Physical Activity in Survivors of Adolescent and Young Adult Cancer

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Abstract

Survivors of adolescent and young adult (AYA) cancer endure a range of symptoms and side effects, including weight gain, unfavourable changes in body composition, physical disfigurements, and tissue damage, which can impair their physical and psychological health. Identifying and optimizing interventions that can mitigate negative side effects are necessary. Whereas physical activity has been identified as one such intervention for child and older adult cancer survivors, the evidence for survivors of AYA cancer is far less convincing to put forward recommendations and argue for integrating physical activity into practice. Research seeking to understand if/how and under what circumstances physical activity is related to physical and psychological outcomes is of particular importance to guide care aimed at relieving cancer-related damage and distress. This research program sought to address this through three interrelated studies, which progressed sequentially. Study One examined the clarity, appropriateness, and relevancy of eight widely used questionnaires assessing self-reported physical activity and psychological outcomes. Cognitive interviews were conducted with seven survivors of AYA cancer who were representative of individuals likely to participate in future research. Findings from this study indicated most of the questionnaires tested could be used to assess self-reported physical activity and psychological outcomes among survivors of AYA cancer with or without slight modifications. After incorporating participants' feedback into the questionnaires, Study Two was conducted to: (1) examine the cross-sectional relationships between physical self-perceptions and self-esteem (physical and global), and (2) explore if physical activity and/or self-efficacy for physical activity moderated these relationships. Correlation analyses were conducted, and as hypothesized, physical self-perceptions and physical and global self-esteem were positively related. Hierarchical multivariate linear

regression analyses showed that self-efficacy for physical activity moderated the relationship between physical self-perceptions and physical self-esteem (but not global self-esteem), such that at higher levels of self-efficacy for physical activity, the magnitude of the association between physical self-perceptions and physical self-esteem was greater. Physical activity did not moderate the relationship between physical self-perceptions and physical or global self-esteem. These findings provide empirical evidence that physical self-perceptions and self-esteem (physical and global) are related and suggest self-efficacy for physical activity may serve to strengthen the relationship between physical self-perceptions and physical self-esteem among survivors of AYA cancer. However, more work exploring if/how and under what circumstances physical activity is implicated in this relationship is needed via experimental study designs. In Study Three, a two-arm, mixed-methods randomized controlled trial (RCT) designed to test a 12-week physical activity intervention among survivors of AYA cancer was piloted. The objectives of this study were to assess the feasibility and acceptability of trial methods and the intervention. Findings suggest modifications to the methods and intervention are required. Making the trial multi-site, using multiple recruitment strategies, refining assessments of directly-measured physical activity behaviour and aerobic capacity, and incorporating behavioural support into the intervention may improve feasibility and acceptability. This study highlights the value of pilot trials and provides useful data that can be used to optimize trial methods and physical activity interventions for this population. Collectively, the studies comprising this thesis lay the foundation for further testing of if/how and under what circumstances physical activity and physical and psychological outcomes are related in survivors of AYA cancer. Findings offer researchers and practitioners information to aid in the development of theoretically- and

empirically-based interventions seeking to mitigate the adverse effects of cancer and its treatments in this population.

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Table of Contents

Abstract ii

Acknowledgements v

Table of Contents x

Statement of Contribution xv

Overview of Thesis xviii

List of Abbreviations xix

List of Tables xx

List of Figures xxi

Chapter One 1

Review of Literature 1

Cancer in Adolescents and Young Adults (AYAs) 1

Physical Activity for Cancer Survivors 3

Physical Activity for Survivors of AYA Cancer 3

A Theoretical Perspective 4

Research Rationale and Purposes 6

Objective One (Study One): 7

Objective Two (Study Two): 8

Objective Three (Study Three): 9

References 11

Chapter Two 20

Article One, Study One 20
Abstract 21
Background 22
Methods 23
Participants 23
Data Collection 24
Data Analysis 25
Results 25
Comprehension Concerns 27
Recall and Response Category Concerns 28
Appropriateness and Relevancy Concerns 28
Structural-Logical Concerns 29
Brief Summary and Second Round of Cognitive Interviews 30
Discussion 31
Limitations and Future Directions 34
Conclusion 34
References 36
Bridging Text 44
Chapter Three 46
Article Two, Study Two 46
Abstract 47
Introduction 48
Methods 51

Participants 51
Procedures 51
Measures 52
Data Analysis 54
Results 55
Discussion 57
References 62
Bridging Text 73
Chapter Four 75
Article Three, Study Three 75
Abstract 76
Background 78
The Need for a Trial 78
Mediators and Moderators of the Relationship Between Physical Activity and Health 79
Current Study 80
Methods 80
Study Design 80
Sample 81
Procedures 81
Physical Activity Intervention 82
Wait-List Control Group 84
Measures 84
Sample Size 87

Data Analysis....87
Results....88
Participants....88
Quantitative Results....89
Qualitative Results....92
Discussion....93
Conclusions....97
References....99
Chapter Five....108
Global Discussion....108
Theoretical Contributions....109
Conceptual Contributions....113
Methodological Contributions....114
Practical Contributions....116
Limitations....118
Conclusions....118
References....120
Appendix A: Research Ethics Board Approval Notices....128
Study One (Chapter Two)....129
Study Two (Chapter Three)....132
Study Three (Chapter Four)....135
Appendix B: Questionnaires and Assessment Tools Used....142
Study One (Chapter Two)....143

Questionnaires 144
Cognitive Interview Guide 154
Study Two (Chapter Three) 155
Questionnaires 156
Study Three (Chapter Four) 166
Questionnaires 167
Physical Tests 178
Accelerometer Instructions 179
Accelerometer Logbook 180
Interview Guide 181
Weekly Physical Activity Logbook 183

Statement of Contribution

I, Amanda Wurz, was responsible for conceptualizing and designing each of the studies included in this thesis under the supervision of Dr. Jennifer Brunet.

Chapter Two (Article One, Study One): Evaluating Questionnaires Used to Assess Self-Reported Physical Activity and Psychosocial Outcomes Among Survivors of Adolescent and Young Adult Cancer: A Cognitive Interview Study [Amanda Wurz, Jennifer Brunet]

I performed a literature review (Wurz & Brunet, 2016) to inform and develop study objectives and guide questionnaire selection. I conducted all interviews, analyzed all data, drafted and revised the manuscript, and was primary author of the manuscript.

Status: Published in the *Journal of Adolescent and Young Adult Cancer*.

Additional questionnaires were included in this study so as to facilitate further research opportunities in Study Two and Study Three. Manuscripts and presentations emanating from these opportunities are described below.

Chapter Three (Article Two, Study Two): Exploring the Relationships Between Physical Activity, Self-Efficacy, Physical Self-Perceptions, and Self-Esteem Among Survivors of Adolescent and Young Adult Cancer [Amanda Wurz, Jennifer Brunet]

I collected and analyzed all data, reimbursed each participant, drafted and revised the manuscript, and was primary author of the manuscript.

Status: Submitted to a peer-reviewed journal.

Additional questionnaires were included in this study to facilitate further research opportunities. Specifically, two additional manuscripts (Barrett-Bernstein, Wurz, & Brunet, forthcoming; Wurz & Brunet, in press) and two conference presentations (Barrett-Bernstein, Wurz, & Brunet, 2018; Wurz & Brunet, 2018) emanated from the additional data collected. These manuscripts and

presentations ask alternative research questions and/or utilize questionnaires assessing constructs unrelated to this thesis. Where I am the first listed author, I analyzed all data and drafted and revised the manuscript under the supervision of Dr. Jennifer Brunet. Where I am the second listed author, Meagan Barrett-Bernstein led data analysis and together we prepared the resultant manuscript and presentation under the supervision of Dr. Jennifer Brunet.

Chapter Four (Article Three, Study Three): Exploring the Feasibility and Acceptability of a Mixed-Methods Pilot Randomized Controlled Trial Testing a 12-Week Physical Activity Intervention Among Adolescent and Young Adult Cancer Survivors [Amanda Wurz, Jennifer Brunet]

I secured donations, designed and delivered the intervention, collected and analyzed all data, drafted and revised the manuscript, and was primary author of the manuscript.

Status: Prepared for submission to a peer-reviewed journal.

Additional questionnaires, qualitative interview questions, and assessments were included in this study to facilitate further research opportunities. The manuscripts and conference presentations that are expected to emanate from this data will ask alternative research questions and will utilize questionnaires, qualitative interview questions, and/or assessments unrelated to this thesis. I will analyze all data and draft and revise the manuscripts and presentations under the supervision of Dr. Jennifer Brunet.

Dr. Jennifer Brunet provided insight and guidance from design through to successful completion of each study and critically reviewed the articles contained within this thesis. Dr. Raveena Ramphal and Dr. Natalie Durand-Bush provided conceptual and pragmatic feedback on the thesis proposal.

Ethical approval was obtained from appropriate Research Ethics Boards prior to data collection for each of the three studies found within this thesis. Research Ethics Board approval notices can be found in Appendix A.

Overview of Thesis

The following is a scholarly presentation of my doctoral research program. Five chapters comprise this document, followed by appendices. Chapter One provides the background for my research program. Throughout this chapter, the limitations of the current literature are underscored to make a case for the significance of this research program. The chapter ends with the overarching purpose of the thesis and its specific objectives. Chapter Two, Chapter Three, and Chapter Four present the three articles that resulted from this research program. Chapter Two presents the results from the cognitive interview study that explored how survivors of adolescent and young adult (AYA) cancer interpreted and responded to commonly used questionnaires that assess self-reported physical activity and psychological outcomes (Wurz & Brunet, 2017). Chapter Three presents data from the cross-sectional study that explored the relationships between physical self-perceptions and self-esteem (physical and global) and examined whether moderate-to-vigorous physical activity (MVPA) or self-efficacy for MVPA moderate these relationships among survivors of AYA cancer (Wurz & Brunet, submitted). Chapter Four presents the feasibility and acceptability data from a two-arm, mixed-methods pilot randomized controlled trial designed to test a 12-week physical activity intervention on a range of physical and psychological outcomes among AYA cancer survivors (Wurz & Brunet, prepared for submission). Chapter Five collates key findings and highlights the theoretical, conceptual, methodological, and practical contributions and implications from this research program. Appendices include relevant Research Ethics Board approval notices (Appendix A) and the questionnaires, interview guides, and data collection forms used within this research program (Appendix B).

List of Abbreviations

6MWT=6-minute walk test

AYA=Adolescent and young adult

BMI=Body mass index

CONSORT=Consolidated Standards of Reporting Trials

EXSEM=Exercise and Self-Esteem Model

EXSES=Exercise Self-Efficacy Scale

HRR=Heart rate reserve

LTEQ=Leisure Time Exercise Questionnaire

MVPA=Moderate-to-vigorous physical activity

PA=Physical activity

PSDQ=Physical Self Description Questionnaire

PSDQ-S=PSDQ Short Form

RCT=Randomized controlled trial

RM=Repetition maximum

RSES=Rosenberg Global Self-Esteem Scale

SD=Standard deviation

List of Tables

Chapter Two

Table 1: Characteristics of Study Participants.....26

Chapter Three

Table 1: Correlations Between Study Variables……71

Table 2: Results of Hierarchical Multivariate Regression Analyses with MVPA and Self-Efficacy for MVPA as Potential Moderators…….....72

Chapter Four

Table 1: Overview of the 12-Week Physical Activity Program ……...84

Table 2: Participants' Baseline Demographic, Medical, and Outcome Characteristics……..89

List of Figures

Chapter One

Figure 1: The Exercise and Self-Esteem Model (EXSEM)……...10

Chapter Three

Figure 1: Significant Two-Way Interaction Involving Self-Efficacy for MVPA and Physical Self-Perceptions on Physical Self-Esteem at the Mean Level of MVPA……..70

Chapter Four:

Figure 1: CONSORT Flow Diagram…….91

Chapter One

Review of Literature

Cancer in Adolescents and Young Adults (AYAs)

Each year, over one million AYAs between the ages of 15 to 39 years are diagnosed with cancer internationally [1], translating to approximately 5% of all new cancers diagnosed each year in North America [2, 3]. Until recently, little attention and few resources were devoted to studying incidence rates, tumour biology, and survival outcomes among AYAs [4]. However, it is now widely recognized that AYAs are a unique population in cancer care. In contrast to their younger and older counterparts, incidence rates in this age group continue to increase and the types of cancer diagnosed and underlying tumour biology differ from those seen in younger and older individuals [1]. Moreover, cancer typically progresses more quickly in this population [1].

The available treatment options for the types of cancers diagnosed among AYAs include surgery, chemotherapy, radiotherapy, immunotherapy, stem cell transplantation, and hormonal therapy. These treatments can be used independently or in combination, depending on the type of cancer and stage. Though clinical trial accrual among AYAs is lower than for any other age group [5], large-scale efforts are being made to maximize progress in AYA cancer therapy [6] and current treatment protocols offer many AYAs a positive outlook for surviving [7]. However, the treatments necessary for sustaining remission are associated with a number of side effects. Unlike older adults, AYAs tolerate the acute (short-term) effects of treatment relatively well [8]. However, treatments often produce complications that may not become apparent until months or years later. The persistent (sometimes late-occurring) physical effects may include weight gain, decreased range of motion, pain, disfigurement, lymphedema, fatigue, cardiopulmonary complications, peripheral neuropathy, muscle loss/weakness, and osteoporosis whereas chronic

psychological outcomes may include heightened feelings of depression, anxiety, stress, loss of sense of control, and decreased overall quality of life [9-15]. Though many of these longer-term effects are reported regardless of age at diagnosis, many researchers have found AYAs experience a greater physical and psychological symptom burden following treatment than older adults diagnosed with similar cancers [16-18].

The enhanced symptom burden among AYAs may be underpinned in part by biological explanations; however, many suggest that the differences documented are a function of timing, in that AYAs are in a transitional period, moving from childhood to adulthood physically, psychologically, financially, and educationally at the time of their diagnosis [10]. This population is tasked with navigating crucial developmental challenges and changes amidst cancer-related sequelae [10]. Considering the number of AYAs diagnosed with cancer each year, their age at diagnosis, and the subsequent number of life-years affected by cancer, the global burden of cancer among survivors of AYA cancer (i.e., individuals diagnosed with and completed treatment for cancer as an AYA) exceeds that in all other ages [1]. This potential longevity and recognition of the considerable personal, societal, and economic effects (due to marked differences in premature mortality and morbidity; [19]), have spurred concerted efforts to *close the gap* observed by better understanding and minimizing the negative impact of cancer upon treatment completion [20, 21].

Despite burgeoning interest in developing interventions to improve the negative effects of cancer and its treatments among survivors of AYA cancer, the research conducted to date has been low quality (e.g., small, homogenous samples) and has produced small and non-significant effects. Further, there has been a lack of research focused on the important period of early survivorship (i.e., <5 years post-treatment) among survivors of AYA cancer. This is problematic

as this time is widely considered a *teachable moment*, wherein individuals are most conducive to making positive lifestyle changes [22] as a way of being in control over the possibility of recurrence [23]. As well, survivors of AYA cancer report difficulties returning to their previous level of functioning and routines [24, 25] and have asked for support and/or access to programs to assist them during this time [26]. Finally, few, if any, interventions that have the potential to promote length and quality of life have been conducted with survivors of AYA cancer (see [27-29] for relevant reviews).

