention would still hold added value in improving aerobic exercise behavior over weekly generic exercise advice, or better yet, versus a TPB-based (i.e., intention-focused) intervention.

An additional important extension to Study 2 would be the integration of home-based strength exercise. If researchers can develop a strength training program that could be safe in

unsupervised settings, standardized across participants, and foster adequate compliance, it would be interesting to test whether the application of the M-PAC through TC could also help improve strength exercise in addition to or simultaneously with aerobic exercise. Perhaps such programming could center around the use of resistance bands which could be more readily be delivered to participants' homes and be used to target all major muscle groups. Still guiding participants to use effective and safe techniques for exercises remains a great enough challenge in supervised exercise settings that no doubt additional risks would be incurred in such home-based training. Perhaps emerging app-based technologies can help mitigate these risks by providing participants access to electronic "personal" trainers that could guide proper technique for their exercises in an at-home-setting [34, 35]. Finally, it is important to note that similar to many other unsupervised exercise interventions in cancer survivors [26, 36-42], significant improvements on patient-reported outcomes were absent in Study 2. Perhaps relatively favorable levels of QoL and fatigue noted at baseline thwarted some effects, however, supervised exercise trials have been able to produce significant improvements in similar circumstances [43]. Thus, perhaps future TC interventions may promote greater improvements in patient-reported outcomes if they implemented more demanding exercise prescriptions such as high-intensity interval training (HIIT) instead of generic walking, progressed participants through more demanding exercise prescriptions more rapidly, and allowed for additional social interaction between study participants [43, 44].

Another important potential direction for future research is the investigation of the I-B gap in other cancer survivor groups. This dissertation was exclusively focused on HCS as they represent a diverse and largely underrepresented cancer survivor group in the literature, but the extent to which the I-B gap would differ in magnitude or correlates across other groups.

Presumably because other cancer survivor groups report differences in exercise behavior, the magnitude and important correlates of the I-B gap may too differ. Ultimately this greater understanding of the I-B gap and its correlates in other cancer survivor groups the targeting of interventions. Perhaps in the pursuit of better intervention targeting researchers can also lean on analytic methods that are novel to the field. For example, though not considered traditional hypothesis testing, machine learning in the context of classification decision tree modelling may yield algorithms that allow researchers to approach exercise behavior change from a precision medicine perspective [45, 46]. In other words, algorithms that reveal the behavioral implications of the interplay between meaningful thresholds on psychosocial variables can be used to move from group-based targeting efforts to individual-level program tailoring.

Given the preliminary nature of Study 2 and its promising findings, conducting a more definitive phase III trial in HCS seems appropriate. I would propose that this follow-up trial incorporate a two-armed randomized controlled design targeting improvements in aerobic exercise behavior, where the intervention condition would again receive 12-weeks of TC based on the M-PAC (i.e., targeting intention formation and translation), and the control condition would receive 12-weeks of TC based on the TPB (i.e., targeting intention formation). Furthermore, to maximize clinical relevance and practicality for HCS themselves, the trial would benefit from being powered to detect meaningful changes in important patient-reported outcomes (i.e., QoL). Because these changes seem to depend on changes in cardiorespiratory fitness [37], it would seem important to gather accurate measures of aerobic exercise behavior and physical fitness in order to explain the mechanism of QoL change. Thus, in addition to capturing survey data on processes from the M-PAC, using research-grade accelerometers and remote heart-rate

monitors to measure aerobic exercise behavior, and testing VO2max within a laboratory setting are recommended.

7.5 CONCLUSIONS

This dissertation aimed to examine and influence exercise behavior in HCS. In doing so, Study 1 of this dissertation revealed that few HCS were sufficiently active, possibly as a result of the existence of large I-B gaps for aerobic exercise, strength exercise, or both simultaneously. By examining the correlates of intention formation, a framework for helping HCS want to do exercise indicated a need to target the M-PAC's motivational processes, while the correlates of intention translation showed that targeting the M-PAC's ongoing motivational processes, behavioral regulations, and reflexive processes could help improve exercise behavior. Furthermore, it was suggested that should HCS wish to receive assistance to meet both aerobic and strength exercise guidelines simultaneously, interventionist should target the M-PAC processes for both types of exercise even if they are already meeting one of the guidelines. By applying evidence from Study 1, Study 2 attempted to influence exercise behavior in HCS through a TC intervention based on the M-PAC. This TC intervention was feasible, demonstrated preliminary efficacy in improving aerobic exercise behavior, and may have improved mental health aspects of QoL. Furthermore, the TC intervention improved HCS' motivational processes and behavioral regulations, while changes in coping planning, perceived opportunity, exercise identity, and habit emerged as potential mediators of aerobic exercise behavior. Therefore, applying the M-PAC framework appears to be useful for influencing exercise behavior change and understanding its correlates. Should a more definitive Phase III trial demonstrate improvements in exercise behavior and patient-reported outcomes in HCS or

other cancer survivor groups, TC interventions based on the M-PAC may be intriguing alternatives to supervised exercise interventions for improving cancer survivors' health and QoL.

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Chapter 7

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Appendix A – *Study 1 materials*

Recruitment letter

Questionnaire

Recruitment Letter

Behavioural Medicine Laboratory
Faculty of Physical Education and Recreation

Kerry S. Courneya, PhD
E-488 Van Vliet Center
Edmonton, Alberta, Canada T6G 2H9

Tel: 780.492.1031
Fax: 780.492.8003
E-mail: kerry.courneya@ualberta.ca

Dear Madam or Sir,

My name is Kerry Courneya and I am a Professor and Canada Research Chair at the University of Alberta. I am also a Scientific Staff member of the Cross Cancer Institute in Edmonton. As part of my responsibilities, I conduct research on the health of cancer survivors. The Alberta Cancer Registry is contacting you on my behalf to see if you might be interested in participating in a survey questionnaire study which requires the voluntary participation of people who were diagnosed with one of the hematologic cancers (i.e., Hodgkin lymphoma, non-Hodgkin lymphoma, or leukemia). This study has been approved by the Alberta Cancer Research Ethics Committee and the University of Alberta Health Research Ethics Board, and has met rigorous requirements for ethical approval.

Research has shown that regular aerobic and strength exercise is good for hematologic cancer survivors, however many survivors do not exercise enough to improve their health. One important question that remains unanswered relates to what motivates hematologic cancer survivors to exercise regularly. By gaining a better understanding of exercise motives in hematologic cancer survivors, we may be able to help these survivors exercise regularly and improve their own health.

To participate in this study, all you need to do is complete the enclosed questionnaire and return it to us at your earliest convenience in the self-addressed stamped envelope. Even if you don't currently exercise, your participation in this study is still extremely valuable. Your participation involves only the completion of this one questionnaire that takes between 30-45 minutes to complete. For this study, you will not be asked to follow an exercise program; we are merely interested in your current thoughts about exercise. It is only by understanding the motives and barriers of both exercisers and non-exercisers that we can hope to gain a complete understanding of exercise behavior in hematologic cancer survivors.

Your participation in this study is completely voluntary. Any information that you provide will be held in strict confidence. If at any time you have questions about the study, please contact my Research Coordinator James Vallerand at (780) 492-2829 or e-mail james.vallerand@ualberta.ca for more information.

Thank you for considering our study.

Sincerely,

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

Questionnaire

Date Completed: _____ Identification #_____

Exercise in Hematologic Cancer Survivors

Principal Investigators:

Kerry S. Courneya, PhD, University of Alberta

James R. Vallerand, PhD Student, University of Alberta

Instructions

We sincerely 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 exercise activities. Even if you don't currently exercise, your participation in this study is still extremely valuable. All responses are completely confidential and will never be used in any way that could link them to you. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible. Many of the questions may seem similar but it is important to treat each question separately and provide an answer for each. If at all possible, please complete all questions so that we can include your responses in our analysis. The survey should take about 30-45 minutes to complete. If you have any questions about completing the survey, please email James Vallerand at (james.vallerand@ualberta.ca) or phone 1-780-492-2829.

1. For this first question, we would like you to recall your average weekly exercise during the past month. We will ask you separate questions about aerobic or endurance exercise (i.e., exercise that improves the heart and lungs such as walking or running) and strength or resistance exercise (i.e., exercise that improves muscular strength such as weight lifting).

When answering these questions please remember:

- 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 categories 'a,' 'b', and 'c' is the intensity of the aerobic (endurance) exercise 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 exercise 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 aerobic and strength exercise and what was the average duration?

	Average Frequency (days per week) (0-7 days)	Average Duration (minutes per session) (0-120 minutes)
a. VIGOROUS INTENSITY **AEROBIC** EXERCISE (HEART BEATS RAPIDLY, SWEATING) (e.g., running, aerobics classes, cross country skiing, vigorous swimming, vigorous bicycling).	_____ days	_____ minutes
b. MODERATE INTENSITY **AEROBIC** EXERCISE (NOT EXHAUSTING, LIGHT PERSPIRATION) (e.g., fast walking, tennis, easy bicycling, easy swimming, popular and folk dancing).	_____ days	_____ minutes
c. LIGHT INTENSITY **AEROBIC** EXERCISE (MINIMAL EFFORT, NO PERSPIRATION) (e.g., easy walking, yoga, bowling, lawn bowling, shuffleboard).	_____ days	_____ minutes
d. **STRENGTH** EXERCISE (MODERATE TO INTENSE EFFORT) (e.g., weight lifting, resistance bands, sit-ups, push-ups)	_____ days	_____ minutes

2. The following set of questions ask you to rate how you feel about doing regular **aerobic exercise** over the next month.