Physical Activity for Cancer Survivors

Physical activity (i.e., any bodily movement produced by the skeletal muscle that results in a substantial increase in energy expenditure over resting levels; [30]) is one intervention that has been shown to promote longevity, reduce the risk of disease and disability, and improve physical and psychological outcomes among child and older adult cancer survivors [31-34]. Moreover, physical activity has been found to be safe and feasible [35-38] and can mitigate the negative effects of cancer and its treatments [36-38]. As a result, several cancer-specific physical activity guidelines and recommendations have been developed for cancer survivors [39-41].

Physical Activity for Survivors of AYA Cancer

While recognition for the safety, feasibility, and benefits of physical activity in the context of cancer care has increased, the evidence base for survivors of AYA cancer has not [27]. This is problematic because survivors of AYA cancer may have different correlates and responses to physical activity, which could impact if/how and under what circumstances physical activity is related to physical and psychological outcomes. Understanding if/how and when physical activity is related to physical and psychological outcomes is important from practical

perspective so as to optimize interventions seeking to mitigate the negative effects of cancer and its treatments and to promote longevity.

Though findings from cross-sectional studies suggest physical activity may be related to physical health [42, 43], few researchers have examined the relationships between physical activity and a range of potentially relevant psychological outcomes (e.g., self-efficacy, self-esteem; [44-46]) among survivors of AYA cancer. There is preliminary evidence from health behaviour support interventions suggesting physical activity may be related to psychological outcomes [28]; however, in general, there is a dearth of literature examining if/how and when physical activity is related to both physical and psychological outcomes in this population. Indeed, recent systematic reviews have concluded physical activity is not a well-researched topic among survivors of AYA cancer [27-29] and several gaps remain in the literature with regards to the relationships between physical activity and physical and psychological outcomes. First, within the studies that have been conducted, most have used questionnaires that were not developed with or for survivors of AYA cancer. It is unclear as to whether the questionnaires being used are clear, appropriate, and relevant for this population. Second, few experimental studies assessing a range of physical and psychological outcomes have been conducted and the mechanisms through which physical activity might exert its beneficial effects remain unknown.

A Theoretical Perspective

Examining the mechanisms (i.e., if/how and under what circumstances) underlying the relationship between physical activity and physical and psychological outcomes requires investigating potential mediators and moderators. A mediator is a variable that explains the relationship between two variables [47], whereas moderator variables affect the strength and/or direction of the relationship between two variables [48]. Identifying how (i.e., mediators) and

under what circumstances (i.e., moderators) physical activity is related to physical and psychological outcomes could help highlight which components are necessary to target in physical activity interventions for survivors of AYA cancer. Because selecting mediators and moderators can be challenging, researchers often use theories or models to guide construct selection [49].

One model used for examining if/how physical activity is related to physical and psychological outcomes is the Exercise and Self-Esteem Model (EXSEM; [50]). Researchers using the EXSEM suggest that physical activity results in changes in one's physical fitness (i.e., physical measures such as weight status, muscular strength and endurance, aerobic capacity, etc.) and self-efficacy beliefs (i.e., confidence regarding one's ability to successfully engage in physical activity). Improved physical fitness and self-efficacy beliefs then lead to improved physical self-perceptions (i.e., self-evaluation of one's overall physical condition and fitness), which enhance physical self-esteem (i.e., subjective evaluation of the function and appearance of one's body) and subsequently global self-esteem (i.e., subjective evaluation of one's self-worth). Cross-sectional, experimental, and longitudinal research with healthy adolescents, university-aged students, middle-aged adults, older-adults, overweight and obese women, menopausal women, breast cancer survivors, and sedentary adults supports these relationships (e.g., [51-64]). However, the majority of the evidence supporting the EXSEM comes from research providing evidence for select relationships between model components. Furthermore, few studies have explored the conditions under which the associations between physical activity and physical and psychological outcomes would differ in magnitude or direction. For theoretical and practical reasons, it is important to identify moderators in order to identify conditions when desired outcomes may be maximized.

Although the aforementioned studies had conceptual and practical rationale for excluding select variables and/or for not including moderator variables, each of the constructs contained within the EXSEM may be of particular relevance for survivors of AYA cancer. Specifically, survivors of AYA cancer typically report changed physical fitness (e.g., increased weight status; [14]), decreased self-efficacy [65], reduced perceptions of physical functioning [13], declines in perceptions of appearance [66], and low levels of physical and global self-esteem [67, 68] – variables that may be positively impacted by physical activity [69, 70]. Including measures of physical fitness, self-efficacy, physical self-perceptions, physical self-esteem, and global self-esteem may therefore be necessary to determine if/how and when physical activity is related to physical and psychological outcomes among survivors of AYA cancer. In doing so, researchers would benefit from adopting mixed methodologies that combine the strengths of quantitative and qualitative research, but currently methodologies grounded in the positivist paradigm dominate the literature in this area. Consequently, survivors' unique perceptions and experiences with physical activity and physical and psychological outcomes are not reflected in research. Adopting a mixed-methods approach would allow for a deeper understanding of if/how and when physical activity is related to physical and psychological outcomes from survivors' perspectives and would provide better insight into factors to target to mitigate the negative effects of cancer and its treatments in this population.

Research Rationale and Purposes

Though survivors of AYA cancer represent a small proportion of diagnoses each year, there is no other age group with a similar array of malignancies and cancer- and age-specific challenges [1]. Considering the potential benefits physical activity may confer, studies testing if/how and under what circumstances physical activity is related to physical and psychological

outcomes for this population are needed. The EXSEM is a promising model to achieve these aims as it enables researchers to adapt the model to their research objectives and to test alternative pathways and consider additional theoretically informed variables [50]. Though, definitive randomized controlled trials (RCTs) testing the relationships between constructs within the EXSEM are required before claims can be made, considering the lack of literature in this field, several precursory steps are required. Specifically, it is prudent to establish whether previously validated questionnaires can be used with this population, to begin exploring relationships between EXSEM variables, and to answer questions regarding the feasibility and acceptability of a physical activity intervention designed for this population. Therefore, the main purpose of this research program was to lay a strong foundation, using an established framework, to start better understanding if/how and under what circumstances physical activity is related to physical and psychological outcomes among survivors of AYA cancer. To this end, three specific objectives were set forth and three interrelated studies were conducted to address each:

Objective One (Study One):

To explore how survivors of AYA cancer interpret and respond to questionnaires widely used to assess self-reported physical activity and psychological outcomes.

Research Question 1: What difficulties, if any, do survivors of AYA cancer encounter when interpreting, recalling, processing, and responding to questionnaires used to assess physical activity and physical and psychological outcomes?

Research Question 2: Are the questionnaires used to assess physical activity and physical and psychological outcomes appropriate and relevant for survivors of AYA cancer?

To address this objective and answer the research questions, a cognitive interview study was conducted with a purposeful sample comprised of seven survivors of AYA cancer. Data were

collected through two rounds of cognitive interviews. Data consisted of participants' responses during the interview as well as field notes. Summaries were prepared and compared across participants in a qualitative and quantitative sense. The findings are presented in Article One, entitled: *Evaluating Questionnaires Used to Assess Self-Reported Physical Activity and Psychosocial Outcomes Among Survivors of Adolescent and Young Adult Cancer: A Cognitive Interview Study* (see Chapter Two).

Objective Two (Study Two):

To start exploring relationships between the EXSEM variables among survivors of AYA cancer, using questionnaires that were shown to be appropriate and relevant in Study One.

Research Question 1: What are the relationships between physical self-perceptions and physical and global self-esteem among survivors of AYA cancer?

Research Question 2: Do physical activity and self-efficacy for physical activity moderate the relationship between physical self-perceptions and self-esteem (physical and global) among survivors of AYA cancer?

To address this objective, a cross-sectional study was conducted with a convenience sample of 87 survivors of AYA cancer. Data were collected using an online survey, which was distributed across North America. Correlations and hierarchical multivariate linear regression analyses were conducted and the findings are presented in Article Two, entitled: *Exploring the Relationships Between Physical Activity, Self-Efficacy, Physical Self-Perceptions, and Self-Esteem Among Survivors of Adolescent and Young Adult Cancer* (see Chapter Three).

Objective Three (Study Three):

To lay the foundation for a definitive RCT seeking to explore if/how and under what circumstances physical activity is related to the physical and psychological outcomes among survivors of AYA cancer.

Research Question 1: Are the methods used in a RCT designed to test a 12-week physical activity intervention feasible and acceptable for survivors of AYA cancer?

Research Question 2: Is a 12-week physical activity intervention feasible and acceptable for survivors of AYA cancer?

To address this objective, a two-arm, mixed-methods pilot RCT designed to test a 12-week physical activity intervention on a range of physical and psychological outcomes among AYA cancer survivors was conducted with 16 survivors of AYA cancer recruited over a 12-month period via purposive and snowball sampling. Participants were randomized into an intervention group or wait-list control group using rolling recruitment. Data were collected at baseline (week 0), mid-intervention (week 6), and post-intervention (week 12). Descriptive statistics and content analysis were used and the results are presented in Article Three, entitled: *Exploring the Feasibility and Acceptability of a Mixed-Methods Pilot Randomized Controlled Trial Testing a 12-Week Physical Activity Intervention Among Adolescent and Young Adult Cancer Survivors* (see Chapter Four).

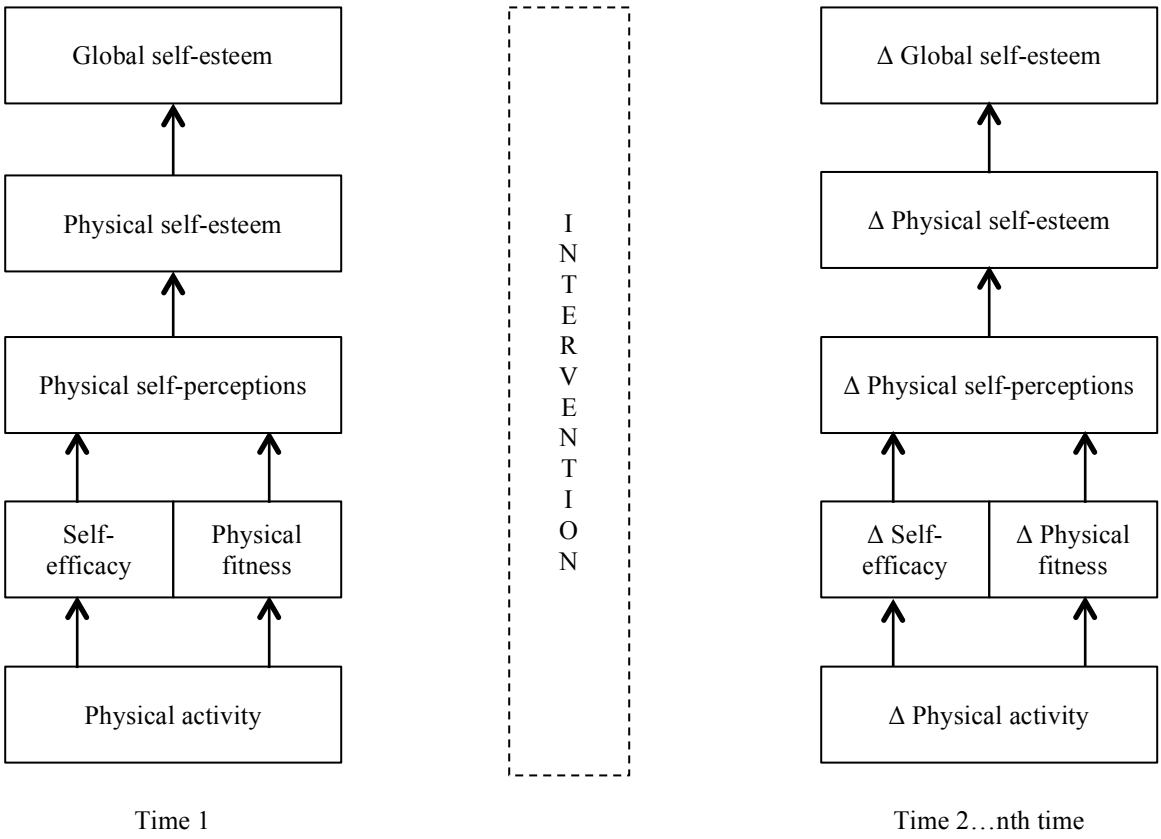

Figure 1. The Exercise and Self-Esteem Model (EXSEM).

Adapted from the original EXSEM [50] and work by Fox and Corbin [71] and McAuley and colleagues [61, 62].

References

1. Bleyer A, Ferrari A, Whelan J, Barr RD. Global assessment of cancer incidence and survival in adolescents and young adults. Pediatr Blood Cancer. 2017;64(9).
2. American Cancer Society. Cancer Facts & Figures 2015. Atlanta, Georgia; 2015.
3. Canadian Cancer Society's Advisory Committee on Cancer Statistics. Canadian Cancer Statistics 2015. Toronto, Ontario; 2015.
4. Barr RD, Ries R, Ferrari A, Whelan J, Bleyer A. Adolescent and young adult oncology: historical and global perspectives. In: Bleyer A, Barr R, Ries L, Whelan J, Ferrari A, editors. Cancer in adolescents and young adults. 2nd ed. Cham, Switzerland: Springer International Publishing AG (Springer Nature); 2017. p. 1-7.
5. Bleyer A, Tai E, Siegel S. Role of clinical trials in survival progress of American adolescents and young adults with cancer-and lack thereof. Pediatr Blood Cancer. 2018;65(8):e27074.
6. Baxter NN, Daly C, Gupta S, Pole JD, Sutradhar R, Greenberg ML et al. The Initiative to Maximize Progress in Adolescent and Young Adult Cancer Therapy (IMPACT) cohort study: a population-based cohort of young Canadians with cancer. BMC Cancer. 2014;14:805.
7. Lewis DR, Seibel NL, Smith AW, Stedman MR. Adolescent and young adult cancer survival. J Natl Cancer Inst Monogr. 2014;2014(49):228-35.
8. Baker KS, Toogood AA, Hawkins M, Nathan PC. Adolescent and young adult cancer survivors: late effects of treatment. In: Bleyer A, Barr R, Ries L, Whelan J, Ferrari A, editors. Cancer in adolescents and young adults. 2nd ed. Cham, Switzerland: Springer International Publishing AG (Springer Nature); 2017. p. 687-711.

9. Hallquist Viale P. Late effects: focus on adolescent and young adult cancer survivors. J Adv Pract Oncol. 2016;7(1):15-6.

10. Epelman CL. The adolescent and young adult with cancer: state of the art -- psychosocial aspects. Curr Oncol Rep. 2013;15(4):325-31.

11. Gupta AA, Edelstein K, Albert-Green A, D'Agostino N. Assessing information and service needs of young adults with cancer at a single institution: the importance of information on cancer diagnosis, fertility preservation, diet, and exercise. Support Care Cancer. 2013;21(9):2477-84.

12. Quinn GP, Goncalves V, Sehovic I, Bowman ML, Reed DR. Quality of life in adolescent and young adult cancer patients: a systematic review of the literature. Patient Relat Outcome Meas. 2015;6:19-51.

13. Smith AW, Bellizzi KM, Keegan TH, Zebrack B, Chen VW, Neale AV et al. Health-related quality of life of adolescent and young adult patients with cancer in the United States: the Adolescent and Young Adult Health Outcomes and Patient Experience study. J Clin Oncol. 2013;31(17):2136-45.

14. Tai E, Buchanan N, Townsend J, Fairley T, Moore A, Richardson LC. Health status of adolescent and young adult cancer survivors. Cancer. 2012;118(19):4884-91.

15. Woodward E, Jessop M, Glaser A, Stark D. Late effects in survivors of teenage and young adult cancer: does age matter? Ann Oncol. 2011;22(12):2561-8.

16. Sanford SD, Zhao F, Salsman JM, Chang VT, Wagner LI, Fisch MJ. Symptom burden among young adults with breast or colorectal cancer. Cancer. 2014;120(15):2255-63.

17. Devlin SM, Murphy JD, Yeung HN. A retrospective analysis of pain burden in hospitalized young adult cancer patients compared with their older adult counterpart. J Palliat Med. 2018;epub ahead of print.

18. Lang MJ, Giese-Davis J, Patton SB, Campbell DJT. Does age matter? Comparing post-treatment psychosocial outcomes in young adult and older adult cancer survivors with their cancer-free peers. Psychooncology. 2018;27(5):1404-11.

19. Fidler MM, Gupta S, Soerjomataram I, Ferlay J, Steliarova-Foucher E, Bray F. Cancer incidence and mortality among young adults aged 20-39 years worldwide in 2012: a population-based study. Lancet Oncol. 2017;18(12):1579-89.

20. McGoldrick D, Gordon P, Whiteson M, Adams H, Rogers P, Sutcliffe S. Awareness and advocacy for adolescents and young adults with cancer. Cancer. 2011;117(10):2311-5.

21. Adolescent and Young Adult Oncology Progress Review Group. Closing the gap: research and care imperatives for adolescents and young adults with cancer. Department of Health and Human Services, National Institutes of Health (NIH), National Cancer Institute, and the LIVESTRONG Young Adult Alliance: NIH publication 06-6067; 2006.

22. Frazelle ML, Friend PJ. Optimizing the teachable moment for health promotion for cancer survivors and their families. J Adv Pract Oncol. 2016;7(4):422-33.

23. Bellizzi KM, Smith A, Schmidt S, Keegan TH, Zebrack B, Lynch CF et al. Positive and negative psychosocial impact of being diagnosed with cancer as an adolescent or young adult. Cancer. 2012;118(20):5155-62.

24. Parsons HM, Harlan LC, Lynch CF, Hamilton AS, Wu XC, Kato I et al. Impact of cancer on work and education among adolescent and young adult cancer survivors. J Clin Oncol. 2012;30(19):2393-400.

25. Pedersen KJ, Boisen KA, Midtgaard J, Elsbernd A, Larsen HB. Facing the maze: young cancer survivors' return to education and work-a professional expert key informant study. J Adolesc Young Adult Oncol. 2018;7(4):445-52

26. Wong JN, McAuley E, Trinh L. Physical activity programming and counseling preferences among cancer survivors: a systematic review. Int J Behav Nutr Phys Act. 2018;15(1):48.

27. Brunet J, Wurz A, Shallwani SM. A scoping review of studies exploring physical activity among adolescents and young adults diagnosed with cancer. Psychooncology. 2018;27(8):1875-88.

28. Pugh G, Gravestock HL, Hough RE, King WM, Wardle J, Fisher A. Health behavior change interventions for teenage and young adult cancer survivors: a systematic review. J Adolesc Young Adult Oncol. 2016;5(2):91-105.

29. Richter D, Koehler M, Friedrich M, Hilgendorf I, Mehnert A, Weissflog G. Psychosocial interventions for adolescents and young adult cancer patients: a systematic review and meta-analysis. Crit Rev Oncol Hematol. 2015;95(3):370-86.

30. Canadian Society for Exercise Physiology. Canadian Society for Exercise Physiology - Physical Activity Training for Health (CSEP-PATH). Ottawa, ON; 2013.

31. Baumann FT, Bloch W, Beulertz J. Clinical exercise interventions in pediatric oncology: a systematic review. Pediatric research. 2013;74(4):366-74.

32. Mishra SI, Scherer RW, Geigle PM, Berlanstein DR, Topaloglu O, Gotay CC et al. Exercise interventions on health-related quality of life for cancer survivors. Cochrane Database Syst Rev. 2012;8:CD007566.

33. Albrecht TA, Taylor AG. Physical activity in patients with advanced-stage cancer: a systematic review of the literature. Clin J Oncol Nurs. 2012;16(3):293-300.

34. Wurz A, Brunet, J. The effects of physical activity on health and quality of life in adolescent cancer survivors: a systematic review. JMIR Cancer. 2016;2(1):e6.

35. Ugolini D, Neri M, Cesario A, Bonassi S, Milazzo D, Bennati L et al. Scientific production in cancer rehabilitation grows higher: a bibliometric analysis. Support Care Cancer. 2012;20(8):1629-38.

36. Cormie P, Zopf EM, Zhang X, Schmitz KH. The Impact of Exercise on Cancer Mortality, Recurrence, and Treatment-Related Adverse Effects. Epidemiol Rev. 2017;39(1):71-92.

37. Segal R, Zwaal C, Green E, Tomasone JR, Loblaw A, Petrella T et al. Exercise for people with cancer: a systematic review. Curr Oncol. 2017;24(4):e290-e315.

38. Stout NL, Baima J, Swisher AK, Winters-Stone KM, Welsh J. A systematic review of exercise systematic reviews in the cancer literature (2005-2017). PM R. 2017;9(9S2):S347-S84.

39. Rock CL, Doyle C, Demark-Wahnefried W, Meyerhardt J, Courneya KS, Schwartz AL et al. Nutrition and physical activity guidelines for cancer survivors. CA Cancer J Clin. 2012;62(4):243-74.

40. Schmitz KH, Courneya KS, Matthews C, Demark-Wahnefried W, Galvao DA, Pinto BM et al. American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. Med Sci Sports Exerc. 2010;42(7):1409-26.

41. Chamorro-Vina C, Keats M, Culos-Reed SN. Pediatric Oncology Exercise Manual. Calgary, Alberta: Health & Wellness Lab, University of Calgary; 2015.

42. Erickson JM, Adelstein KE, Letzkus LC. A feasibility study to measure physical activity, fatigue, sleep-wake disturbances, and depression in young adults during chemotherapy. J Adolesc Young Adult Oncol. 2014;3(1):37-41.

43. Gundle KR, Punt SE, Mattioli-Lewis T, Conrad EU. Can a made-for-consumer activity monitor assess physical activity in adolescents and young adults after lower extremity limb salvage for osseous tumors? J Pediatr Ortho. 2016; 37(3):e192-96.

44. Love C, Sabiston CM. Exploring the links between physical activity and posttraumatic growth in young adult cancer survivors. Psycho-Oncology. 2011;20(3):278-86.

45. Valle CG, Tate DF, Mayer DK, Allicock M, Cai J. Exploring mediators of physical activity in young adult cancer survivors: evidence from a randomized trial of a facebook-based physical activity intervention. J Adolesc Young Adult Oncol. 2015;4(1):26-33.

46. Brunet J, Love C, Ramphal R, Sabiston CM. Stress and physical activity in young adults treated for cancer: the moderating role of social support. Supportive Care in Cancer. 2014;22(3):689-95.

47. MacKinnon DP, Fairchild AJ, Fritz MS. Mediation analysis. Annu Rev Psychol. 2007;58:593-614.

48. Fields A. Discovering statistics using IBM SPSS statistics. 4 ed. Thousand Oaks, California: SAGE; 2013.

49. Michie S JM, Francis J, Hardeman W, Eccles M. From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. Appl Psychol. 2008;57:660-80.

50. Sonstroem RJ, Morgan, W.P. Exercise and self-esteem: rationale and model. Medicine and Science in Sport and Exercise. 1989;21(3):329-37.

51. Elavsky S. Longitudinal examination of the exercise and self-esteem model in middle-aged women. J Sport Exerc Psychol. 2010;32(6):862-80.

52. Elavsky S, McAuley E. Exercise and self-esteem in menopausal women: a randomized controlled trial involving walking and yoga. Am J Health Promot. 2007;22(2):83-92.

53. Gothe NP, Mullen SP, Wojcicki TR, Mailey EL, White SM, Olson EA et al. Trajectories of change in self-esteem in older adults: exercise intervention effects. J Behav Med. 2011;34(4):298-306.

54. Levy SS, Ebbeck, V. The exercise and self-esteem model in adult women: the inclusion of physical acceptance. Psychology of Sport and Exercise. 2005;6:571-84.

55. Martin Ginis KA, McEwan D, Josse AR, Phillips SM. Body image change in obese and overweight women enrolled in a weight-loss intervention: the importance of perceived versus actual physical changes. Body Image. 2012;9(3):311-7.

56. Martin Ginis KA, Strong HA, Arent SM, Bray SR, Bassett-Gunter RL. The effects of aerobic- versus strength-training on body image among young women with pre-existing body image concerns. Body Image. 2014;11(3):219-27.

57. Moore JB, Mitchell NG, Beets MW, Bartholomew JB. Physical self-esteem in older adults: A test of the indirect effect of physical activity. Sport Exerc Perform Psychol. 2012;1(4):231-41.

58. Moore JB, Mitchell NG, Bibeau WS, Bartholomew JB. Effects of a 12-week resistance exercise program on physical self-perceptions in college students. Res Q Exerc Sport. 2011;82(2):291-301.

59. Noack P, Kauper T, Benbow AE, Eckstein K. Physical self-perceptions and self-esteem in adolescents participating in organized sports and religious groups. Eur J Dev Psychol. 2013;10(6):663-75.

60. Opdenacker J, Delecluse C, Boen F. The longitudinal effects of a lifestyle physical activity intervention and a structured exercise intervention on physical self-perceptions and self-esteem in older adults. Journal of Sport & Exercise Psychology. 2009;31(6):743-60.

61. McAuley E, Blissmer B, Katula J, Duncan TE, Mihalko SL. Physical activity, self-esteem, and self-efficacy relationships in older adults: a randomized controlled trial. Ann Behav Med. 2000;22(2):131-9.

62. McAuley E, Elavsky S, Motl RW, Konopack JF, Hu L, Marquez DX. Physical activity, self-efficacy, and self-esteem: longitudinal relationships in older adults. J Gerontol B Psychol Sci Soc Sci. 2005;60(5):268-75.

63. Baldwin MK, Courneya, K.S. Exercise and self-esteem in breast cancer survivors: an application of the exercise and self-esteem model. J Sport Exerc Psychol. 1997;19:347-58.

64. Musanti R. A study of exercise modality and physical self-esteem in breast cancer survivors. Med Sci Sports Exerc. 2012;44(2):352-61.

65. Perkins HY, Baum GP, Taylor CL, Basen-Engquist KM. Effects of treatment factors, comorbidities and health-related quality of life on self-efficacy for physical activity in cancer survivors. Psychooncology. 2009;18(4):405-11.

66. Rosenberg SM, Tamimi RM, Gelber S, Ruddy KJ, Kereakoglow S, Borges VF et al. Body image in recently diagnosed young women with early breast cancer. Psychooncology. 2013;22(8):1849-55.

67. Katz MR, Rodin G, Devins GM. Self-esteem and cancer: theory and research. Can J Psychiatry. 1995;40(10):608-15.

68. von Essen L, Enskar K, Kreuger A, Larsson B, Sjoden PO. Self-esteem, depression and anxiety among Swedish children and adolescents on and off cancer treatment. Acta Paediatr. 2000;89(2):229-36.

69. Gill E, Goldenberg M, Starnes H, Phelan S. Outdoor adventure therapy to increase physical activity in young adult cancer survivors. J Psychosoc Oncol. 2016;34(3):184-99.

70. Adamsen L, Andersen C, Midtgaard J, Moller T, Quist M, Rorth M. Struggling with cancer and treatment: young athletes recapture body control and identity through exercise: qualitative findings from a supervised group exercise program in cancer patients of mixed gender undergoing chemotherapy. Scand J Med Sci Sports. 2009;19(1):55-66.

71. Fox KR, Corbin CB. The physical self-perception profile: development and preliminary validation. Journal of Sport & Exercise Psychology. 1989;11:408-30.

Chapter Two

Article One, Study One

Evaluating Questionnaires Used to Assess Self-Reported Physical Activity and Psychosocial Outcomes Among Survivors of Adolescent and Young Adult Cancer: A Cognitive Interview Study

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Abstract

Physical activity is increasingly being studied as a way to improve psychosocial outcomes (e.g., quality of life, self-efficacy, physical self-perceptions, self-esteem, body image, posttraumatic growth) among survivors of adolescent and young adult (AYA) cancer. Assessing levels of and associations between self-reported physical activity and psychosocial outcomes requires clear, appropriate, and relevant questionnaires. To explore how survivors of AYA cancer interpreted and responded to the following eight published questionnaires: Leisure Time Exercise Questionnaire, Exercise Self-Efficacy Scale, Physical Self-Description Questionnaire, Rosenberg Global Self-Esteem Scale, Multidimensional Body-Self Relations Questionnaire, Posttraumatic Growth Inventory, Functional Assessment of Cancer Therapy-General (FACT-G), RAND 36-Item Health Survey 1.0 (RAND-36), cognitive interviews were conducted with three men and four women age 18-36 years who were diagnosed with cancer at age 16-35 years. Initially, the first seven questionnaires listed above were assessed. Summaries of the interviews were prepared and compared across participants. Potential concerns were identified with the FACT-G; thus, a second interview was conducted with participants to explore the clarity, appropriateness, and relevance of the RAND-36. Concerns identified for the FACT-G related mostly to the lack of relevance of items pertaining to cancer-specific aspects of quality of life given that participants were post-treatment. No or few concerns related to comprehension and/or structure/logic were identified for the other questionnaires. In general, the questionnaires assessed were clear, appropriate, and relevant. Participants' feedback suggested they could be used to assess self-reported physical activity and varied psychosocial outcomes in studies with survivors of AYA cancer, either with or without slight modifications.