- As a reminder, aerobic exercise is any activity that improves the heart and lungs such as brisk walking, jogging, biking, swimming, etc.
- By regular, we mean that you do aerobic exercise for at least 75 minutes per week at a vigorous intensity (i.e., heavy sweating, heavy breathing, fast heart rate) or 150 minutes per week at a moderate intensity (i.e., some sweating, increased breathing, increased heart rate).
- The total exercise minutes can be completed with different frequencies and durations. For example, you could do the 150 minutes of moderate intensity aerobic exercise per week by walking briskly 3 days per week for 50 minutes each time or 5 days per week for 30 minutes each time.

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 aerobic exercise 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

3. This next set of statements and questions asks you to rate how other people in your life would feel about you participating in regular **aerobic exercise** 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 aerobic exercise 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

4. These next questions ask you to rate how much aerobic exercise you think other people in your life are likely to do themselves over the next month. Please answer all items from (a) to (c).

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

(a)	1 no aerobic exercise	2	3	4 some aerobic exercise	5	6	7 regular aerobic exercise

I think that over the next month, most people who are important to me will participate in regular aerobic exercise…

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

I think that over the next month, most people who are important to me will participate in regular aerobic exercise…

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

5. These next statements and questions ask you to rate how likely it is that you would be able to participate in regular **aerobic exercise** over the next month if you were really motivated. Please pay careful attention to the words in each scale. Circle the number that best represents how you feel. Please answer all items from (a) to (f).

Again, by regular aerobic exercise we mean that you do aerobic exercise for at least 75 minutes per week at a vigorous intensity (i.e., heavy sweating, heavy breathing, fast heart rate) or 150 minutes per week at a moderate intensity (i.e., some sweating, increased breathing, increased heart rate).

If I were really motivated…

a. The amount of control I would have over doing regular aerobic exercise over the next month would be…

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

b. Whether or not I engage in regular aerobic exercise over the next month would be 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. I would have complete control over how much I engaged in aerobic exercise over the next month…

1	2	3	4	5	6	7
not at all			somewhat			very much

d. Participating in regular aerobic exercise over the next month would be...

1	2	3	4	5	6	7
extremely difficult	quite difficult	slightly difficult	neither	slightly easy	moderately easy	extremely easy

e. I could easily engage in regular aerobic exercise 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. The level of confidence I would have in doing regular aerobic exercise over the next month would be…

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

6. This next set of questions asks you about your intention and motivation to do regular **aerobic exercise** over the next month. Pay careful attention to the words at the end of each scale.

a. Do you intend to do regular aerobic exercise over the next month? (please circle)? Yes No

b. Over the next month, I intend to engage in aerobic exercise for _____ days per week and for _____ duration (minutes) each time.

c. Do you intend to do regular aerobic exercise over the next month?

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

d. How motivated are you to do regular aerobic exercise over the next month?

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

e. How dedicated are you to doing regular aerobic exercise over the next month?

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

f. How committed are you to doing regular aerobic exercise over the next month?

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

7. This next set of questions asks you about your feelings towards doing regular **aerobic exercise** over the next month. Please pay careful attention to the words in each scale. Circle the number that best represents how you feel. Please answer all items from (a) to (m).

a. If I do not engage in regular aerobic exercise over the next month, I will feel regret.

1	2	3	4	5	6	7	8	9	10	11
Definitely No										**Definitely yes**

b. If I do not engage in regular aerobic exercise over the next month, I will feel upset.

1	2	3	4	5	6	7	8	9	10	11
Definitely No										**Definitely yes**

c. I feel obligated to do regular aerobic exercise over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

d. I feel it is necessary for me to do regular aerobic exercise over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

e. I feel it is my duty to do regular aerobic exercise over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

f. Compared to doing regular aerobic exercise over the next month, there are other things I could do which would be more fun…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

g. Compared to doing regular aerobic exercise over the next month, there are other things I could do which would be more enjoyable…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

h. Compared to doing regular aerobic exercise over the next month, there are other things I could do which would be more worthwhile…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

i. I would be happier doing something else instead of doing regular aerobic exercise over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

j. I have invested a lot of effort into doing regular aerobic exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

k. I have invested a lot of energy into doing regular aerobic exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

l. I have invested a lot of time into doing regular aerobic exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

m. I have invested a lot of my own money into doing regular aerobic exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

8. This next set of questions asks you about your plans to do regular **aerobic exercise** over the next month. Please pay careful attention to the words in each scale. Circle the number that best represents how you feel. Please answer all items from (a) to (f).

a. Do you have plans for when, where, and what type of regular aerobic exercise you will do in the next month?

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

b. I have made plans concerning 'when' I am going to engage in regular aerobic exercise over the next month.

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

c. I have made plans concerning 'where' I am going to engage in regular aerobic exercise over the next month.

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

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

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

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

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

f. I have made plans concerning 'who' I am going to engage in regular aerobic exercise with over the next month.

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

9. The following set of questions now ask you to rate how you feel about doing regular **strength exercise** over the next month.

- As a reminder, strength exercise is any activity that improves muscular strength such as weight lifting, resistance band training, push ups, sit ups, etc.
- By regular, we mean that you do strength exercise for at least 2 days per week.

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 strength exercise 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

10. This next set of statements and questions asks you to rate how other people in your life would feel about you participating in regular **strength exercise** 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 strength exercise 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

10. These next questions ask you to rate how much strength exercise you think other people in your life are likely to do themselves over the next month. Please answer all items from (a) to (c).

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

(a)	1 no strength exercise	2	3	4 some strength exercise	5	6	7 regular strength exercise

I think that over the next month, most people who are important to me will participate in regular strength exercise…

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

I think that over the next month, most people who are important to me will participate in regular strength exercise over the next month…

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

11. These next statements and questions ask you to rate how likely it is that you would be able to participate in regular **strength exercise** over the next month if you were really motivated. Please pay careful attention to the words in each scale. Circle the number that best represents how you feel. Please answer all items from (a) to (f).

Again, by regular strength exercise we mean that you do strength exercise for at least 2 days per week.

If I were really motivated…

a. The amount of control I would have over doing regular strength exercise over the next month would be…

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

b. Whether or not I engage in regular strength exercise over the next month would be 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. I would have complete control over how much I engaged in regular strength exercise over the next month…

1	2	3	4	5	6	7
not at all			somewhat			very much

d. Participating in regular strength exercise over the next month would be...

1	2	3	4	5	6	7
extremely difficult	quite difficult	slightly difficult	neither	slightly easy	quite easy	extremely easy

e. I could easily engage in regular strength exercise 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. The level of confidence I would have over doing regular strength exercise over the next month would be…

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

12. This next set of questions asks you about your motivation to do regular **strength exercise** over the next month. Pay careful attention to the words at the end of each scale.

a. Do you intend to do regular strength exercise over the next month? (please circle) Yes No

b. Over the next month, I intend to engage in strength exercise for _____ days per week and for _____ duration (minutes) each time.

c. Do you intend to do regular strength exercise over the next month?

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

d. How motivated are you to do regular strength exercise over the next month?

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

e. How dedicated are you to doing regular strength exercise over the next month?

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

f. How committed are you to doing regular strength exercise over the next month?

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

13. This next set of questions asks you about your feelings towards doing regular **strength exercise** over the next month. Please pay careful attention to the words in each scale. Circle the number that best represents how you feel. Please answer all items from (a) to (m).

a. If I don't do regular strength exercise over the next month, I will feel regret…

1	2	3	4	5	6	7	8	9	10	11
Definitely No										**Definitely yes**

b. If I don't do regular strength exercise over the next month, I will feel upset...

1	2	3	4	5	6	7	8	9	10	11
Definitely No										**Definitely yes**

c. I feel obligated to do regular strength exercise over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

d. I feel it is necessary for me to do regular strength exercise over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

e. I feel it is my duty to do regular strength over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

f. Compared to doing regular strength exercise over the next month, there are other things I could do which would be more fun…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

g. Compared to doing regular strength exercise over the next month, there are other things I could do which would be more enjoyable…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

h. Compared to doing regular strength exercise over the next month, there are other things I could do which would be more worthwhile…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

i. I would be happier doing something else instead of doing regular strength exercise over the next month…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

j. I have invested a lot of effort into doing regular strength exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

k. I have invested a lot of energy into doing regular strength exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

l. I have invested a lot of time into doing regular strength exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

m. I have invested a lot of my own money into doing regular strength exercise…

1	2	3	4	5	6	7	8	9	10
Not at all true for me									**Completely true for me**

14. This next set of questions asks you about your plans to do regular **strength exercise** over the next month. Pay careful attention to the words at the end of each scale.

a. Do you have plans for when, where, and what type of regular strength exercise you will do in the next month?