Background

Adolescents and young adults (AYAs) diagnosed with cancer between the age of 15-39 years comprise a unique population in cancer care.[1] Similar to survivors of child and adult cancer, survivors of AYA cancer experience negative side effects, which may increase their risk of developing other chronic diseases and heighten their risk of premature mortality.[2-5] Survivors of AYA cancer may also face delays in achieving developmental milestones because of disease- and treatment-related factors.[6-9] This can have a negative impact on their health and psychosocial functioning.[10-12] For these reasons, many have called for more research into possible ways to promote health and psychosocial functioning among survivors of AYA cancer.[13,14]

Several systematic reviews show that physical activity is related to enhanced health and psychosocial functioning throughout the cancer trajectory (i.e., during treatment, short-term and long-term survivorship, palliation), regardless of cancer type and age at diagnosis.[15-18] Among the studies reviewed, several psychosocial outcomes have been assessed, including quality of life, self-efficacy, physical self-perceptions, self-esteem, body image, and posttraumatic growth.[15-18] However, few studies have examined the relationships between physical activity and psychosocial outcomes among survivors of AYA cancer.[19-25] These studies provide evidence that physical activity is related to various psychosocial outcomes. A key limitation associated with published studies focused on survivors of AYA cancer is that most of the questionnaires used were not developed specifically for them. Ensuring the questionnaires used are clear, appropriate, and relevant for survivors of AYA cancer is necessary to enhance confidence in the validity of the findings and to inform decisions around questionnaire selection in future research.

Conducting cognitive interviews with individuals who are representative of the population from which the sample will be drawn from in subsequent studies (e.g., survivors of AYA cancer)

is a useful technique by which to evaluate questionnaires.[26,27] This type of interview can help researchers gain in-depth information pertaining to comprehension, processing, and response selection, and can help to identify potentially problematic questions, ambiguities, and/or difficulties participants may encounter while interpreting and responding to questionnaires.[27] In addition, the findings from cognitive interviews allow researchers to see if participants' responses represent the intended meaning of the question.[27] Therefore, the purpose of this study was to conduct cognitive interviews to explore how survivors of AYA cancer interpret and respond to questionnaires widely used to assess self-reported physical activity and psychosocial functioning (i.e., quality of life, self-efficacy, physical self-perceptions, self-esteem, body image, posttraumatic growth). The specific research questions addressed were:

(1) What difficulties, if any, do survivors of AYA cancer encounter when interpreting, recalling, processing, and responding to selected questionnaires used to assess physical activity and psychosocial outcomes?

(2) Are the selected questionnaires used to assess physical activity and psychosocial outcomes appropriate and relevant for survivors of AYA cancer?

Methods

Participants

After receiving approval from the University Research Ethics Board, a purposeful sample representative of survivors of AYA cancer likely to be recruited in future studies were approached to participate in this study. Age at cancer diagnosis and current age were the primary factors taken into account when selecting participants, such that at least one AYA diagnosed for the first time between age 15-19, 20-24, 25-29, 30-34, and 35-39 years (and currently age 15-44 years) were recruited. Secondary factors that were taken into consideration included diagnosis

and time since treatment. Thus, survivors of AYA cancer meeting the aforementioned age criteria were eligible if they: (1) had completed cancer treatment within the past 5 years; (2) showed no current evidence of progressive disease, secondary cancer, or second cancers; (3) lived within 150 km of the University of Ottawa; and, (4) were able to read, understand, and provide informed consent in English. Survivors of AYA cancer were not eligible if they: (1) had physical impairments precluding participation in physical activity; (2) were unwilling or unable to provide informed consent and/or passive parental consent (the latter if they were younger than 18 years); and/or, (3) received a diagnosis of brain cancer or thyroid cancer.

Data Collection

Data were collected during a face-to-face interview at a private location of participants' choosing (e.g., their home). At the beginning of the interview, the first author (and interviewer) informed participants that the research team was evaluating questionnaires developed by other researchers. She explained that the goal of the interview was to find out what, if anything, was problematic with the questionnaires. Participants then completed a brief electronic sociodemographic questionnaire and the following seven questionnaires, which were chosen based on their wide usage by researchers investigating self-reported physical activity and psychosocial functioning among adults diagnosed with cancer: (1) Leisure Time Exercise Questionnaire (LTEQ);[28] (2) Exercise Self-Efficacy scale (EXSES);[29] (3) Physical Self-Description Questionnaire (PSDQ) Appearance, Strength, Endurance, Body Fat, and Physical Self- Esteem scales;[30] (4) Rosenberg Global Self-Esteem Scale (RSES);[31] (5) Multidimensional Body-Self Relations Questionnaire (MBSRQ) Appearance Evaluation (AE) scale and Body Areas Satisfaction Scale (BASS);[32] (6) Posttraumatic Growth Inventory (PTGI);[33] and, (7) Functional Assessment of Cancer Therapy-General (FACT-G).[34] Participants completed this task

without any assistance. Afterward, the cognitive interview began. Methodological descriptions of what conducting cognitive interviews involve and techniques used during the interviews have been published elsewhere.[27] Interviews were audio recorded and lasted between 51 and 111 minutes (mean=73, *SD*=19). During the interviews, participants had access to the questionnaires so that they could follow along.

Data Analysis

Data analyzed consisted of participants' responses during the interview as well as the interviewer's notes.[27] Summaries were compared across participants. This was done in a qualitative (i.e., identifying common patterns) and quantitative sense (i.e., frequency of the concerns that emerged). Following this, both authors met to review the summaries. Through discussion and a process of consensus, concerns were categorized into: comprehension, recall, response category, appropriateness and relevancy, or structural-logical concerns.[27]

Results

Seven survivors of AYA cancer were recruited and consented to participate in this study. They were currently age 18-36 years and had been diagnosed when they were age 16-35 years. Participants' sociodemographic and disease-related characteristics are presented in Table 1.

Table 1. Characteristics of study participants.

Sex	**Age** (years)		**Type of cancer**	**Treatment(s) received**	**Months since treatment completion**	**Annual household income**[a]	**Highest level of education attained**	**Currently studying** (Yes/No)	**Currently working** (Yes/No)
	At diagnosis	Current							
F	16	18	Hodgkin's lymphoma	Chemotherapy	38	Don't know	Completed some university / college	Yes	Yes
M	18	20	Hodgkin's lymphoma	Chemotherapy	22	>100,000	Completed some university / college	Yes	No
F	23	25	Breast	Surgery, chemotherapy, radiotherapy, hormonal therapy	25	20-39,999	Completed university / college	No	Yes
M	28	30	Rectal	Surgery, chemotherapy, radiotherapy	20	<20,000	Completed some high school	No	Yes
M	28	30	Testicular	Surgery, chemotherapy, stem-cell transplant	9	>100,000	Completed university / college	No	Yes
F	31	36	Hodgkin's lymphoma	Chemotherapy	59	>100,000	Completed graduate school[b]	Yes	No
F	35	36	Ovarian	Surgery, chemotherapy	8	80-99,999	Completed graduate school[b]	No	Yes

All participants self-identified as culturally/racially White. [a] Reported as Canadian dollars. [b] To help participants differentiate between the response options of *Completed (some) university/college* and *Completed graduate school,* Master's and doctoral degrees were listed as examples in the latter response option. F: female, M: male.

During the interviews, no concerns were identified for the MBSRQ-AE scale and BASS. Comprehension and/or structural-logical concerns were identified for the LTEQ, EXSES, PSDQ Appearance, Strength, Endurance, Body Fat, and Physical Self-Esteem scales, RSES, and PTGI, and concerns related to appropriateness and relevancy were identified for the FACT-G. The findings are summarized below.

Comprehension Concerns

In general, participants understood what each questionnaire was asking. They demonstrated this by accurately paraphrasing or explaining items and instructions in their own words. Despite this, participants commented that brief introductory sentences preceding each questionnaire would be helpful to explain what was being assessed. In addition, they had concerns with the instructions of the EXSES and some of the terminology used in the LTEQ.

Overly General Instructions

The first concern was related to the instructions of the EXSES, which state: "*Assuming you are planning on beginning, or are already engaging in physical activity regularly, the item below is designed to assess your beliefs in your ability to begin or continue engaging in physical activity for 150 minutes per week at moderate to vigorous intensities for the next 12 weeks.*" Participants must then use a 0%-100% scale to indicate their degree of confidence. Probing during the interviews revealed that participants had different interpretations of the question, and thus responded with different information in mind. All participants considered how confident they felt in their physical ability (i.e., task self-efficacy) to begin or continue engaging in physical activity; however, some also considered how confident they felt in their ability to overcome barriers to physical activity (i.e., barrier self-efficacy) and their ability to fit physical activity into their schedule (i.e., scheduling self-efficacy). When asked to consider other aspects

of self-efficacy, the participants who had only focused on task self-efficacy indicated that their responses might have been different. They therefore felt that the instructions of the EXSES could be more specific to ensure the desired type(s) of self-efficacy is/are being assessed.

Overly General Definitions of Complex Terminology

The second concern participants had was with regard to the terminology used in the LTEQ. A key feature of the LTEQ is that participants are asked to report how often they participated in *strenuous*-, *moderate*-, or *mild*-intensity physical activity during the past week. Although participants were comfortable recalling the number of times they participated in physical activity, probing revealed that they held differing interpretations for each intensity. Consequently, participants reported the frequency of activities of similar intensity in different intensity categories. For example, some participants reported activities typically categorized as *mild* based on the Compendium of Physical Activities[35] as *moderate* and others reported activities typically categorized as *strenuous* as *moderate*. Moreover, some participants were unsure about the intensity of the physical activity they had done. After discussing these concerns, participants expressed that having a more thorough definition of each intensity, alongside the examples already provided, would have helped.

Recall and Response Category Concerns

No concerns were identified with regard to ease of recall. In addition, participants' confidence in their ability to recall information and select answers from the response categories provided was not an issue.

Appropriateness and Relevancy Concerns

One of the main concerns participants had was related to the appropriateness and relevancy of the FACT-G because there were questions they failed to connect with. For example,

when being asked to reflect on whether they felt they were losing hope in their fight against their illness, participants did not know how to respond now that they had completed treatment. They noted this question (and others) would be more relevant before or during treatment because they now felt they had "won" their fight against cancer and were "disease-free". Relatedly, they did not feel as though the FACT-G was capturing their current quality of life, which they saw as being essential. They explained that although they could complete this questionnaire, they believed another questionnaire focused on more general quality of life (rather than cancer- and treatment-specific quality of life) would have been more appropriate. In addition, probing during the interviews allowed for the discovery that even though participants were asked to report pain symptoms when completing the FACT-G, few reported any. Indeed, only one participant indicated that they had experienced pain *somewhat* during the past 7 days, despite other participants revealing they had been experiencing pain *somewhat* to *very much* when interviewed. They explained that they felt the question about pain was to be linked explicitly to their cancer, not because of recent injuries (e.g., broken finger), persistent conditions (e.g., chronic knee pain), and long-term effects of their treatment (e.g., peripheral neuropathy). Therefore, they did not bother reporting that they had been experiencing pain and suggested that if the goal was to assess both general and cancer-related symptoms, this should have been specified.

Structural-Logical Concerns

Participants raised concerns in relation to the structure of the seven questionnaires when combined into a single online survey. For example, only after completing the questionnaires and taking part in the interview did some participants notice that they completed the RSES incorrectly as they failed to realize that the response options were ordered differently for this questionnaire. Participants suggested that response options presented in the RSES be reversed

such that they are presented from low/disagree (left) to high/agree (right) to be congruent with the response options presented in the other questionnaires they completed. They also discussed how adding brief descriptive anchors to the PTGI would be helpful and would reduce the need to scroll up/down when responding (which may have to do with how the electronic questionnaire was set up). Although the overall amount of time it took to complete the questionnaires was not an issue (mean=25 minutes, *SD*=9, range=16-37), participants did comment on the length and repetitive nature of the PSDQ-Appearance, Strength, Endurance, Body Fat, and Physical Self-Esteem scales. In turn, they wondered if it was possible to remove repetitive/redundant items. As well, participants commented that, despite having no issues using the response options, the close-ended nature was limiting because they could not elaborate or explain their responses. They further expressed a strong desire for an open-ended question to be included.

Brief Summary and Second Round of Cognitive Interviews

Overall, six of the seven questionnaires tested were clear, appropriate, and relevant with this sample of survivors of AYA cancer, and participants did not have major issues with them. However, concerns related to appropriateness and relevancy were identified for the FACT-G. Participants' feedback suggested that a general measure of quality of life should be considered. This prompted the assessment of another quality of life questionnaire that could be used either instead of or in combination with the FACT-G. The RAND 36-Item Health Survey 1.0 (RAND-36),[36] a questionnaire that has demonstrated good psychometric properties,[37] and that has been used in several studies with adults diagnosed with various types of cancers,[38-41] was selected. The RAND-36 contains the same items as the Medical Outcomes Study Short-Form 36 Health Survey,[42] a widely used questionnaire with demonstrated psychometric properties among adults diagnosed with cancer,[43,44] but the scoring method differs (i.e., the RAND-36 is scored on a 0-

100 scale) and it is free of charge. The RAND-36 was assessed during a follow-up cognitive interview with all seven participants. The same procedures used during the first interview were followed, with the exception that the interview was conducted over the phone. These interviews lasted on average 13 minutes (*SD*=3, range=11-16). Data were analyzed in the same way as it was for the first round. No concerns were identified by participants.

Discussion

Due to a growing interest in exploring the relationships between physical activity and psychosocial functioning among survivors of AYA cancer, establishing that questionnaires not specifically developed for this population are interpreted and responded to accurately is important. Considering the limited evidence for the clarity, appropriateness, and relevancy of many of the questionnaires used in previous studies,[19-25] conducting cognitive interviews is a crucial step in the process. Whereas studies employing cognitive interviews are becoming popular to better understand how questionnaires perform across a range of populations,[45-48] this study represents the first of its nature to use cognitive interviews to explore how survivors of AYA cancer interpreted and responded to questionnaires that can be used to assess self-reported physical activity and psychosocial functioning (i.e., quality of life, self-efficacy, physical self-perceptions, self-esteem, body image, posttraumatic growth). Results provide evidence that the LTEQ, EXSES, PSDQ Appearance, Strength, Endurance, Body Fat, and Physical Self- Esteem scales, RSES, MBSRQ-AE scale and BASS, PTGI, and RAND-36 were clear, appropriate, and relevant.

Despite the encouraging findings, concerns related to participants' understanding of the instructions on the EXSES and some of the terminology in the LTEQ were identified. Considering that self-efficacy is a multidimensional construct that includes barrier, task, and

scheduling self-efficacy,[49-51] the EXSES could either be used to obtain information about multiple facets of exercise self-efficacy or a single facet. In either case, modifying the current instructions to explicitly state which type(s) participants should consider when completing the EXSES seems warranted. As well, seeing as the LTEQ is often used to examine associations between physical activity and psychosocial outcomes among adults diagnosed with cancer,[for review, see 52] adding comprehensive definitions for strenuous, moderate, and mild intensity in the LTEQ should be considered to ensure participants are able to accurately classify their activities. If indeed these or other changes are made (e.g., adding a few sentences preceding each questionnaire that describe what the researcher is assessing as suggested by participants), further psychometric testing of the revised versions would be an important next step because making modifications may affect score reliability and validity.[53,54]

In addition to suggesting modifications, participants highlighted that efforts should be made to reduce repetition within questionnaires. Accordingly, when possible, short forms should be favored. For example, the short form of the PSDQ-Appearance, Strength, Endurance, Body Fat, and Physical Self-Esteem scales[55] that consists of 15 items instead of 30 items could be used. Furthermore, as most questionnaires assessed in this study do not include open-ended options, including one or more open-ended questions could be beneficial. Whereas close-ended response options are widely used to collect data in light of the advantages (e.g., amenable to research with large samples, allow for analyses to determine a variety of relationships between variables, and typically have higher response rates),[56,57] there are limitations. As revealed by participants, they do not allow for elaborating or explaining responses. With the understanding that questionnaires with close-ended response options will continue to be used and are useful to answer a range of research questions, it may be valuable to provide survivors of AYA cancer with at least one

open-ended question when administering questionnaires. Zebrack et al.[58] did this by ending their survey with a single open-ended question and found that survivors of AYA cancer provided rich qualitative data about their positive and negative experiences with their medical care. The authors concluded that the data gathered from this single question extended the findings from the closed-ended items, and importantly provided data that would not have been captured otherwise. Thus, including one or more open-ended question may have implications for collecting in-depth information pertaining to the experiences of survivors of AYA cancer.

Last, despite the common use of the FACT-G[59] and demonstrated psychometric properties among adults diagnosed with cancer,[34,59-64] concerns related to appropriateness and relevancy were identified by participants who were diagnosed with cancer at age 16-35 years, were currently age 18-36 years, and had completed treatment 8-59 months prior to being interviewed for this study. The main concern was that it did not cover more general aspects of quality of life. As a result, participants felt it was more suitable for individuals going through cancer treatment. This is perhaps not surprising as the FACT-G was initially developed to measure quality of life during treatment for cancer.[34] To ensure that cancer-specific and more general aspects of quality of life are captured, some researchers have used both cancer-specific and generic measures of quality of life.[65-67] Although decisions regarding which questionnaire(s) to use should be made in light of the research objective(s) being addressed, a combination of cancer-specific and general measures may be necessary to adequately assess aspects of quality of life that are important for individuals diagnosed with and treated for cancer.[68] Based on the current results, the RAND-36, which has previously been used with middle-age and older adult survivors of cancer,[38-41] may be well suited for survivors of AYA cancer who have completed treatment.

Limitations and Future Directions

There are limitations of this study that should be taken into account when interpreting the results. The first limitation is with regard to the culture/race of the sample. All participants recruited self-identified as White, which was not intentional. It is possible that including the perspectives of a more culturally/racially diverse sample might have resulted in additional or different concerns being identified. Despite this limitation, the sample was purposefully selected to be representative of participants likely to be recruited in future studies with regard to age at diagnosis, current age, type of cancer, time since treatment, and socioeconomic status (i.e., education, income). A second limitation is that the RAND-36 was assessed in isolation. It is possible that participants would have raised concerns if the questionnaire was assessed at the same time as other questionnaires. Third, although the present study provides information that may help inform the design of future studies on physical activity and psychosocial functioning, this study was conducted with seven survivors of AYA cancer, which raises the possibility that additional interviews with another sample or more participants could have yielded different insights.[26] Finally, it should be underscored that the findings from cognitive interviews are not meant to confirm score validity or reliability.[27] Further testing of score reliability and validity for these questionnaires with survivors of AYA cancer is required in quantitative studies. Guidelines described by Messick[69] could inform the development of such studies.

Conclusion

Survivors of AYA cancer had few problems interpreting and responding to the LTEQ, EXSES, PSDQ Appearance, Strength, Endurance, Body Fat, and Physical Self-Esteem scales, RSES, MBSRQ-AE scale and BASS, PTGI, and RAND-36. Overall, results were encouraging and suggestive that these questionnaires were clear, appropriate, and relevant for survivors of

AYA cancer. Although not critical, it is possible that providing more specific instructions for the EXSES, defining the different physical activity intensities in the LTEQ, adding explanatory sentences to each questionnaire, and providing at least one open-ended question could improve the quality of data collected from survivors of AYA cancer. Given that the development and refinement of questionnaires is an ongoing process,[70] efforts should be made to continue developing and testing questionnaires for AYAs diagnosed with cancer.

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Author Disclosure Statement

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References

1. Thomas DM, Albritton KH, Ferrari A. Adolescent and young adult oncology: an emerging field. J Clin Oncol. 2010;28(32):4781-2.

2. Tai E, Buchanan N, Townsend J, et al. Health status of adolescent and young adult cancer survivors. Cancer. 2012;118(19):4884-91. doi: 10.1002/cncr.27445. PubMed PMID: 22688896.

3. Spathis A, Booth S, Grove S, et al. Teenage and young adult cancer-related fatigue is prevalent, distressing, and neglected: it is time to intervene. a systematic literature review and narrative synthesis. J Adolesc Young Adult Oncol. 2015;4(1):3-17.

4. Chao C, Xu L, Bhatia S, et al. Cardiovascular disease risk profiles in survivors of adolescent and young adult (AYA) cancer: The Kaiser Permanente AYA Cancer Survivors Study. J Clin Oncol. 2016;34(14):1626-33.

5. Lewis DR, Seibel NL, Smith AW, Stedman MR. Adolescent and young adult cancer survival. J Natl Cancer Inst Monogr. 2014;2014(49):228-35.

6. Kwak M, Zebrack BJ, Meeske KA, et al. Trajectories of psychological distress in adolescent and young adult patients with cancer: a 1-year longitudinal study. J Clin Oncol. 2013;31(17):2160-6.

7. Zebrack B, Isaacson S. Psychosocial care of adolescent and young adult patients with cancer and survivors. J Clin Oncol. 2012;30(11):1221-6.

8. Parsons HM, Harlan LC, Lynch CF, et al. Impact of cancer on work and education among adolescent and young adult cancer survivors. J Clin Oncol. 2012;30(19):2393-400.

9. Patterson P, McDonald FE, Zebrack B, Medlow S. Emerging issues among adolescent and young adult cancer survivors. Semin Oncol Nurs. 2015;31(1):53-9.

10. Champion VL, Wagner LI, Monahan PO, et al. Comparison of younger and older breast cancer survivors and age-matched controls on specific and overall quality of life domains. Cancer. 2014;120(15):2237-46.

11. Smith AW, Bellizzi KM, Keegan TH, et al. Health-related quality of life of adolescent and young adult patients with cancer in the United States: the Adolescent and Young Adult Health Outcomes and Patient Experience study. J Clin Oncol. 2013;31(17):2136-45.

12. Quinn GP, Goncalves V, Sehovic I, et al. Quality of life in adolescent and young adult cancer patients: a systematic review of the literature. Patient Relat Outcome Meas. 2015;6:19-51.

13. Institute of Medicine. Identifying and addressing the needs of adolescents and young adults with cancer: workshop summary. Washington, DC: The National Academies Press; 2013.

14. Fernandez C, Fraser GA, Freeman C, et al. Principles and recommendations for the provision of healthcare in Canada to adolescent and young adult-aged cancer patients and survivors. J Adolesc Young Adult Oncol. 2011;1(1):53-9.

15. Baumann FT, Bloch W, Beulertz J. Clinical exercise interventions in pediatric oncology: a systematic review. Pediatric research. 2013;74(4):366-74.

16. Wurz A, Brunet, J. The effects of physical activity on health and quality of life in adolescent cancer survivors: a systematic review. JMIR Cancer. 2016;2(1):e6.

17. Mishra SI, Scherer RW, Geigle PM, et al. Exercise interventions on health-related quality of life for cancer survivors. Cochrane Database Syst Rev. 2012;8:CD007566.

18. Albrecht TA, Taylor AG. Physical activity in patients with advanced-stage cancer: a systematic review of the literature. Clin J Oncol Nurs. 2012;16(3):293-300.

19. Brunet J, Love C, Ramphal R, Sabiston CM. Stress and physical activity in young adults treated for cancer: the moderating role of social support. Support Care Cancer. 2014;22(3):689-95.

20. Love C, Sabiston CM. Exploring the links between physical activity and posttraumatic growth in young adult cancer survivors. Psychooncology. 2011;20(3):278-86.

21. Murnane A, Gough K, Thompson K, et al. Adolescents and young adult cancer survivors: exercise habits, quality of life and physical activity preferences. Support Care Cancer. 2015;23(2):501-10.

22. Keats MR, Culos-Reed SN, Courneya KS, McBride M. An examination of physical activity behaviors in a sample of adolescent cancer survivors. J Pediatr Oncol Nurs. 2006;23(3):135-42.

23. Erickson JM, Adelstein KE, Letzkus LC. A feasibility study to measure physical activity, fatigue, sleep-wake disturbances, and depression in young adults during chemotherapy. J Adolesc Young Adult Oncol. 2014;3(1):37-41.

24. Valle CG, Tate DF, Mayer DK, et al. A randomized trial of a Facebook-based physical activity intervention for young adult cancer survivors. J Cancer Surviv. 2013;7(3):355-68.

25. Keats MR, Culos-Reed SN. A community-based physical activity program for adolescents with cancer (project TREK): program feasibility and preliminary findings. J Pediatr Hematol Oncol. 2008;30(4):272-80.

26. Beatty PC, Willis, G. Research synthesis: the practice of cognitive interviewing. Public Opin Q. 2007;71(2):287-311.

27. Willis GB. Cognitive interviewing a tool for improving questionnaire design. California: Sage Publications Ltd.; 2005.

28. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. Can J Appl Sport Sci. 1985;10(3):141-6.

29. McAuley E. Self-efficacy and the maintenance of exercise participation in older adults. J Behav Med. 1993;16(1):103-13.

30. Marsh HW, Richards GE, Johnson S, et al. Physical self-description questionnaire: psychometric properties and a multitrait-multimethod analysis of relations to existing instruments. JSEP. 1994;16:270-305.

31. Rosenberg M. Society and adolescent self-image. Princeton, NJ: Princeton University Press; 1965.

32. Cash TF. The multidimensional body-self relations questionnaire. MBSRQ users' manual available at: www.body-images.com. 2000.

33. Tedeschi RG, Calhoun LG. The Posttraumatic Growth Inventory: measuring the positive legacy of trauma. J Trauma Stress. 1996;9(3):455-71.

34. Cella DF, Tulsky DS, Gray G, et al. The Functional Assessment of Cancer Therapy scale: development and validation of the general measure. J Clin Oncol. 1993;11(3):570-9.

35. Ainsworth BE, Haskell WL, Herrmann SD, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. Med Sci Sports Exerc. 2011;43(8):1575-81.

36. Hays RD, Sherbourne CD, Mazel RM. The RAND 36-Item Health Survey 1.0. Health Econ. 1993;2(3):217-27.

37. VanderZee KI, Sanderman R, Heyink JW, de Haes H. Psychometric qualities of the RAND 36-Item Health Survey 1.0: a multidimensional measure of general health status. Int J Behav Med. 1996;3(2):104-22.

38. Brunet J, Burke S, Grocott MP, et al. The effects of exercise on pain, fatigue, insomnia, and health perceptions in patients with operable advanced stage rectal cancer prior to surgery: a pilot trial. BMC Cancer. 2017;17(1):153.

39. Hughes S, Jaremka LM, Alfano CM, et al. Social support predicts inflammation, pain, and depressive symptoms: longitudinal relationships among breast cancer survivors. Psychoneuroendocrinology. 2014;42:38-44.

40. Cary KC, Singla N, Cowan JE, et al. Impact of androgen deprivation therapy on mental and emotional well-being in men with prostate cancer: analysis from the CaPSURE registry. J Urol. 2014;191(4):964-70.

41. Heins MJ, Korevaar JC, Hopman PE, et al. Health-related quality of life and health care use in cancer survivors compared with patients with chronic diseases. Cancer. 2016;122:196-70.

42. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30(6):473-83.

43. Mosewich AD, Hadd V, Crocker PRE, Zumbo BD. Invariance testing of the SF-36 health survey in women breast cancer survivors: do personal and cancer-related variables influence the meaning of quality of life items. Social Indic Res. 2013;110(2):559-7.

44. Treanor C, Donnelly M. A methodological review of the Short Form Health Survey 36 (SF-36) and its derivatives among breast cancer survivors. Qual Life Res. 2015;24(2):339-62.

45. Aiken CRH, Gray M, Clifton S, et al. Improving questions on sexual partnership: lessons learned from cognitive interviews for Britain's third national survey of sexual attitudes and lifestyles ("Natsal-3"). Arch Sex Behav. 2013;42:173-185.

46. Hales S, Gagliese L, Nissim R, et al. Understanding bereaved caregiver evaluations of the quality of dying and death: an application of cognitive interviewing methodology to the quality of dying and death questionnaire. J Pain Symptom Manage. 2012;43(2):195-204.

47. Matter R, Kline S, Cook KF, Amtmann D. Measuring pain in the context of homelessness. Qual Life Res. 2009;18(7):863-72.

48. Adair CE, Holland AC, Patterson ML, et al. Cognitive interviewing methods for questionnaire pre-testing in homeless persons with mental disorders. J Urban Health. 2011;89(1):36-52.

49. Bandura A. Self-efficacy. The exercise of control. New York: W.H. Freeman and Company; 1997.

50. DuCharme KA, Brawley LR. Predicting the intentions and behavior of exercise initiates using two forms of self-efficacy. J Behav Med. 1995;18(5):479-97

51. Woodgate J, Brawley L, Weston ZJ. Maintenance cardiac rehabilitation exercise adherence: effects of task and self-regulatory self-efficacy. J Appl Soc Psychol. 2005;35(1):183-222.

52. Amireault S, Godin G, Lacombe J, Sabiston CM. The use of the Godin-Shephard Leisure-Time Physical Activity Questionnaire in oncology research: a systematic review. BMC Med Res Methodol. 2015;15:60.

53. Stewart AL, Thrasher AD, Goldberg J, Shea JA. A framework for understanding modifications to measures for diverse populations. J Aging Health. 2013;24(6):992-1017.

54. Juniper EF. Validated questionnaires should not be modified. Eur Respir J. 2009;34:1015-17.

55. Marsh HW, Martin AJ, Jackson S. Introducing a short version of the physical self description questionnaire: new strategies, short-form evaluative criteria, and applications of factor analyses. J Sport Exerc Psychol. 2010;32(4):438-82.

56. Reja U, Manfreda KL, Hlebec V, Vehovar V. Open-ended vs. close-ended questions in web questionnaires. Dev Appl Stat. 2003;19:160-77.

57. Dunn DS. Statistics and data analysis for the behavioral sciences. New York, NY: McGraw Hill; 2001.

58. Zebrack B, Kent EE, Keegan TH, et al. "Cancer sucks," and other ponderings by adolescent and young adult cancer survivors. J Psychosoc Oncol. 2014;32(1):1-15.

59. Luckett T, King MT, Butow PN, et al. Choosing between the EORTC QLQ-C30 and FACT-G for measuring health-related quality of life in cancer clinical research: issues, evidence and recommendations. Ann Oncol. 2011;22(10):2179-90.