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

b. I have made plans concerning 'when' I am going to engage in regular strength exercise over the next month.

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

c. I have made plans concerning 'where' I am going to engage in regular strength exercise over the next month.

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

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

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

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

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

f. I have made plans concerning 'who' I am going to engage in regular strength exercise with over the next month.

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

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 or check "don't know" (DK).

a. Which type of hematologic cancer did/do you have?

_____ Leukemia _____ Hodgkin Lymphoma
_____ non-Hodgkin Lymphoma

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

c. What stage of cancer did/do you have?

_____ Stage I _____ Stage II _____ Stage III _____ Stage IV _____ DK

d. How did the doctor(s) describe your cancer?

_____ early/local disease _____ late/advanced disease _____ DK

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

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

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

h. Did your treatment include a stem cell or bone marrow transplant? (please circle) Yes No DK

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

_____ I have completed all my cancer treatments for now.

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

j. Have you ever had a recurrence of your cancer? (please circle) Yes No

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

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

_____ the doctors have told me that I still have cancer.

16. People with cancer frequently have symptoms that are caused by their disease or by their treatment. We ask to rate how severe the following symptoms have been <u>in the last week (7 days)</u>. Please fill in the circle below from 0 (symptom has not been present) to 10 (the symptom was as bad as you can imagine it could be) for each item.

	NOT PRESENT 0	1	2	3	4	5	6	7	8	9	**AS BAD AS YOU CAN IMAGINE** 10
a. Your **pain** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
b. Your **fatigue (tiredness)** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
c. Your **disturbed sleep** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
d. Your feeling of being **distressed (upset)** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
e. Your **shortness of breath** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
f. Your problem with **remembering things** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
g. Your problem with **lack of appetite** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
h. Your **hot flash** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
i. Your having a **dry mouth** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
i. Your feeling **sad** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
j. Your **vomiting** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
k. Your **numbness or tingling** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
l. Your **diarrhea** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
m. Your **swelling of your hands, legs, feet, abdomen, or around your eyes** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
n. Your **rash, blisters, or skin change** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
o. Your **muscle soreness or cramping** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
p. Your **bruising easily or bleeding** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
q. Your **feeling of malaise (not feeling well)** at its WORST?	○	○	○	○	○	○	○	○	○	○	○
q. Your **headache** at its WORST?	○	○	○	○	○	○	○	○	○	○	○

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

a. How would you rate your general health?

_____ Excellent_____ Very Good _____ Good _____ Fair _____ Poor

b. 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? _____

c. 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

d. 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): _____

18. 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. Height _____ Weight _____

c. Current Marital Status: Never Married _____ Married _____

Common Law _____ Separated _____ Widowed _____ Divorced _____

d. Do you have any children living at home? _____No _____Yes

If yes, how many? _____ (number of children)

e. Education (Please check highest level attained):

Some High School _____ Fully Completed High School _____

Some University/College _____ Fully Completed University/College _____

Some Graduate School _____Fully Completed Graduate School _____

f. Annual Family Income:

< 20,000 _____ 20-39,999 _____ 40-59,999 _____

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

g. Current Employment Status:

Disability _____ Retired _____ Part Time _____

Homemaker _____ Full Time _____ Temporarily Unemployed _____

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

White Black Hispanic Asian Aboriginal Other _____

19. Would you be interested in participating in a 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.

☐ Please do not contract me about any future exercise study

☐ Sure, you have my permission to contact me about a future exercise study
(please provide contact information below)

Name: _____

Address: _____

_____

Telephone: Home: _____ cell: _____

E-mail: _____

How do you prefer we contact you? _____

When do you prefer we contact you? (days and/or times) _____

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, exercise, 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 B – *Study 2 materials*

Recruitment letter

Pre-study questionnaire

Baseline questionnaire

Post-intervention questionnaire

Telephone counselling intervention guide

Recruitment letter

Dear Madam/Sir,

Previously, you took part in a voluntary survey study looking at physical activity among hematologic cancer survivors. We thank you for completing that survey, and we are pleased to inform you that you were one of more than 600 survivors who completed that survey! Moreover, we are delighted to share with you that our first couple manuscripts, which report the results from that study, have been published!

We are also very pleased that you were one of 407 hematologic cancer survivors who indicated interest in being contacted to participate in 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 exercise levels.

If you decide to participate in this study, you will be asked to increase your weekly amount of exercise by at least 60 minutes per week, over a 12-week period. In doing so, you will be randomly assigned to 1 of 2 exercise groups: (1) a self-directed exercise group or (2) a telephone-counselling 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 online. Those randomized to the self-directed exercise group will be given Canada's physical activity guideline to follow on their own. Those randomized to the telephone counselling exercise group will be asked to take part in weekly telephone calls for 12 weeks, to help coach them while they try to increase their 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.

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 hematologic cancer survivors, which will be used to help develop physical activity programs to improve quality of life among hematologic cancer survivors. Thank you for taking time to consider our project.

If you have any questions about the study, would like to participate, would like a full copy of either publication, or do not wish to be contacted again, please email or call the study coordinator James Vallerand at james.vallerand@ualberta.ca or 1-780-492-8246.

Thank you for considering our study.

Sincerely,

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

James R. Vallerand, PhD Candidate
Co-Investigator
Study Coordinator
University of Alberta

Pre-study questionnaire

Confidential

Pre-Study Survey - Increasing Weekly Aerobic Exercise in Hematologic Cancer Survivors

Increasing Weekly Aerobic Exercise in Hematologic Cancer Survivors

Pre-Study Survey

Principal Investigators:

Kerry S. Courneya, PhD, University of Alberta

James R. Vallerand, PhD Student, University of Alberta

Instructions

We sincerely thank you for your interest in participating in this study. Before we can include you into this study, we need some additional background information from you to help us understand who might be interested in such a study and to make sure that asking you to increase your weekly exercise will be safe for you.

In this questionnaire, we are going to ask you for your demographic, health, cancer, and exercise information. All responses are completely confidential and will never be displayed in any way that could link them to you. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible.

Many of the questions may seem similar but it is important to treat each question separately and provide an answer for each. If at all possible, please complete all questions so that we can include your responses in our analysis. The survey should take about 10-15 minutes to complete.

If you have any questions about completing the survey, please email James Vallerand at (james.vallerand@ualberta.ca) or call at (1-780-492-8246).

---

1) This first part of the questionnaire is needed to confirm your contact information and help us 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 and will never be shared.

Preferred contact name _____
(You will be addressed as such in follow-up emails)

Preferred phone number _____
(###-###-####)

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What's your age in years?
_____
(# of years)

Sex/gender
◯ Female ◯ Male

Height
_____
(in feet and inches (e.g., 6'1"))

Weight
_____
(in pounds (lbs))

Current Marital Status
◯ Never Married
◯ Married
◯ Common Law
◯ Separated
◯ Widowed
◯ Divorced

Education (Please check highest level attained):
◯ Some High School
◯ Fully Completed High School
◯ Some University/College
◯ Fully Completed University/College
◯ Some Graduate School
◯ Fully Completed Graduate School

Annual Family Income
◯ < 20,000
◯ 20 - 39,999
◯ 40 - 59,999
◯ 60 - 79,999
◯ 80 - 99,999
◯ > 100,000

Current Employment Status
◯ Temporarily Unemployed
◯ Disability
◯ Retired
◯ Part Time
◯ Homemaker
◯ Full Time

Primary ethnic origin or race
◯ White
◯ Black
◯ Hispanic
◯ Asian
◯ Aboroginal
◯ Other

Confidential

2) Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. This questionnaire will tell you if you should check with your doctor before you start.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?	◯ Yes ◯ No
Do you feel pain in your chest when you do physical activity?	◯ Yes ◯ No
In the past month, have you had chest pain when you were not doing physical activity?	◯ Yes ◯ No
Do you lose your balance because of dizziness or do you ever lose consciousness?	◯ Yes ◯ No
Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?	◯ Yes ◯ No
Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?	◯ Yes ◯ No
Do you know of any other reason why you should not do physical activity	◯ Yes ◯ No

Confidential

3) 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 indicate or check "don't know" (DK).

Which type of hematologic cancer did/do you have?
- ◯ Leukemia
- ◯ Hodgkin Lymphoma
- ◯ Non-Hodgkin Lymphoma

When were you diagnosed with this cancer (month/year)?
_____
(If not sure on the day, please use the first of the month. If not sure on the month, please use January of that year.)

What stage of cancer did/do you have?
- ◯ Stage I
- ◯ Stage II
- ◯ Stage III
- ◯ Stage IV

How did the doctor(s) describe your cancer?
- ◯ early/local disease
- ◯ late/advanced disease

Did your cancer treatment include surgery?
- ◯ Yes
- ◯ No

Did your cancer treatment include radiation therapy?
- ◯ Yes
- ◯ No

Did your cancer treatment include chemotherapy/drugs?
- ◯ Yes
- ◯ No

Did your cancer treatment include a stem cell or bone marrow transplant?
- ◯ Yes
- ◯ No

What is the current status of your cancer treatments?
- ◯ I have completed all my medical cancer treatments for now.
- ◯ I am still receiving medical cancer treatments.

Have you ever had a recurrence of your cancer?
- ◯ Yes
- ◯ No

What is the current status of your cancer?
- ◯ the doctors have told me that my cancer is gone.
- ◯ the doctors have told me that I still have cancer.

Confidential

For this next question, we would like you to recall your average weekly exercise during the past month. We ask that you report on your aerobic or endurance exercise (i.e., exercise that improves the heart and lungs such as walking or swimming).

When answering these questions please:

- **Only count exercise that was done during free time (i.e., not occupation or housework).**
- **Only count exercise sessions that lasted 15 minutes or longer in duration.**
- **Note that we are asking you to report your weekly aerobic exercise levels separately based on intensity levels (vigorous, moderate, or light).**
- **If you did not do any exercise in one of the categories, please write in "0" as your average frequency (# of days you do this level of aerobic exercise per week) and "0" as your average duration (# of minutes you do this level of aerobic exercise on a given active day).**
- **If you did exercise in one of the categories, please fill-in the average frequency (# of days you did this level of aerobic exercise per week) and average duration (# of minutes you did this level of aerobic exercise on a given active day). Multiplying your average frequency with your average duration should give us your total weekly minutes spent doing aerobic exercise at each given intensity.**

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

Average frequency of VIGOROUS intensity aerobic exercise
(Heart beats rapidly, Sweating after only a few minutes, You can't say more than a few words without pausing for breath.)
(e.g., vigorous running, jogging, sports, cross country skiing, swimming, long-distance bicycling).

((On a typical week, report the average # of days you did VIGOROUS aerobic exercise))

◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7

Average duration of VIGOROUS intensity aerobic exercise

_____
((On a typical day of VIGOROUS exercise, report the average # of minutes you did aerobic exercise at this intensity))

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Average frequency of MODERATE intensity aerobic exercise
(Not exhausting, Light perspiration, You can carry on a conversation but you can't sing)
(e.g., fast walking, baseball, tennis, easy bicycling, badminton, easy swimming, popular and folk dancing).

((On a typical week, report the average # of days you did MODERATE aerobic exercise))

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

Average duration of MODERATE intensity aerobic exercise

_____
((On a typical day of MODERATE exercise, report the average # of minutes you did aerobic exercise at this intensity))

Average frequency of LIGHT intensity aerobic exercise
(Minimal effort, No perspiration, Could whistle while doing the activity)
(e.g., easy walking, yoga, bowling, golf, shuffleboard).

((On a typical week, report the average # of days you did LIGHT aerobic exercise))

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

Average duration of LIGHT intensity aerobic exercise

_____
((On a typical day of LIGHT exercise, report the average # of minutes you did aerobic exercise at this intensity))

Weekly minutes of moderate-to-vigorous exercise _____

Baseline questionnaire

Confidential

Baseline Survey - Increasing Weekly Aerobic Exercise in Hematologic Cancer Survivors

Increasing Weekly Aerobic Exercise in Hematologic Cancer Survivors

Baseline Survey

Principal Investigators:

Kerry S. Courneya, PhD, University of Alberta

James R. Vallerand, PhD Student, University of Alberta

Instructions

We sincerely thank you for taking the time to complete the previous pre-study survey and agreeing to participate in this study. This next questionnaire marks the start of the 12-week study. Here we are going to ask you a series of questions about your feelings towards exercise, and about your general health.

Again, all responses are completely confidential and will never be displayed in any way that could link them to you. There are no right or wrong answers and all we ask is that you provide responses that are as honest and accurate as possible. Many of the questions may seem similar but it is important to treat each question separately and provide an answer for each. If at all possible, please complete all questions so that we can include your responses in our analysis. The survey should take about 20-30 minutes to complete.

If you have any questions about completing the survey, please email James Vallerand at (james.vallerand@ualberta.ca) or call at (1-780-492-8246).

The following set of questions ask you to rate how you feel about trying to increase your aerobic exercise by at least 60 minutes per week over the NEXT THREE MONTHS.

Please note:

• By "aerobic exercise," we mean any activity that improves the heart and lungs such as brisk walking, jogging, biking, swimming, etc.

• By "increase," we mean that you would do at least an additional 60 minutes of aerobic exercise per week at a moderate intensity (not exhausting, light sweating, ex: fast walking) either from exercising more often or for longer durations.
This additional 60 minutes would be added to your current weekly total time spent doing aerobic exercise.

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1) I think that for me, trying to INCREASE my aerobic exercise over the NEXT THREE MONTHS will be:

- ◯ extremely useless
- ◯ quite useless
- ◯ slightly useless
- ◯ neutral
- ◯ slightly useful
- ◯ quite useful
- ◯ extremely useful

2) I think that for me, trying to INCREASE my aerobic exercise over the NEXT THREE MONTHS will be:

- ◯ extremely unenjoyable
- ◯ quite unenjoyable
- ◯ slightly unenjoyable
- ◯ neutral
- ◯ slightly enjoyable
- ◯ quite enjoyable
- ◯ extremely enjoyable

3) I think that for me, trying to INCREASE my aerobic exercise over the NEXT THREE MONTHS will be:

- ◯ extremely harmful
- ◯ quite harmful
- ◯ slightly harmful
- ◯ neutral
- ◯ slightly beneficial
- ◯ quite beneficial
- ◯ extremely beneficial

4) I think that for me, trying to INCREASE my aerobic exercise over the NEXT THREE MONTHS will be:

- ◯ extremely unpleasant
- ◯ quite unpleasant
- ◯ slightly unpleasant
- ◯ neutral
- ◯ slightly pleasant
- ◯ quite pleasant
- ◯ extremely pleasant

5) I think that for me, trying to INCREASE my aerobic exercise over the NEXT THREE MONTHS will be:

- ◯ extremely unimportant
- ◯ quite unimportant
- ◯ slightly unimportant
- ◯ neutral
- ◯ slightly important
- ◯ quite important
- ◯ extremely important

6) I think that for me, trying to INCREASE my aerobic exercise over the NEXT THREE MONTHS will be:

- ◯ extremely boring
- ◯ quite boring
- ◯ slightly boring
- ◯ neutral
- ◯ slightly fun
- ◯ quite fun
- ◯ extremely fun

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These next statements and questions ask you to rate your ability to INCREASE your weekly aerobic exercise by at least 60 minutes per week over the NEXT THREE MONTHS.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

7) I POSSESS THE SKILLS to increase my weekly aerobic exercise participation over the next three months...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

8) I HAVE THE PHYSICAL ABILITY to increase my weekly aerobic exercise participation over the next three months...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

9) I HAVE A CHANCE to increase my weekly aerobic exercise participation over the next three months...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

10) I HAVE THE OPPORTUNITY to increase my weekly aerobic exercise participation over the next three months...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

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Below is a list of things people might do or say to someone who is trying to increase their aerobic exercise by at least 60 minutes per week over the next three months. Please rate each question.

IF I TRY TO INCREASE MY EXERCISE BY AT LEAST 60 MINUTES/WEEK OVER THE NEXT THREE MONTHS, PEOPLE IN MY LIFE WILL:

		never	rarely	a few times	often	very often
11)	Exercise with me	○	○	○	○	○
12)	Offer to exercise with me	○	○	○	○	○
13)	Give me helpful reminders to exercise ("Are you going to exercise tonight?")	○	○	○	○	○
14)	Give me encouragement to stick with my exercise program	○	○	○	○	○
15)	Change their schedule so we can exercise together	○	○	○	○	○
16)	Discuss exercise with me	○	○	○	○	○
17)	Complain about the time I spend exercising	○	○	○	○	○
18)	Give me rewards for exercising (buy me something or give me something I like)	○	○	○	○	○
19)	Plan for exercise on recreational outings	○	○	○	○	○
20)	Help plan activities around my exercise	○	○	○	○	○
21)	Ask me for ideas on how they can get more exercise	○	○	○	○	○
22)	Talk about how much they like to exercise	○	○	○	○	○

This next set of questions asks you about your feelings towards INCREASING your weekly aerobic exercise by at least 60 minutes per week over the NEXT THREE MONTHS.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

23) If I do not increase my weekly aerobic exercise over the next three months, I WILL FEEL REGRET...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

24) If I do not increase my weekly aerobic exercise over the next three months, I WILL FEEL UPSET...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

25) I FEEL OBLIGATED to increase my weekly aerobic exercise over the next three months...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

26) I FEEL IT IS NECESSARY to increase my weekly aerobic exercise over the next three months...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

27) I FEEL IT IS MY DUTY to increase my weekly aerobic exercise over the next three months...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

Confidential

28) Compared to increasing my weekly aerobic exercise over the next three months, there are other things I could do which would be more FUN...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

29) Compared to increasing my weekly aerobic exercise over the next three months, there are other things I could do which would be more ENJOYABLE...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

30) Compared to increasing my weekly aerobic exercise over the next three months, there are other things I could do which would be more WORTHWHILE...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

31) Compared to increasing my weekly aerobic exercise over the next three months, there are other things I could do which would be more BENEFICIAL...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

The following questions ask about how you experience aerobic exercise when you do it.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

32) Aerobic exercise is something I do AUTOMATICALLY...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

33) Aerobic exercise is something I do WITHOUT HAVING TO CONSCIOUSLY REMEMBER...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

34) Aerobic exercise is something I do WITHOUT THINKING...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

35) Aerobic exercise is something I START DOING BEFORE I REALIZE I'M DOING IT...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

36) I consider myself an exerciser...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

Confidential

37) I include my involvement in exercise when I describe myself to others...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

38) Others see me as someone who exercises regularly...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

Confidential

This next set of questions asks you about your plans to increase your weekly aerobic exercise by at least 60 minutes per week over the NEXT THREE MONTHS.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

I HAVE A DETAILED PLAN TO INCREASE MY AEROBIC EXERCISE OVER THE NEXT THREE MONTHS REGARDING...