60. Costet N, Lapierre V, Benhamou E, Le Gales C. Reliability and validity of the Functional Assessment of Cancer Therapy General (FACT-G) in French cancer patients. Qual Life Res. 2005;14(5):1427-32.

61. Overcash J, Extermann M, Parr J, Perry J, Balducci L. Validity and reliability of the FACT-G scale for use in the older person with cancer. Am J Clin Oncol. 2001;24(6):591-6.

62. Danhauer SC, Rutherford CA, Hurt G, et al. Providing psychosocial group support for young women with breast cancer: findings from a wellness-based community collaboration. J Psychosoc Oncol. 2007;25(1):103-20.

63. Pickering LM, Pyle L, Larkin JM. Sunitinib is superior to interferon alpha with respect to quality of life for patients with renal cell carcinoma. Nat Clin Pract Oncol. 2009;6(1):6-7.

64. Yost KJ, Thompson CA, Eton DT, et al. The Functional Assessment of Cancer Therapy - General (FACT-G) is valid for monitoring quality of life in patients with non-Hodgkin lymphoma. Leuk Lymphoma. 2013;54(2):290-7.

65. Wei JT, Dunn RL, Sandler HM, et al. Comprehensive comparison of health-related quality of life after contemporary therapies for localized prostate cancer. J Clin Oncol. 2002;20(2):557-66.

66. Segal R, Evans W, Johnson D, et al. Structured exercise improves physical functioning in women with stages I and II breast cancer: results of a randomized controlled trial. J Clin Oncol. 2001;19(3):657-65.

67. Thiel DD, Davidiuk AJ, Broderick GA, et al. Comparison of patient-reported quality of life outcome questionnaire response rates between patients treated surgically for renal cell carcinoma and prostate carcinoma. BMC Urol. 2015;15:58.

68. Jacobsen PB, Jim HS. Consideration of quality of life in cancer survivorship research. Cancer Epidemiol Biomarkers Prev. 2011;20(10):2035-41.

69. Messick S. Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. Am Psychol. 1995;50(9):741-9.

70. Zumbo BD, Chan EKH. Setting the stage for validity and validation in social, behavioral, and health sciences: trends in validation practices. In: Zumbo BD, Chan EKH (eds). Validity and Validation in Social, Behavioral, and Health Sciences. New York: Springer; 2014. pp. 3-8.

Bridging Text

This study was conducted to ensure the questionnaires selected to assess the psychological outcomes for this research program (and ancillary studies planned for Study Two and Study Three) were clear, appropriate, and relevant for survivors of adolescent and young adult (AYA) cancer. The main findings from Study One (see Chapter Two) can be summarized as:

1. The questionnaires selected to assess the Exercise and Self-Esteem Model (EXSEM) constructs were deemed to be appropriate and relevant with only minor concerns identified for select questionnaires:
    a. Participants recommended that more thorough definitions and instructions be provided for the questionnaires assessing self-reported physical activity and self-efficacy for physical activity, respectively;
    b. Structural/logical concerns related to the order of response options were identified for the questionnaire assessing global self-esteem; and,
    c. To reduce participant burden and repetition the short-form of the questionnaire assessing physical self-perceptions and physical self-esteem was recommended.
2. Concerns related to appropriateness and relevancy were identified for the Functional Assessment of Cancer Therapy-General (a cancer-specific quality of life questionnaire), whereas no concerns were identified the RAND 36-Item Health Survey 1.0 (a general quality of life questionnaire); though, neither of these questionnaires were included in subsequent studies contained in this thesis.

Taken together, feedback from participants suggested the questionnaires assessing self-reported physical activity and the psychological outcomes for this research program (see Appendix B, Study One for original questionnaires and the cognitive interview guide) could be used in future

studies with survivors of AYA cancer, either with or without minor modifications. Incorporating the minor modifications suggested by participants (see Appendix B, Study Two for revised questionnaires), Article Two (see Chapter Three) presents findings from a cross-sectional study that explored relationships between select EXSEM constructs. Specifically, to examine when desired psychological outcomes may be maximized, the relationships between physical self-perceptions and self-esteem (physical and global) were explored. Based on relevant empirical work; physical activity and self-self-efficacy for physical activity were explored as potential moderators.

Chapter Three

Article Two, Study Two

Exploring the Relationships Between Physical Activity, Self-Efficacy, Physical Self-Perceptions, and Self-Esteem Among Survivors of Adolescent and Young Adult Cancer

Amanda Wurz & Jennifer Brunet

Submitted to a peer-reviewed journal

Abstract

Background: Physical and global self-esteem are important constructs for cancer survivors' psychological health. Both physical activity (PA) and self-efficacy for PA are associated with self-esteem (physical and global) in other populations with and without chronic conditions. However, the relationships between PA, self-efficacy for PA, physical self-perceptions, and self-esteem remain unexplored among survivors of adolescent and young adult (AYA) cancer.

Procedure: Eighty-seven survivors of AYA cancer completed an online questionnaire. Correlations and hierarchical multivariate linear regression analyses were conducted.

Results: Physical self-perceptions and physical and global self-esteem were positively related. Regression analyses showed that self-efficacy for moderate-to-vigorous PA (MVPA) moderated the relationship between physical self-perceptions and physical self-esteem (but not global self-esteem), such that at higher levels of self-efficacy for MVPA, the magnitude of the association between physical self-perceptions and physical self-esteem was greater. MVPA did not moderate the relationship between physical self-perceptions and physical or global self-esteem.

Conclusions: Among survivors of AYA cancer, physical self-perceptions are a significant correlate of physical and global self-esteem. Though MVPA did not relate to self-esteem (physical or global), self-efficacy for MVPA may serve to strengthen the relationship between physical self-perceptions and physical self-esteem among survivors of AYA cancer. As such, it may be particularly important for psychological health outcomes to foster feelings of control over health behaviours among survivors of AYA cancer. In addition to providing directions for future research, this study provides a starting point for identifying the circumstances under which the positive relationship between physical self-perceptions and self-esteem is strengthened.

Introduction

Global self-esteem is a relatively stable construct that reflects how one feels about themselves overall.[1] Based on Shavelson et al.'s model of self-concept[2] and Rosenberg's[3] conceptualization of self-esteem, there are several different types of self-esteem (e.g., academic, social, emotional, physical), which have been confirmed in empirical studies.[4-6] Arguably, physical self-esteem, a specific type of self-esteem, contributes most to global self-esteem.[7] Physical self-esteem reflects one's evaluations of the way his/her body functions and appears,[2] and like global self-esteem, has been positively related to psychological health.[8,9]

Self-esteem is important to consider when thinking about behaviours that may foster psychological health, such as physical activity (PA). Self-esteem has been positively related to PA in cross-sectional studies, whereby active people report more positive physical and global self-esteem than their inactive counterparts.[10,11] As well, PA has been shown to positively predict physical and global self-esteem in longitudinal and experimental studies,[12,13] possibly due to improvements in physical self-perceptions (one's perceived competence in specific domains of appearance and functioning) that result from participating in PA.[14,15]

To examine the pathways underlying the relationships between PA and self-esteem, researchers have used the Exercise and Self-Esteem Model (EXSEM).[16] Within the EXSEM, Sonstroem and Morgan[16] suggest that PA leads to favourable changes in physical fitness and enhanced self-efficacy, which fosters positive physical self-perceptions, and in turn results in increased physical self-esteem and subsequently global self-esteem.[16] To date, many researchers have found self-efficacy, physical fitness, and physical self-perceptions to mediate the relationships between PA and physical and global self-esteem.[17-19]

Though several researchers use the EXSEM to study processes influencing self-esteem, few have sought to identify variables that may affect the direction and/or strength of the relationships presented. Moderation studies can elucidate under what circumstances physical self-perceptions have stronger/weaker or positive/negative relations with physical and global self-esteem. Whereas the EXSEM places PA as one of the first process influencing self-esteem, it is equally plausible that PA moderates the relationships between physical self-perceptions and self-esteem based on evidence that PA impacts both physical self-perceptions and self-esteem (physical and global) positively.[20,21] Self-efficacy for PA, one's confidence to engage in PA, may work in the same way, in that it may moderate the relationship between one's physical self-perceptions and their self-esteem (physical and global) by concurrently impacting more specific and generalized perceptions of the self. There is preliminary support for these contentions in other fields.[22] However, within literature reporting on the EXSEM, hypotheses regarding the moderating effect of situation-specific constructs (i.e., PA, self-efficacy for PA) on the relationship between specific (i.e., physical self-perceptions) and more general types of self-esteem (i.e., physical and global self-esteem) remain unexplored.

Another limitation is that many researchers have drawn support for the EXSEM from studies conducted with non-clinical populations (e.g., healthy children/youth, community-dwelling adults).[17-19] This has not given researchers much understanding of the associations between the EXSEM constructs among individuals living with chronic conditions, such as cancer.[23-25] Survivors of adolescent and young adult (AYA) are one population within cancer care who merit particular attention as they must manage disease-related changes in physical functioning and appearance (e.g., muscle wasting, physical deconditioning, scarring/disfigurement)[26] during a time when body-related self-evaluations are of utmost

importance.[27] Indeed, survivors of AYA cancer not only report reduced perceptions of physical functioning and appearance,[28,29] but researchers have linked these experiences to their changed body.[30,31] Further, this population report low self-esteem in quantitative and qualitative studies.[32-34] Given the considerable personal and societal impact of cancer during AYA years,[35] exploring ways to enhance physical and global self-esteem, central parameters in psychological health,[8,9] is warranted.

Based on theoretical[16] and empirical work[17-19] supporting the notion that physical self-perceptions influence a person's self-esteem (physical and global) in the general population, determining if/how such perceptions are related to self-esteem (physical and global) among survivors of AYA cancer is necessary. Among survivors of breast cancer, researchers have found that physical self-perceptions are positively related to physical and global self-esteem.[24,25] However, there are notable limitations with regards to the samples recruited, research questions asked, and measures used. Specifically, both studies included homogenous samples comprised of women diagnosed with breast cancer who had a mean age of >48 years, did not consider alternative relationships between the EXSEM constructs, and failed to confirm whether the questionnaires selected were appropriate or relevant for the sample.

To address these issues, the purpose of this study was to explore the relationships between PA, self-efficacy for PA, physical self-perceptions, and physical and global self-esteem among survivors of AYA cancer using questionnaires that have been shown to be appropriate and relevant.[36] To this end, we explored the relationship between physical self-perceptions and self-esteem (physical and global; objective 1), and tested if PA and self-efficacy for PA moderated the relationship between physical self-perceptions and self-esteem (physical and global) among survivors of AYA cancer (objective 2). Consistent with theoretical

underpinnings[16] and empirical research,[17-19] we hypothesized that physical self-perceptions and self-esteem would be positively related, with stronger relationships observed between physical self-perceptions and physical self-esteem than with global self-esteem. We also hypothesized that the relationships between physical self-perceptions and self-esteem (physical and global) would be of greater magnitude for survivors of AYA cancer who reported higher levels of PA and greater self-efficacy for PA.

Methods

Participants

Survivors of AYA cancer were eligible if they: (1) were diagnosed with cancer between the ages of 15-39 years; (2) had completed cancer treatment within the past 5 years; (3) showed no evidence of progressive or recurrent disease or of secondary or second cancers; and, (4) were able to read, understand, and provide informed consent in English. Survivors of AYA cancer were not eligible if they: (1) had physical impairments precluding participation in PA; and/or, (2) were unwilling or unable to provide informed consent and/or passive parental consent (the latter if they were <18 years).

Procedures

Following Research Ethics Board approval, survivors of AYA cancer were recruited to participate in this cross-sectional observational study through advertisements containing a study link placed on social media websites (e.g., Facebook, Twitter), online bulletin boards/discussion groups, and websites that provide supportive care and/or services to survivors of AYA cancer. As well, snowball sampling was employed. Once potential participants clicked on the link provided, they were directed to a study objectives and eligibility information page to read before being directed to an informed consent and/or passive parental consent form page. After consent

(and where indicated, passive parental informed consent) was secured, participants gained access to the online survey. At the end of the survey, all participants had the option to enter their email address to receive a $10.00 iTunes gift card. The survey took approximately 20-30 minutes to complete.

Measures

The questionnaires included in this study were deemed appropriate and relevant for survivors of AYA cancer in a cognitive interview study,[36] in addition to having previously demonstrated score reliability and validity.

Personal and medical factors. Participants completed questions about their age, sex, cancer diagnosis, and time since treatment. As well, participants were asked to report their height (meters) and body mass (kilograms) to compute body mass index (BMI), a proxy measure of body composition. This information was collected to describe the sample and to identify potential confounders in the analyses.

Physical self-perceptions. The Physical Self Description Questionnaire Short Form (PSDQ-S) subscales of strength (3-items), endurance (3-items), appearance (3-items), and body fat (3-items) were used to measure physical self-perceptions.[37] The PSDQ-S employs a Likert-type scale ranging from 1 (*false*) to 6 (*true*). After reverse scoring three negatively worded items, a composite score was calculated by averaging all subscale scores, with higher scores indicating more positive appraisals of physical self-perceptions. This approach as been employed previously[38,39] and was done in the current study to conserve power. Scores on the PSDQ-S have demonstrated reliability, good factor structure, invariance across sexes, age, BMI, and convergent and discriminant validity based on relationships with other measures.[37,40]

Physical self-esteem. The PSDQ-S subscale of physical self-esteem (3-items) was used to measure physical self-esteem.[37] As described above, the PSDQ-S employs a Likert-type scale and the subscale score was calculated by averaging responses on the subscale, with higher scores indicating more positive physical self-esteem. Scores on the PSDQ-S have demonstrated reliability, good factor structure, invariance, and convergent and discriminant validity.[37,40]

Global self-esteem. The Rosenberg Global Self-Esteem Scale (RSES)[41] was used to assess global self-esteem. The RSES is a 10-item scale with five positively and five negatively worded items using a Likert-type scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). After reverse scoring the negatively worded items, a global self-esteem score was calculated by summing the scores for all 10 items, with higher scores indicating higher global self-esteem. Scores from the RSES have demonstrated good reliability and validity across a range of samples, including survivors of breast cancer[25,42] young adult survivors of childhood cancer[43], and AYA cancer patients.[44]

PA. A modified version of the Leisure Time Exercise Questionnaire (LTEQ)[45] was used to assess time spent per week in moderate-to-vigorous PA (MVPA), which was of interest in this study due to current PA recommendations for cancer survivors of 150 minutes of MVPA/week.[46] Participants were asked to indicate the number of times they engage in moderate and vigorous bouts of PA for at least 10 minutes in a typical week and to indicate the duration of each session. For the analyses, a MVPA score was computed using the following formula: [frequency of moderate bouts*duration of moderate bouts]+[frequency of vigorous bouts*duration of vigorous bouts]. LTEQ scores have demonstrated reliability and concurrent validity with scores derived from accelerometers.[47] Further, the LTEQ has been used extensively in studies with child[48] and adult survivors of cancer.[49]

Self-efficacy for MVPA. A modified single-item version of the Exercise Self-Efficacy scale[50] was used to assess participant's self-efficacy for MVPA. Participants were asked to indicate their confidence to engage in at least 150 minutes/week of MVPA over the next 12 weeks on a 100-point percentage scale comprised of 10-point increments, ranging from 0% (*not at all confident*) to 100% (*highly confident*). The confidence rating for the single item represents participants' overall confidence to engage in 150 minutes/week of MVPA over the next 12 weeks. Scores on the original measure have demonstrated excellent internal consistency and have evidence of score validity.[51,52]

Data Analysis

Data were analyzed using IBM SPSS (Version 25).[53] Data were first screened following recommended procedures.[54] Of the 116 who completed the online survey, 28 were excluded from the analyses because they were missing >5% of data (*n*=8), provided insufficient information to confirm eligibility (*n*=10), or were ineligible based on reported age at diagnoses and/or time since treatment (*n*=10). Participants who were missing <5% of data had their missing data replaced using their mean score from remaining items on the subscale.[55] Data were normally distributed based on skewness and kurtosis values. Two univariate outliers were identified and retained after running the analyses with and without the cases and obtaining the same results. There were no multivariate outliers according to Mahalanobis distance values; however, considering the relatively small sample size, leverage and Cook's distance values were examined in parallel[54] and three multivariate outliers were identified. Each was visually inspected and all three were retained after running the analyses with and without outlier cases and obtaining similar results. Standardized residuals were then inspected and one case with a standardized residual >3 was removed from the dataset. Visual inspection of the scatterplots and non-

significant Box's M statistics indicated homoscedasticity. There were no indications of multicollinearity.