39) WHEN I am going to engage in aerobic exercise...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

40) WHERE I am going to engage in aerobic exercise...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

41) WHAT KIND of aerobic exercise activities I am going to engage in...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

42) HOW I am going to engage in aerobic exercise...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Confidential

43) WHO I am going to engage in aerobic exercise with...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

44) What to do if something interferes with my plans...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

45) How to cope with possible setbacks...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

46) What to do in difficult situations in order to act according to my intentions...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

47) Which good opportunities for action to take...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

48) When I have to pay extra attention to prevent lapses...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

This next 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.

For each of the following questions, please indicate the response that best describes your answer.

49) In general, would you say your health is:

- ◯ Excellent
- ◯ Very Good
- ◯ Good
- ◯ Fair
- ◯ Poor

50) 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 now than one year ago
- ◯ Much worse now than one year ago

Confidential

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
51)	Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	○	○	○
52)	Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○	○	○
53)	Lifting or carrying groceries	○	○	○
54)	Climbing several flights of stairs	○	○	○
55)	Climbing one flight of stairs	○	○	○
56)	Bending, kneeling, or stooping	○	○	○
57)	Walking more than a mile	○	○	○
58)	Walking several hundred yards	○	○	○
59)	Walking one hundred yards	○	○	○
60)	Bathing or dressing yourself	○	○	○

Confidential

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
61)	Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
62)	Accomplished less than you would like	○	○	○	○	○
63)	Were limited in the kind of work or other activities	○	○	○	○	○
64)	Had difficulty performing the work or other activities (for example, it took extra effort)	○	○	○	○	○

Confidential

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
65) Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
66) Accomplished less than you would like	○	○	○	○	○
67) Did work or other activities less carefully than usual	○	○	○	○	○

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

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

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

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

70) 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
○ A little bit
○ 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 the 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
71) Did you feel full of life?	◯	◯	◯	◯	◯
72) Have you been very nervous?	◯	◯	◯	◯	◯
73) Have you felt so down in the dumps that nothing could cheer you up	◯	◯	◯	◯	◯
74) Have you felt calm and peaceful?	◯	◯	◯	◯	◯
75) Did you have a lot of energy?	◯	◯	◯	◯	◯
76) Have you felt downhearted and depressed?	◯	◯	◯	◯	◯
77) Did you feel worn out?	◯	◯	◯	◯	◯
78) Have you been happy?	◯	◯	◯	◯	◯
79) Did you feel tired?	◯	◯	◯	◯	◯

80) 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

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

		Definitely true	Mostly true	Don't know	Mostly false	Definitely false
81)	I seem to get sick a little easier than other people	○	○	○	○	○
82)	I am as healthy as anybody I know	○	○	○	○	○
83)	Have you felt so down in the dumps that nothing could cheer you up	○	○	○	○	○
84)	I expect my health to get worse	○	○	○	○	○
85)	Did you have a lot of energy?	○	○	○	○	○
86)	My health is excellent	○	○	○	○	○

Confidential

The following section asks about any fatigue that you have been feeling. For each of the questions, please indicate the extent to which you have experienced each of the statements during the past 7 days.

During the PAST WEEK:

		not at all	a little bit	somewhat	quite a bit	very much
87)	I felt fatigued	○	○	○	○	○
88)	I felt weak all over	○	○	○	○	○
89)	I felt listless ("washed out")	○	○	○	○	○
90)	I felt tired	○	○	○	○	○
91)	I had trouble starting things because I am tired	○	○	○	○	○
92)	I had trouble finishing things because I am tired	○	○	○	○	○
93)	I had energy	○	○	○	○	○
94)	I was able to do my usual activities	○	○	○	○	○
95)	I needed to sleep during the day	○	○	○	○	○
96)	I was too tired to eat	○	○	○	○	○
97)	I needed help doing my usual activities	○	○	○	○	○
98)	I was frustrated by being too tired to do the things I want to do	○	○	○	○	○
99)	I had to limit my social activity because I am tired	○	○	○	○	○

Post-intervention questionnaire

Confidential

End of Study Survey - Increasing Weekly Aerobic Exercise in Hematologic Cancer Survivors

Increasing Weekly Aerobic Exercise in Hematologic Cancer Survivors

End of Study Survey

Principal Investigators:

Kerry S. Courneya, PhD, University of Alberta

James R. Vallerand, PhD Student, University of Alberta

Instructions

Thank you for your continued participation in this study!

In this end-of-study assessment, we are going to ask you many of the same questions as in the previous questionnaires. 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.

Many of the questions may seem similar but it is important to treat each question separately and provide an answer for each. If at all possible, please complete all questions so that we can include your responses in our analysis. All responses are completely confidential and will never be used in any way that could link them to you. 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 20-30 minutes of your time to complete.

If you have any questions about completing the survey, please email James Vallerand at (james.vallerand@ualberta.ca) or call at (1-780-492-8246).

For this first set of questions, we would like you to recall your average weekly exercise during the past month. We ask that you report on your aerobic or endurance exercise (i.e., exercise that improves the heart and lungs such as walking or swimming).

When answering these questions please:

- **Only count exercise that was done during free time (i.e., not occupation or housework).**
- **Only count exercise sessions that lasted 15 minutes or longer in duration.**

- **If you did not do any exercise in one of the categories, please write in "0" as your average frequency (# of days you do this level of aerobic exercise per week) and "0" as your average duration (# of minutes you do this level of aerobic exercise on a given active day).**

- **If you did exercise in one of the categories, please fill-in the average frequency (# of days you did this level of aerobic exercise per week) and average duration (# of minutes you did this level of aerobic exercise on a given active day). Multiplying your average frequency with your average duration should give us your total weekly minutes spent doing aerobic exercise at each given intensity.**

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

Average frequency of VIGOROUS intensity aerobic exercise
(Heart beats rapidly, Sweating after only a few minutes, You can't say more than a few words without pausing for breath)
(e.g., vigorous running, jogging, sports, cross country skiing, swimming, long-distance bicycling).
((On a typical week, report the average # of days you did VIGOROUS aerobic exercise))

◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7

Average duration of VIGOROUS intensity aerobic exercise

_____
((On a typical day of VIGOROUS exercise, report the average # of minutes you did aerobic exercise at this intensity))

Average frequency of MODERATE intensity aerobic exercise
(Not exhausting, Light sweat after about 10 minutes of activity, You can carry on a conversation but you can't sing)
(e.g., fast walking, baseball, tennis, easy bicycling, badminton, easy swimming, popular and folk dancing).

((On a typical week, report the average # of days you did MODERATE aerobic exercise))

◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7

Average duration of MODERATE intensity aerobic exercise

_____
((On a typical day of MODERATE exercise, report the average # of minutes you did aerobic exercise at this intensity))

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Average frequency of LIGHT intensity aerobic exercise
(Minimal effort, No perspiration, Could whistle while doing the activity)
(e.g., easy walking, yoga, bowling, golf, shuffleboard).

((On a average week, report the average # of days you did LIGHT aerobic exercise))

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7

Average duration of LIGHT intensity aerobic exercise

_____
((On a typical day of LIGHT exercise, report the average # of minutes you did aerobic exercise at this intensity))

MVPA2 _____

The following set of questions ask you to rate how you felt about trying to increase your aerobic exercise by at least 60 minutes per week over the PAST THREE MONTHS.

Please note:

• By "aerobic exercise," we mean any activity that improves the heart and lungs such as brisk walking, jogging, biking, swimming, etc.

• By "increase," we mean that you tried to do at least 60 minutes of additional aerobic exercise per week at a moderate intensity (not exhausting, light sweating, ex: fast walking) either from exercising more often or for longer durations.
This additional 60 minutes would have been added to your prior weekly total time spent doing aerobic exercise at the start of the study.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

I think that for me, trying to INCREASE my aerobic exercise over the PAST THREE MONTHS was:

◯ extremely useless
◯ quite useless
◯ slightly useless
◯ neutral
◯ slightly useful
◯ quite useful
◯ extremely useful

I think that for me, trying to INCREASE my aerobic exercise over the PAST THREE MONTHS was:

◯ extremely unenjoyable
◯ quite unenjoyable
◯ slightly unenjoyable
◯ neutral
◯ slightly enjoyable
◯ quite enjoyable
◯ extremely enjoyable

I think that for me, trying to INCREASE my aerobic exercise over the PAST THREE MONTHS was:

◯ extremely harmful
◯ quite harmful
◯ slightly harmful
◯ neutral
◯ slightly beneficial
◯ quite beneficial
◯ extremely beneficial

Confidential

I think that for me, trying to INCREASE my aerobic exercise over the PAST THREE MONTHS was:

◯ extremely unpleasant
◯ quite unpleasant
◯ slightly unpleasant
◯ neutral
◯ slightly pleasant
◯ quite pleasant
◯ extremely pleasant

I think that for me, trying to INCREASE my aerobic exercise over the PAST THREE MONTHS was:

◯ extremely unimportant
◯ quite unimportant
◯ slightly unimportant
◯ neutral
◯ slightly important
◯ quite important
◯ extremely important

I think that for me, trying to INCREASE my aerobic exercise over the PAST THREE MONTHS was:

◯ extremely boring
◯ quite boring
◯ slightly boring
◯ neutral
◯ slightly fun
◯ quite fun
◯ extremely fun

These next statements and questions ask you to rate your ability to increase your weekly aerobic exercise by at least 60 minutes per week over the PAST THREE MONTHS.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

I POSSESSED THE SKILLS to increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I HAD THE PHYSICAL ABILITY to increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I HAD THE CHANCE to increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I HAD THE OPPORTUNITY to increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Confidential

Below is a list of things people might have done or said to you while you were trying to increase your weekly aerobic exercise by at least 60 minutes per week over the past three months. Please rate each question.

WHILE TRYING TO INCREASE MY EXERCISE BY AT LEAST 60 MINUTES/WEEK OVER THE PAST THREE MONTHS, PEOPLE IN MY LIFE:

	never	rarely	a few times	often	very often
Exercised with me	○	○	○	○	○
Offered to exercise with me	○	○	○	○	○
Gave me helpful reminders to exercise ("Are you going to exercise tonight?")	○	○	○	○	○
Gave me encouragement to stick with my exercise program	○	○	○	○	○
Changed their schedule so we can exercise together	○	○	○	○	○
Discussed exercise with me	○	○	○	○	○
Complained about the time I spend exercising	○	○	○	○	○
Gave me rewards for exercising (bought me something or gave me something I like)	○	○	○	○	○
Planned for exercise on recreational outings	○	○	○	○	○
Helped plan activities around my exercise	○	○	○	○	○
Asked me for ideas on how they can get more exercise	○	○	○	○	○
Talked about how much they like to exercise	○	○	○	○	○

This next set of questions asks you about your feelings towards increasing your weekly aerobic exercise by at least 60 minutes per week over the PAST THREE MONTHS.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

a. I would have felt REGRET if I did not increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I would have felt UPSET if I did not increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I felt OBLIGATED to increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I felt IT WAS NECESSARY for me to increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I felt IT WAS MY DUTY to increase my weekly aerobic exercise over the past three months...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

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Compared to increasing my weekly aerobic exercise over the past three months, there were other things I could have done which would have been more FUN...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Compared to increasing my weekly aerobic exercise over the past three months, there were other things I could have done which would have been more ENJOYABLE...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Compared to increasing my weekly aerobic exercise over the past three months, there were other things I could have done which would have been more WORTHWHILE...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Compared to increasing my weekly aerobic exercise over the past three months, there were other things I could have done which would have been more BENEFICIAL...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

The following questions ask about how you experience aerobic exercise when you do it.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

Aerobic exercise is something I do AUTOMATICALLY...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Aerobic exercise is something I do WITHOUT HAVING TO CONSCIOUSLY REMEMBER...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Aerobic exercise is something I do WITHOUT THINKING...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Aerobic exercise is something I START DOING BEFORE I REALIZE I'M DOING IT...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

I consider myself an exerciser...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Confidential

I include my involvement in exercise when I describe myself to others...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

Others see me as someone who exercises regularly...

- ◯ strongly disagree
- ◯ moderately disagree
- ◯ slightly disagree
- ◯ neutral
- ◯ slightly agree
- ◯ moderately agree
- ◯ strongly agree

This next set of questions asks you about your plans to increase your weekly aerobic exercise by at least 60 minutes per week over the PAST THREE MONTHS.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

I HAD A DETAILED PLAN TO INCREASE MY WEEKLY AEROBIC EXERCISE OVER THE PAST THREE MONTHS REGARDING...

WHEN I would engage in aerobic exercise...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

WHERE I would engage in aerobic exercise...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

WHAT kinds of aerobic exercise activities I would engage in...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

HOW I would engage in aerobic exercise...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Confidential

WHO I would engage in aerobic exercise with...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

What to do if something interfered with my plans...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

How to cope with possible setbacks...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

What to do in difficult situations in order to act according to my intentions...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

Which good opportunities for action to take...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

When I had to pay extra attention to prevent lapses...

◯ strongly disagree
◯ moderately disagree
◯ slightly disagree
◯ neutral
◯ slightly agree
◯ moderately agree
◯ strongly agree

This next 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.

For each of the following questions, please indicate the response that best describes your answer.

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
◯ Somewhat better
◯ About the same
◯ Somewhat worse
◯ Much worse

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
Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	○	○	○
Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○	○	○
Lifting or carrying groceries	○	○	○
Climbing several flights of stairs	○	○	○
Climbing one flight of stairs	○	○	○
Bending, kneeling, or stooping	○	○	○
Walking more than a mile	○	○	○
Walking several hundred yards	○	○	○
Walking one hundred yards	○	○	○
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
Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
Accomplished less than you would like	○	○	○	○	○
Were limited in the kind of work or other activities	○	○	○	○	○
Had difficulty performing the work or other activities (for example, it took extra effort)	○	○	○	○	○

Confidential

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
Cut down on the amount of time you spent on work or other activities	○	○	○	○	○
Accomplished less than you would like	○	○	○	○	○
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, neighbors, 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
○ A little bit
○ Moderately
○ Quite a bit
○ Extremely

Confidential

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the 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
Did you feel full of life?	◯	◯	◯	◯	◯
Have you been very nervous?	◯	◯	◯	◯	◯
Have you felt so down in the dumps that nothing could cheer you up	◯	◯	◯	◯	◯
Have you felt calm and peaceful?	◯	◯	◯	◯	◯
Did you have a lot of energy?	◯	◯	◯	◯	◯
Have you felt downhearted and depressed?	◯	◯	◯	◯	◯
Did you feel worn out?	◯	◯	◯	◯	◯
Have you been happy?	◯	◯	◯	◯	◯
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

Confidential

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

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

Confidential

The following section asks about any fatigue that you have been feeling. For each of the questions, please indicate the extent to which you have experienced each of the statements during the past 7 days.

During the PAST WEEK:

	not at all	a little bit	somewhat	quite a bit	very much
I felt fatigued	○	○	○	○	○
I felt weak all over	○	○	○	○	○
I felt listless ("washed out")	○	○	○	○	○
I felt tired	○	○	○	○	○
I had trouble starting things because I am tired	○	○	○	○	○
I had trouble finishing things because I am tired	○	○	○	○	○
I had energy	○	○	○	○	○
I was able to do my usual activities	○	○	○	○	○
I needed to sleep during the day	○	○	○	○	○
I was too tired to eat	○	○	○	○	○
I needed help doing my usual activities	○	○	○	○	○
I was frustrated by being too tired to do the things I want to do	○	○	○	○	○
I had to limit my social activity because I am tired	○	○	○	○	○

This next set of questions asks you how satisfied you were with the telephone counseling intervention.

Please pay careful attention to the words in each scale. Indicate the response that best represents how you feel.

How SATISFIED were you with the telephone counselling intervention overall?

◯ Absolutely unsatisfied
◯ Very unsatisfied
◯ Somewhat unsatisfied
◯ Neutral
◯ Somewhat satisfied
◯ Very satisfied
◯ Absolutely satisfied

How USEFUL was the 12-week telephone counselling intervention in helping you increase your weekly aerobic exercise participation?

◯ Absolutely useless
◯ Very useless
◯ Somewhat useless
◯ Neutral
◯ Somewhat useful
◯ Very useful
◯ Absolutely useful

Were you satisfied with receiving exercise counselling over the telephone or would you have preferred another method?

◯ Preferred other method ◯ Preferred telephone calls

What other method would you have preferred receiving exercise counselling instead of via telephone? (ex: In-person counselling, internet website, printed guidebook, email):

Was the 12-week telephone counselling intervention too long, too short, or about right?

◯ Too long
◯ Too short
◯ About right

If too long or too short, how many weeks would you have preferred?

_____
((# of weeks))

Were the length of the telephone counselling sessions (about 15-30minutes) too long, too short, or about right?

◯ Too long
◯ Too short
◯ About right

If too long or too short, what duration of phone call would you have preferred?

_____
((minutes per call))

Was receiving one telephone counselling call per week too frequent, not frequent enough, or about right?