After confirming all assumptions were met for hierarchical multivariate linear regression, descriptive statistics were computed for all study variables, along with Pearson and Spearman bivariate correlations to explore associations and identify potential confounders. Sex and BMI were correlated with main study variables >.20 and thus were controlled for in the analyses. Last, to address the study objectives, two models were tested wherein physical (Model A) and global self-esteem (Model B) were regressed on sex and BMI (step 1), physical self-perceptions (step 2), MVPA and self-efficacy for MVPA (step 3), and the interaction terms (physical self-perceptions*MVPA, physical self-perceptions*self-efficacy for MVPA; step 4).[54,56] All continuous variables were mean-centered. A moderator effect was supported when the interaction term was statistically significant at $p<.05$. Significant interactions were explored using simple slopes analyses using the pick-a-point method of probing interactions at low, medium, and high levels (>1 standard deviation [*SD*] above and below the mean) of the moderator variable at the mean level of the other moderator variable.[56,57]

Results

The analytic sample was comprised of 87 survivors of AYA cancer between the ages of 20 to 42 years (M_{age}=32.90±4.38 years) who had been diagnosed with breast cancer (51%) or other cancers (49%; e.g., leukemia, lymphoma) and had completed treatment on average 2.08±1.37 years earlier. Most participants self-identified as female (75%) and Caucasian (88%) and were, on average, classified as overweight based on their BMI (M_{BMI}=25.41±6.08). Participants reported engaging in 103.91±109.44 minutes of MVPA/week and scored, on average, 61.26±23.66 out of 100% confidence they could meet current PA guidelines. Relative to scale

ranges, participants reported moderate levels of physical self-perceptions (M=3.58±0.66; scale range=1-6), physical self-esteem (M=3.64±1.01; scale range=1-6), and global self-esteem (M=29.71±3.79; scale range=10-40).

There were small to large positive and significant correlations between physical self-perceptions and physical self-esteem, global self-esteem, and self-efficacy for MVPA (see Table 1). There was a moderate and significant positive relationship between MVPA and self-efficacy for MVPA. The relationships between MVPA and physical self-perceptions and physical and global self-esteem were small and non-significant.

The results of the hierarchical multivariate linear regression analyses are presented in Table 2. In Model A, sex, BMI, physical self-perceptions, MVPA, self-efficacy for MVPA, and the interaction terms collectively accounted for a significant amount of variance in physical self-esteem in step 4 (R^2=.66, p<.001). Regarding the first objective, physical self-perceptions were a significant and positive correlate of physical and global self-esteem, though the magnitude of the relationship observed between physical self-perceptions and physical self-esteem was stronger than the magnitude of the relationship observed between physical self-perceptions and global self-esteem. In relation to the second objective, self-efficacy for MVPA moderated the relationship between physical self-perceptions and physical self-esteem. As shown in Fig. 1 and based on the simple slope analysis, the two-way interaction between physical self-perceptions and self-efficacy for MVPA indicated that at lower (1 *SD* below the mean) levels of self-efficacy for MVPA, there was a weaker significant relationship between physical self-perceptions and physical self-esteem (β=0.33, p=.023), whereas at higher levels (1 *SD* above the mean) of self-efficacy for MVPA there was a stronger significant relationship between physical self-perceptions and physical self-esteem (β=0.77, p<.001). In Model B, sex, BMI, physical self-

perceptions, MVPA, self-efficacy for MVPA, and the interaction terms did not collectively account for a significant amount of variance in global self-esteem in step 4 (R^2=.13, p=.113).

Discussion

The purpose of this study was to explore the relationships between physical self-perceptions and physical and global self-esteem among survivors of AYA cancer (objective 1), and test MVPA and self-efficacy for MVPA as potential moderators of these relationships (objective 2). Our hypotheses were partially supported. Positive associations between physical self-perceptions and physical and global self-esteem were found; however, MVPA and self-efficacy for MVPA were not significant correlates of physical or global self-esteem. Further, self-efficacy for MVPA, but not MVPA, moderated the relationship between physical self-perceptions and physical self-esteem.

In line with conceptualizations of self-esteem,[2,3] the EXSEM,[16] and hypotheses for objective 1, physical self-perceptions were a significant positive correlate of both physical and global self-esteem. Notably, physical self-perceptions were more strongly related to physical self-esteem than to global self-esteem (based on visually comparing the magnitude of correlation coefficients and β coefficients). Findings echo those reported in studies with survivors of breast cancer[24,25] and adolescents without a history of cancer[58] suggesting there may be overlap between people's perceptions of their physical functioning and appearance and more global self-evaluations, regardless of disease status and age. Since global self-esteem is influenced by the degree to which specific facets of oneself are valued,[3] further work exploring the role of the body for survivors of AYA cancer is warranted.

The moderating effect of self-efficacy for MVPA on the relationship between physical self-perceptions and physical self-esteem suggests that self-efficacy for MVPA may serve to

bolster the positive association between physical self-perceptions and physical self-esteem among survivors of AYA cancer. This finding matched hypotheses and aligns with resilience perspectives[59,60] and recent empirical work[61] underscoring empowerment and confidence as a means of promoting psychological health among survivors of cancer. Moreover, one's self-efficacy to engage in protective health behaviours following a diagnosis of cancer has been described in qualitative investigations as important for a range of outcomes, including self-esteem.[62] Thus, interventions and programs seeking to enhance survivors self-efficacy for MVPA may be a viable way to not only enhance health promoting behaviours,[63] but to develop more positive physical self-perceptions and simultaneously enhance the likelihood that these positive physical self-perceptions translate to improvements in physical self-esteem. Based on theory, accounting for PA history, teaching about responses to PA, creating supportive environments, ensuring survivors experience success, and providing opportunities for vicarious experiences are potential targets.[64] Further, drawing on recent research conducted with older survivors of prostate cancer,[65] helping survivors of AYA cancer develop positive outcome expectations, set meaningful goals, and reduce perceived barriers may also enhance self-efficacy for PA. Nonetheless, factors promoting or hindering self-efficacy for PA may differ among survivors of AYA cancer. It would be necessary to conduct further research identifying the specific factors that should be targeted to enhance self-efficacy for PA among AYA cancer survivors.

The lack of support for the moderating effect of self-efficacy for MVPA on the relationship between physical self-perceptions and global self-esteem may be due to the context-specific measure of self-efficacy used. It is plausible this form of self-efficacy does not simultaneously impact domain-specific perceptions of physical competence and global

evaluations of oneself overall. Rather, one's confidence to engage in other regulatory behaviours and/or manage the effects and symptoms of their disease and its treatments may be more decisive. Researchers may wish to explore broader conceptualizations of self-efficacy. Among adults with chronic obstructive pulmonary disease, generalized forms of self-efficacy have been related to both perceptions of physical capability/capacity and global evaluations of self-esteem.[66]

Though PA has been suggested to help survivors of cancer cope with their changed body, manage symptoms and side effects, and improve physical and psychological health,[67] there was no evidence that MVPA moderated the relationships between physical self-perceptions and physical or global self-esteem in this study. As well, contrary to previous research,[12-15] there were no significant relationships observed with this sample. One reason for the lack of relationships and interaction may relate to one's motives for PA. Specifically, those participating in PA as means of taking control over their health may feel more positively about themselves, a finding that has been confirmed among older cancer survivors.[62] Whereas those engaging in PA out of fear of cancer recurrence, secondary or second cancers, and/or other health conditions may feel less positively about themselves, a finding consistent with protection motivation theory.[68] These differing motives and subsequently psychological responses to PA may ultimately work to cancel one another out. Exploring motives may be one start to teasing apart the effect of PA on the relationships between physical self-perceptions and physical or global self-esteem among survivors of AYA cancer.

Notwithstanding the implications from this study, there are limitations that must be taken into account. First, the sample was relatively small for moderation analyses.[54] Replicating these findings with a larger sample is warranted. Second, the cross-sectional nature of this study precludes statements about directionality. As well, though decisions about moderator variables

were informed by empirical work and theory, other moderators could have been tested. Third, without manipulating the moderator variable, it is unknown as to whether the observed effect was "true" moderation or "proxy" moderation. Looking forward, to make robust inferences, researchers need to collect longitudinal data and explore potential causal pathways using experimental research designs. Fourth, to conserve power, we treated physical self-perceptions as unidimensional by creating a composite score. Researchers may wish to examine whether the observed relationships hold across different subscales in the future. Relatedly, select subscales from the PSDQ were used to measure physical self-perceptions of strength, endurance, body fat, and appearance. Considering the range of adverse physical health outcomes experienced in the wake of a cancer diagnosis and treatments, examining physical self-perceptions related to illness and capacity to engage in activities of daily living may be warranted. Finally, to better understand whether physical activity moderates the relationships between physical self-esteem and global self-esteem, a more heterogeneous sample reporting a wider range of physical activity levels would need to be examined. At the same time, researchers may wish to also test these moderation effects across the cancer trajectory (i.e., from diagnosis onward).

In conclusion, physical self-perceptions were a positive correlate of both physical and global self-esteem, and self-efficacy for MVPA moderated the association between physical self-perceptions and physical self-esteem among survivors of AYA cancer. Findings underscore the potential role self-efficacy to engage in a health promoting behaviour holds to improve/diminish one's evaluation of themselves physically. Continued examination of factors that may influence physical self-perceptions and self-efficacy for MVPA such as one's physical activity history (e.g., experience), symptom management efficacy, affective responses to exercise, importance of physical appearance, and/or social factors, is clearly needed as these could in turn impact

physical (and potentially) global self-esteem – important constructs for survivors' psychological health.

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Conflict of interest statement

The authors declare they have no competing interests.

References

1. Coopersmith S. *The antecedents of self-esteem.* San Francisco, CA: Freeman; 1967.
2. Shavelson RJ, Hugner JJ., Stanton GC. Self-concept: validation of construct interpretations. *Rev Educ Res.* 1976;46(3):401-441.
3. Rosenberg M, Schooler C, Schoenbach C, Rosenberg F. Global self-esteem and specific self-esteem: different concepts, different outcomes. *Am Sociol Rev.* 1995;60(1):141-156.
4. Pierce JL, Gardner D, Cummings LL, Dunham RB. Organization-based self-esteem: construct definition, measurement, and validation. *Acad Manage J.* 1989;32(3):622-648.
5. Marsh HW. Global self-esteem: its relation to specific facets of self-concept and their importance. *J Person Soc Psychol.* 1986;51:1224-236.
6. Du H, King RB, Chi P. Self-esteem and subjective well-being revisited: the roles of personal, relational, and collective self-esteem. *PLoS One.* 2017;12(8):e0183958.
7. Faulkner GE, Trinh L, Arbour-Nicitoploulos K. Physical activity and mental health. In: Crocker PRE, ed. *Sport and Exercise Psychology: A Canadian Perspective.* 3 ed. Toronto, ON: Pearson; 2016.
8. Freire T, Ferreira G. Health-related quality of life of adolescents: relations with positive and negative psychological dimensions. *Int J Adol Youth.* 2018;23(1):11-24.
9. Griffiths LJ, Parsons TJ, Hill AJ. Self-esteem and quality of life in obese children and adolescents: a systematic review. *Int J Pediatr Obes.* 2010;5(4):282-304.
10. Haugen T, Säfvenbom R, Ommundsen Y, Physical activity and global self-worth: the role of physical self-esteem indices and gender. *Ment Health Phys Act.* 2011;4:49-56.
11. Knox E, Muros JJ. Association of lifestyle behaviours with self-esteem through health-related quality of life in Spanish adolescents. *Eur J Pediatr.* 2017;176(5):621-628.

12. Zamani Sani SH, Fathirezaie Z, Brand S, et al. Physical activity and self-esteem: testing direct and indirect relationships associated with psychological and physical mechanisms. *Neuropsychiatr Dis Treat.* 2016;12:2617-2625.

13. McAuley E, Elavsky S, Motl RW, Konopack JF, Hu L, Marquez DX. Physical activity, self-efficacy, and self-esteem: longitudinal relationships in older adults. *J Gerontol B Psychol Sci Soc Sci.* 2005;60(5):268-275.

14. Gothe NP, Mullen SP, Wojcicki TR, et al. Trajectories of change in self-esteem in older adults: exercise intervention effects. *J Behav Med.* 2011;34(4):298-306.

15. Opdenacker J, Delecluse C, Boen F. The longitudinal effects of a lifestyle physical activity intervention and a structured exercise intervention on physical self-perceptions and self-esteem in older adults. *J Sport Exerc Psych.* 2009;31:743-760.

16. Sonstroem RJ, Morgan WP. Exercise and self-esteem: rationale and model. *Med Sci Sports Exerc.* 1989;21(3):329-337.

17. Moore JB, Mitchell NG, Beets MW, Bartholomew JB. Physical self-esteem in older adults: a test of the indirect effect of physical activity. *Sport Exerc Perform Psychol.* 2012;1(4):231-241.

18. Dodd RK, Vetter, R.E. College females' self-perceptions of their overall self-worth. *Am J Health Stud.* 2015;30(3):110-118.

19. Lemoyne J, Valois P, Guay F. Physical self-concept and participation in physical activity in college students. *Med Sci Sports Exerc.* 2015;47(1):142-150.

20. Babic MJ, Morgan PJ, Plotnikoff RC, Lonsdale C, White RL, Lubans DR. Physical activity and physical self-concept in youth: systematic review and meta-analysis. *Sport Med.* 2014;44(11):1589-1601.

21. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med.* 2011;45(11):886-895.

22. Niemiec T, Lachowicz-Tabaczek K. The moderating role of specific self-efficacy in the impact of positive mood on cognitive performance. *Motiv Emot.* 2015;39(4):498-505.