◯ Too frequent
◯ Not frequent enough
◯ About right

If too frequent or not frequent enough, what frequency would you have preferred

_____

Confidential

This last set of questions asks you to rate the individual telephone counselling topics included in the intervention. Please answer each one as honestly as possible.

How useful were each of the following topics in increasing your physical activity level? If you missed a session, please just skip it.

	Absolutely useless	Very useless	Somewhat useless	Neutral	Somewhat useful	Very useful	Absolutely useful
The benefits of exercise & making exercise fun	◯	◯	◯	◯	◯	◯	◯
Goal setting & goal commitment	◯	◯	◯	◯	◯	◯	◯
Self-monitoring & exercise logs	◯	◯	◯	◯	◯	◯	◯
Exercise planning	◯	◯	◯	◯	◯	◯	◯
Decision balance (pros & cons)	◯	◯	◯	◯	◯	◯	◯
Overcoming exercise barriers	◯	◯	◯	◯	◯	◯	◯
Stimulus controls (reminders & cues)	◯	◯	◯	◯	◯	◯	◯
Booster sessions	◯	◯	◯	◯	◯	◯	◯

Were the telephone counselling sessions interesting?

◯ Not interesting at all
◯ Not very interesting
◯ Somewhat not interesting
◯ Neutral
◯ Somewhat interesting
◯ Very interesting
◯ Absolutely interesting

Were the topics covered in the telephone counselling sessions clear?

◯ Absolutely unclear
◯ Very unclear
◯ Somewhat unclear
◯ Neutral
◯ Somewhat clear
◯ Very clear
◯ Absolutely clear

Would you recommend this telephone counselling intervention to other hematologic cancer survivors?

◯ Not at all likely
◯ Very unlikely
◯ Somewhat unlikely
◯ Neutral
◯ Somewhat likely
◯ Very likely
◯ Absolutely likely

Confidential

Did you learn new information from the telephone counselling sessions?

◯ Not at all
◯ Very little
◯ Somewhat
◯ Quite a bit yes

Were you satisfied with the topics covered in the telephone counselling sessions?

◯ Completely unsatisfied
◯ Very unsatisfied
◯ Somewhat unsatisfied
◯ Neutral
◯ Somewhat satisfied
◯ Very satisfied
◯ Completely satisfied

What other topics would you have liked to see covered in the telephone counselling sessions?

What topics could have been eliminated in the telephone counselling sessions?

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

Telephone counseling intervention guide

Study ID#: _____ Initials: __ __ __

Behavioural Support Tracking

Behavioral Support Session	Completed	Comments
1. Introduction	Week: **1**	
2. Exercise attitudes	Week: ___	
3. Goal setting contracts	Week: ___	
4. Self-monitoring	Week: ___	
5. Planning	Week: ___	
6. Decision balance	Week: ___	
7. Overcoming barriers	Week: ___	
8. Stimulus Control	Week: ___	
9. Booster 1	Week: **9**	
10.Booster 2	Week: **10**	
11.Booster 3	Week: **11**	
12.Booster 4	Week: **12**	

Notes:

Study ID#: _____ Initials: __ __ __

Introduction

BSI objectives

☐ 1. Welcome participant to the trial!

☐ 2. Get to know one another
- Introduce myself, my background, my interests and hobbies
- Ask participant:
  - Why they were interested in signing up?
  - Exercise background?
  - What they do for work?
  - Family members living at home?

☐ 3. Learn about the trial
- Remind participant that calls will take place weekly for the first 12-weeks
- These calls should only be about 30 minutes long but will always start with a period for them to ask questions about their exercise
- Another round of assessments will take place at the end of the trial
- Ensure that the scheduled appointment time still works for the participant going forward.

☐ 4. Outline major goal of the trial
- Remind participant that the goal of the trial is to increase exercise participation as much as possible (minimum increase of 60 mins, up to a weekly total of 300mins)
- Assure that I will be there to support them via these telephone calls as best as I can.

☐ 5. Discuss the proper exercise intensity
- Moderate: not exhausting (have energy left at the end of workout), light perspiration
  - Ex: fast walking, easy bicycling
  - Should be able to carry a conversation but unable to sing
- Vigorous: exhausting (should feel drained by the end), heavy breathing, heart rate up, sweating
  - Ex: running, aerobics classes, fast bicycling
  - Should be more difficult to carry a conversation – huffing and puffing.

☐ Note that vigorous minutes count as double towards goal

☐ 6. Learn when to increase exercise, how, and by how much
- Once able to successfully complete your bout of exercise, you should look to challenge yourself in your next workout
- Can increase your exercise by doing it for a longer duration, or making it more intense
- Determining how much to increase each time differs for everybody. Try adding 5 minutes to your workout, or try to get the same distance in less time

☐ 7. Get to know the opportunities that the participant has available to exercise
- Where (i.e., what locations: around the block, fitness centre, etc)
- When (time of day, which days)

☐ Confirm next appointment

Notes:

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature

Study ID#: _____ Initials: __ __ __

Exercise Attitudes (Benefits & Fun)

- ☐ Ask how did the past week go?
- ☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
- ☐ Any challenges or barriers in the past week?

BSI objectives

- ☐ 1. Ask what are the most important benefits for participant participating in exercise and why?
- ☐ 2. Discuss the specific exercise benefits for hematologic cancer survivors
  - Improves your health (heart, blood pressure, muscle strength, bones and joints, fatigue)
  - Helps you feel good about yourself (better QOL, able to perform daily routines)
  - Helps get your mind off cancer
  - Helps relieve stress & anxiety
  - Improves your energy level / reduces fatigue
  - Helps improve your immune system
  - May help you live longer
  - May help prevent your cancer from coming back
  - Helps you get back to normal
- ☐ 3. Find out what makes PA fun for participant
- ☐ 4. Discuss the importance of making PA fun for long-term adherence
  - e.g., "People who have fun exercising are more likely to keep doing it long-term"
- ☐ 5. Brainstorm how to make exercise more enjoyable
  - **Music:** Tends to make PA much more enjoyable! *(think: personal listening devices, stereos, audiobooks)*
  - **New locations:** Can add excitement and new challenges while allowing you to explore
  - **New activities:** Adding variety to your routine lets you work different muscles, and can add excitement
  - **Active vacations**- Great for spending time with friends and family as well as achieve your fitness goals. There are many different kinds of active vacations: hiking, canoeing, biking, and walking
  - **Add a friend:** Don't just choose anyone! Pick someone who is full of energy, fun and who you look forward to spending time with. That way, you'll want to exercise just to be with your friend
  - **Group fitness:** Classes are a great way to keep motivated, and come with an instructor who will guide you on your form
  - **Play something:** A great way to do a lot of PA and make it fun instead of work (*think: sports)*
  - **Television:** Adding your favorite shows to your workout routine can motivate you to get through the workout
  - **Relax**: Take five minutes after your cool down to relax
- ☐ Book next appointment

Notes:

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature

Study ID#: _____ Initials: __ __ __

Goal Setting Contract

- ☐ Ask how did the past week go?
- ☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
- ☐ Any challenges or barriers in the past week?

BSI objectives

- ☐ 1. Explain to participant that those who set goals for their exercise are more likely to exercise, to do more of it, and to stick with it over time.
- ☐ 2. Explain the importance of setting SMART goals *(specific, measurable attainable, realistic, timely)*
- ☐ 3. Have the participant establish the following set of goals. Note: these goals ought to be developed by the participant with the understanding that he/or she is expected to commit to these goals.
  - Long-term health goal (e.g., lose 10lbs by the end of the study)

    List goal here: _____
  - Short-term health goal (e.g., lose 2lbs by the end of the month)

    List goal here: _____
  - Long-term behavioral goal (e.g., walk 30minutes at vigorous intensity every day in 6 months)

    List goal here: _____
  - Short-term behavioral goal (e.g., walk at a moderate intensity 3x/wk for 30mins each)

    List goal here: _____
- ☐ 4. Congratulate the participant for setting important and challenging goals
- ☐ 5. Explain now that goals have been established, we want to make sure that you are absolutely committed to these goals.
- ☐ 6. Ask participant how we can get him/her to commit to the behavioral goal?
  - ☐ Have participant write down his/her goal and place them in a public space for others to see.
  - ☐ Think of rewards at the end of each week if you stick to your goal
  - ☐ Think of 'punishments' at the end of each week if you don't stick to your goal
- ☐ Book next appointment

Notes:

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature

Study ID#: _____ Initials: __ __ __

Self-Monitoring

☐ Ask how did the past week go?
☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
☐ Any challenges or barriers in the past week?

BSI objectives

☐ 1. Explain to participant that daily self-monitoring is important for accurately keeping track of how much exercise you do each week

- Sometimes if you wait until the end of the week and think back, people have a tendency to inflate the amount of exercise they report

☐ 2. Explain the RPE scale with key anchors (e.g., 13 = carry conversation but can't sing; 15 = struggle to converse)

☐ 3. Create a plan/routine for when participants will complete their exercise logs (i.e, same time each day)

- Discuss pros/cons for different times of day

☐ 4. Encourage the participant to continue to use these logs throughout the course of the intervention

☐ Book next appointment

Notes:

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature

Exercise Log

Day	Activity 1	Intensity & Time	Activity 2	Intensity & Time	Comments
Monday	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	
Tuesday	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	
Wednesday	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	
Thursday	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	
Friday	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	
Saturday	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	
Sunday	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	☐ Walking ☐ Bicycling ☐ Other (specify below): _____	**L** _____ mins **M** _____ mins **V** _____ mins	

Intensity

Symbol	Description	Example
L	Light	Requires effort but no change in breathing (normal pace for a long walk)
M	Moderate	Able to carry a conversation but not sing (brisk walk)
V	Vigorous	Struggling to carry a conversation (one or two words at time)

Study ID#: _____ Initials: __ __ __

Planning

☐ Ask how did the past week go?
☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
☐ Any challenges or barriers in the past week?

BSI objectives

☐ 1. Discuss the importance of detailed planning for achieving long term PA changes
- People with a general goal (i.e., try and increase my PA) do not do as well as people who have a detailed plan for achieving their PA goal
- Detailed plan includes the who, what, where, and how of the PA goal
- Maintains motivation and direction for participants PA

☐ 2. Review behavioral goal that the participant committed to:

Days: _____ Minutes:_____

☐ 3. Have the participant establish the following components of their plan:

- Which activities will you do to achieve your exercise goal

  List activities here: _____

- When are you planning on doing your exercise to achieve your exercise goal

  List ToD here: _____

- Where are you planning on doing your exercise to achieve your exercise goal

  List locations here: _____

- Who are you planning on doing your exercise with to achieve your exercise goal

  List partners here: _____

- How are you planning on doing your exercise to achieve your exercise goal

  List how here: _____

☐ 4. Explain now that your plan has been established, we want to make sure that you are absolutely committed to this plan.

☐ 5. Ask participant how we can get him/her to commit to this plan?

☐ Have participant write down his/her plan and place them in a public space for others to see.

☐ Think of rewards at the end of each week if you stick to your plan

☐ Think of 'punishments' at the end of each week if you don't stick to your plan

☐ Book next appointment

Notes:

_____ _____ _____
Call Duration Date (mm/dd/yyyy) Signature

Study ID#: _____ Initials: __ __ __

Decision Balance

☐ Ask how did the past week go?
☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
☐ Any challenges or barriers in the past week?

BSI objectives

☐ 1. Make a list of all the possible activities the participant could do instead of doing exercise (think of activities that could be more fun / more beneficial / time conflict)

- List the pros and cons for each alternative activity

☐ 2. Make a list of all the possible alternative types of exercise the participant could be doing other than what they are already

- List the pros and cons for each alternative mode of exercise (think intensity / benefit)

☐ 3. Make a list of all the possible times of day you could do your exercise

- List the pros and cons for each time of day for exercise (think morning/before work, lunch, after work, after dinner)

☐ Book next appointment

Notes.

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature

DB - Activities competing with exercise

Option#1: ___EXERCISING_____		Option #2: _____	
Pros	Cons	Pros	Cons
Option#3: _____		Option #4: _____	
Pros	Cons	Pros	Cons

Ranking of activities:

1)

2)

3)

4)

DB - Other modes of exercise

Option#1: _____		Option #2: _____	
Pros	Cons	Pros	Cons
Option#3: _____		Option #4: _____	
Pros	Cons	Pros	Cons

Ranking of types of exercise:

1)

2)

3)

4)

DB - Time of day for exercise

Option#1: _____		Option #2: _____	
Pros	Cons	Pros	Cons
Option#3: _____		Option #4: _____	
Pros	Cons	Pros	Cons

Ranking of exercise times:

1)

2)

3)

4)

Study ID#: _____ Initials: __ __ __

Overcoming Exercise Barriers

- ☐ Ask how did the past week go?
- ☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
- ☐ Any challenges or barriers in the past week?

BSI objectives

☐ 1. Discuss personal barriers
- Ask about main barriers so far & any anticipated barriers
- Brainstorm with participant about possible unique barriers to PA
- Talk about the importance of having a plan to address each barrier

☐ 2. Discuss fatigue as a barrier
- Studies show that 30 minutes of brisk walking can reduce tiredness (can even be 3 x 10minute bouts)
- Notice the days and times you feel fatigued. Do PA when you feel the least tired.
- Try reducing the level of exercise – try slowing down your walk or decreasing the distance
- Keep a regular sleep schedule
- Take a short nap

☐ 3. Discuss time as a barrier
- How much free time do you have for exercise every day?
  - How much time do you spend sleeping?
  - How much time do you spend at work?
  - How much time do you spend taking care of family?

☐ 4. Discuss motivation to overcome barriers
- What is it about your exercise that is most important to you?
- Review briefly the benefits of PA (improves health, helps you feel good about yourself, relieves stress, improves energy levels, etc.)
- Exercise with a friend: you're more likely to stick to a plan you made with a friend
- Exercise first thing in the morning, every morning! This gives you less time to make excuses
- Train for a run/walk in your area: having a goal can be used to motivate you to get up and go!
- Reward yourself when you achieve your short and long term goals
- Use step and PA logs to keep track of your activity!

☐ Book next appointment

Notes:

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature

Study ID#: _____ Initials: __ __ __

Stimulus Control

☐ Ask how did the past week go?
☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
☐ Any challenges or barriers in the past week?

BSI objectives

☐ 1. Explain what stimulus control is and why it may be useful

- Stimulus control is learning to pay attention and responding to things we perceive in the environment (stimuli) that give us information on what to do
- More simply: the use of prompts in your environment can kick-start your PA

☐ 2. Give a list of examples that apply to PA

- Put your running shoes by the side of your bed or lay your workout clothes the night before if you would like to do PA when you wake up in the morning.
- Prompt yourself with a water bottle or gym bag near the door.
- Schedule your workout in your phone calendar/daytimer like a business meeting.
- Create posters of people walking up stairs and place them by the elevator at work - this will remind you as well as others to take the stairs.
- Write and stick a positive message on your milk or something else you pull out frequently asking 'have I done physical activities today'?
- Get a friend to call and prompt you to get active.
- Establish a routine for your exercise (e.g., walking each day after dinner; finishing dinner will be your prompt to get going!)

☐ 3. Setup a tangible personalized stimulus control for the participant

- Discuss with participant what could be appropriate stimuli for their PA regime.
- Brainstorm ideas on how to incorporate it into their everyday lives.

☐ Book next appointment

Notes:

_____ Call Duration

_____ Date (mm/dd/yyyy)

_____ Signature

Study ID#: _____ Initials: __ __ __

Booster Session 1

☐ Ask how did the past week go?
☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
☐ Any challenges or barriers in the past week? List:

_____ _____
_____

_____ _____
_____

BSI objectives

☐ 1. Troubleshoot challenge

☐ 2. Remind participant of their behavioral goal (e.g., walk at a moderate intensity 3x/wk for 30mins each)

- List goal here: _____

☐ 3. Prompt participant to think of increasing this goal

- List new goal here: _____

☐ Book next appointment

Notes:

_____ _____ _____
Call Duration Date (mm/dd/yyyy) Signature

Study ID#: _____ Initials: __ __ __

Booster Session 2

- ☐ Ask how did the past week go?
- ☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
- ☐ Any challenges or barriers in the past week? List:

_____ _____
_____

_____ _____
_____

BSI objectives

- ☐ 1. Troubleshoot challenge
- ☐ 2. Remind participant of their behavioral goal (e.g., walk at a moderate intensity 3x/wk for 30mins each)
  - List goal here: _____
- ☐ 3. Prompt participant to think of increasing this goal
  - List new goal here: _____
- ☐ Book next appointment

Notes:

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature

Study ID#: _____ Initials: __ __ __

Booster Session 3

☐ Ask how did the past week go?
☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
☐ Any challenges or barriers in the past week? List:

_____ _____
_____

_____ _____
_____

BSI objectives

☐ 1. Troubleshoot challenge

☐ 2. Remind participant of their behavioral goal (e.g., walk at a moderate intensity 3x/wk for 30mins each)

- List goal here: _____

☐ 3. Prompt participant to think of increasing this goal

- List new goal here: _____

☐ Book next appointment

Notes:

_____ _____ _____
Call Duration Date (mm/dd/yyyy) Signature

Study ID#: _____ Initials: __ __ __

Booster Session 4

- ☐ Ask how did the past week go?
- ☐ How often did you exercise? Days: _____ Minutes_____ Intensity_____
- ☐ Any challenges or barriers in the past week? List:

_____ _____
_____

_____ _____
_____

BSI objectives

- ☐ 1. Troubleshoot challenge
- ☐ 2. Remind participant of their behavioral goal (e.g., walk at a moderate intensity 3x/wk for 30mins each)
  - List goal here: _____
- ☐ 3. Prompt participant to think of increasing this goal
  - List new goal here: _____
- ☐ Book next appointment

Notes:

_____	_____	_____
Call Duration	Date (mm/dd/yyyy)	Signature