23. Awick EA, Phillips SM, Lloyd GR, McAuley E. Physical activity, self-efficacy and self-esteem in breast cancer survivors: a panel model. *Psychooncology.* 2017;26(10):1625-1631.

24. Baldwin MK, Courneya, K.S. Exercise and self-esteem in breast cancer survivors: an application of the exercise and self-esteem model. *J Sport Exerc Psychol.* 1997;19:347-358.

25. Musanti R. A study of exercise modality and physical self-esteem in breast cancer survivors. *Med Sci Sports Exerc.* 2012;44(2):352-361.

26. Tai E, Buchanan N, Townsend J, Fairley T, Moore A, Richardson LC. Health status of adolescent and young adult cancer survivors. *Cancer.* 2012;118(19):4884-4891.

27. Bucchianeri MM, Arikian AJ, Hannan PJ, Eisenberg ME, Neumark-Sztainer D. Body dissatisfaction from adolescence to young adulthood: findings from a 10-year longitudinal study. *Body Image.* 2013;10(1):1-7.

28. Smith AW, Bellizzi KM, Keegan TH, et al. Health-related quality of life of adolescent and young adult patients with cancer in the United States: the Adolescent and Young Adult Health Outcomes and Patient Experience study. *J Clin Oncol.* 2013;31(17):2136-2145.

29. Rosenberg SM, Tamimi RM, Gelber S, et al. Body image in recently diagnosed young women with early breast cancer. *Psychooncology.* 2013;22(8):1849-1855.

30. Olsson M, Enskar K, Steineck G, Wilderang U, Jarfelt M. Self-perceived physical attractiveness in relation to scars among adolescent and young adult cancer survivors: a population-based study. *J Adolesc Young Adult Oncol.* 2018;7(3):358-366.

31. Zucchetti G, Bellini S, Bertolotti M, et al. Body image discomfort of adolescent and young adult hematologic cancer survivors. *J Adolesc Young Adult Oncol.* 2017;6(2):377-380.

32. Katz MR, Rodin G, Devins GM. Self-esteem and cancer: theory and research. *Can J Psychiatr.* 1995;40(10):608-615.

33. von Essen L, Enskar K, Kreuger A, Larsson B, Sjoden PO. Self-esteem, depression and anxiety among Swedish children and adolescents on and off cancer treatment. *Acta Paediatr.* 2000;89(2):229-236.

34. Adamsen L, Andersen C, Midtgaard J, Moller T, Quist M, Rorth M. Struggling with cancer and treatment: young athletes recapture body control and identity through exercise: qualitative findings from a supervised group exercise program in cancer patients of mixed gender undergoing chemotherapy. *Scand J Med Sci Sports.* 2009;19(1):55-66.

35. Guy GP, Jr., Yabroff KR, Ekwueme DU, et al. Estimating the health and economic burden of cancer among those diagnosed as adolescents and young adults. *Health Aff.* 2014;33(6):1024-1031.

36. Withheld for blinded peer review.

37. Marsh HW, Martin AJ, Jackson S. Introducing a short version of the physical self description questionnaire: new strategies, short-form evaluative criteria, and applications of factor analyses. *J Sport Exerc Psychol.* 2010;32(4):438-482.

38. Bowker A. The relationship between sports participation and self-esteem during early adolescence. *Can J Behav Sci.* 2006;38(3):214-229.

39. Monsma EV, Malina RM, Feltz DL. Puberty and physical self-perceptions of competitive female figure skaters: an interdisciplinary approach. *Res Quart Exerc Sport* 2006;77(2):158-166.

40. Maiano C, Morin AJ, Mascret N. Psychometric properties of the short form of the Physical Self-Description Questionnaire in a French adolescent sample. *Body Image.* 2015;12:89-97.

41. Rosenberg M. *Society and adolescent self-image.* Princeton, NJ: Princeton University Press; 1965.

42. Tae YS, Heitkemper M, Kim MY. A path analysis: a model of depression in Korean women with breast cancer-mediating effects of self-esteem and hope. *Oncol Nurs Forum.* 2012;39(1):E49-57.

43. Langeveld NE, Grootenhuis MA, Voute PA, de Haan RJ, van den Bos C. Quality of life, self-esteem and worries in young adult survivors of childhood cancer. *Psychooncology.* 2004;13(12):867-881.

44. Burns DS, Robb SL, Haase JE. Exploring the feasibility of a therapeutic music video intervention in adolescents and young adults during stem-cell transplantation. *Cancer Nurs.* 2009;32(5):E8-E16.

45. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci.* 1985;10(3):141-146.

46. Schmitz KH, Courneya KS, Matthews C, et al. American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. *Med Sci Sports Exerc.* 2010;42(7):1409-1426.

47. Amireault S, Godin G, Lacombe J, Sabiston CM. Validation of the Godin-Shephard Leisure-Time Physical Activity Questionnaire classification coding system using accelerometer assessment among breast cancer survivors. *J Canc Surviv.* 2015;9(3):532-540.

48. Norris JM, Moules NJ, Pelletier G, Culos-Reed SN. Families of young pediatric cancer survivors: A cross-sectional survey examining physical activity behavior and health-related quality of life. *J Pediatr Oncol Nurs.* 2010;27(4):196-208.

49. Amireault S, Godin G, Lacombe J, Sabiston CM. The use of the Godin-Shephard Leisure-Time Physical Activity Questionnaire in oncology research: a systematic review. *BMC Med Res Methodol.* 2015;15:60.

50. McAuley E. Self-efficacy and the maintenance of exercise participation in older adults. *J Behav Med.* 1993;16(1):103-113.

51. McAuley E, Mailey EL, Mullen SP, et al. Growth trajectories of exercise self-efficacy in older adults: influence of measures and initial status. *Health Psychol.* 2011;30(1):75-83.

52. Shin Y, Jang H, Pender NJ. Psychometric evaluation of the exercise self-efficacy scale among Korean adults with chronic diseases. *Res Nurs Health.* 2001;24(1):68-76.

53. IBM Corp. *IBM SPSS Statistics for Macintosh.* Armonk, NY: IBM Corp.; Released 2017.

54. Tabachnick BG, Fidell LS. *Using multivariate statistics.* Pearson; 2007.

55. Rowe DA, Mahar MT, Raedeke TD, Lore J. Measuring physical activity in children with pedometers: reliability, reactivity, and replacement of missing data. *Pediatr Exerc Sci.* 2004;16:343-354.

56. Aiken LS, West SG, Pitts SC. Multiple linear regression. In: Weiner IB, ed *Handbook of Psychology.* John Wiley & Sons, Inc.; 2003.

57. Dawson JF. Moderation in management research: what, why, when, and how. *J Bus Psychol.* 2014;29:1-19.

58. Noack P, Kauper, T., Benbow, A.E.F., Eckstein, K. Physical self-perceptions and self-esteem in adolescents participating in organized sports and religious groups. *Eur J Dev Psychol.* 2013;10(6):663-675.

59. Luthar SS, Cicchetti D, Becker B. The construct of resilience: a critical evaluation and guidelines for future work. *Child Dev.* 2000;71(3):543-562.

60. Masten AS. Resilience in children threatened by extreme adversity: frameworks for research, practice, and translational synergy. *Dev Psychopathol.* 2011;23(2):493-506.

61. Kaal SEJ, Husson O, van Duivenboden S, et al. Empowerment in adolescents and young adults with cancer: relationship with health-related quality of life. *Cancer.* 2017;123(20):4039-4047.

62. Burke S, Wurz A, Bradshaw A, Saunders S, West MA, Brunet J. Physical activity and quality of life in cancer survivors: a meta-synthesis of qualitative research. *Cancers (Basel).* 2017;9(5).

63. Stacey FG, James EL, Chapman K, Courneya KS, Lubans DR. A systematic review and meta-analysis of social cognitive theory-based physical activity and/or nutrition behavior change interventions for cancer survivors. *J Cancer Surviv.* 2015;9(2):305-338.

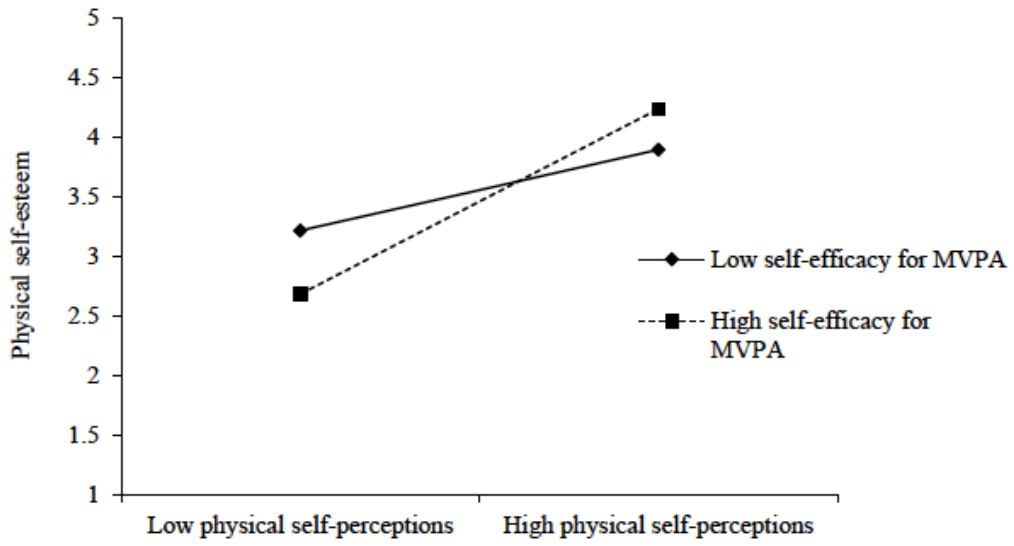
64. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev.* 1977;84(2):191-215.

65. Craike MJ, Gaskin CJ, Mohebbi M, Courneya KS, Livingston PM. Mechanisms of physical activity behavior change for prostate cancer survivors: a cluster randomized controlled trial. *Ann Behav Med.* 2018;52(9):798-808.

66. Ng WI, Smith GD. Effects of a self-management education program on self-efficacy in patients with COPD: a mixed-methods sequential explanatory designed study. *Int J Chron Obstruct Pulmon Dis.* 2017;12:2129-2139.

67. Segal R, Zwaal C, Green E, et al. Exercise for people with cancer: a systematic review. *Curr Oncol.* 2017;24(4):e290-e315.

68. Rogers R. Cognitive and psychological processes in fear appeals and attitude change: a revised theory of protection motivation. In: Cacioppo J, Petty R, ed. *Social Psychology: A Sourcebook.* New York, NY: Guilford Press; 1983:153-176.



Note. MVPA=moderate-to-vigorous physical activity.

FIGURE 1 Significant two-way interaction involving self-efficacy for MVPA and physical self-perceptions on physical self-esteem at the mean level of MVPA

TABLE 1 Correlations between study variables

Variable	1[a]	2	3	4	5	6	7
1. Sex (0=male; 1=female)[a]							
2. BMI	-.03						
3. Physical self-perceptions	-.23*	-.51**					
4. Physical self-esteem	-.08	-.61**	.74**				
5. Global self-esteem	.02	-.10	.26*	.23*			
6. MVPA	-.05	.19	.17	.09	.12		
7. Self-efficacy for MVPA	.03	.11	.35**	.14	.06	.48**	

Note. MVPA=moderate-to-vigorous physical activity.
[a]Spearman rho correlation coefficients.
*p<.05, **p<.01.

TABLE 2 Results of hierarchical multivariate regression analyses with MVPA and self-efficacy for MVPA as potential moderators

	Physical self-esteem (Model A)					Global self-esteem (Model B)				
	F	R^2	ΔR^2	β	*p*	*F*	R^2	ΔR^2	β	*p*
Step 1	25.70	.38			<.001	0.43	.01			.650
Sex (0=male; 1=female)				-0.08	.376				0.03	.794
BMI[mc]				-0.61	<.001				-0.10	.370
Step 2[a]	45.91	.62	.24		<.001	2.24	.08	.07		.090
Physical self-perceptions[mc]				0.59	<.001				0.30	.018
Step 3[b]	27.79	.63	.01		<.001	1.60	.09	.01		.169
MVPA[mc]				0.09	.241				0.12	.339
Self-efficacy for MVPA[mc]				-0.08	.331				-0.13	.335
Step 4[c]	21.82	.66	.03		<.001	1.74	.13	.04		.113
Physical self-perceptions[mc] X MVPA[mc]				-0.16	.070				0.28	.054
Physical self-perceptions[mc] X self-efficacy for MVPA[mc]				0.23	.014				-0.22	.133

Notes. MVPA=moderate-to-vigorous physical activity; β=standardized beta coefficient.
[a]Sex and BMI omitted from table
[b]Sex, BMI, and physical self-perceptions omitted from table
[c]Sex, BMI, physical self-perceptions, MVPA, and self-efficacy for MVPA omitted from table
[mc]variables are mean-centered.

Bridging Text

This study was conducted to begin exploring relationships between variables in the Exercise and Self-Esteem Model (EXSEM). The main findings from Study Two (see Chapter Three) can be summarized as:

1. Physical self-perceptions are a significant and positive correlate of physical and global self-esteem among survivors of adolescent and young adult (AYA) cancer;
2. Physical activity did not moderate relationships between physical self-perceptions and physical or global self-esteem; and,
3. Self-efficacy for physical activity moderated relationships between physical self-perceptions and physical self-esteem (but not global self-esteem).

As such, this study presents preliminary evidence supporting relationships between select variables contained within the EXSEM. Specifically, this study included physical self-perceptions, self-esteem (physical and global), physical activity, and self-efficacy for physical activity. On the basis of these findings, and the non-significant relationships observed between physical activity and psychological outcomes, more work is required to understand if/how and under what circumstances physical activity might be related to psychological outcomes among survivors of AYA cancer. To begin to address this, and to overcome the limitation of the cross-sectional design of Study Two (see Chapter Three), a next step is to use experimental designs. However, few physical activity interventions have been conducted with survivors of AYA cancer, warranting a pilot randomized controlled trial (RCT) in advance of a definitive RCT. Therefore, Article Three (see Chapter Four) presents the feasibility and acceptability data from a two-arm, mixed-methods RCT designed to test a 12-week physical activity intervention on a range of physical and psychological outcomes. Of note, additional questionnaires, qualitative interview

questions, and assessments were included in this study. These data have not been presented herein as they were included to facilitate further research opportunities and as such are not necessary to answer the specific research questions asked within this program of research. Appendix B, Study Three contains the assessment materials used.

Chapter Four

Article Three, Study Three

Exploring the Feasibility and Acceptability of a Mixed-Methods Pilot Randomized Controlled Trial Testing a 12-Week Physical Activity Intervention Among Adolescent and Young Adult Cancer Survivors

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Abstract

Background: Few researchers have explored the physical and psychological outcomes associated with physical activity among adolescent and young adult (AYA) cancer survivors. Prior to conducting a randomized controlled trial (RCT) to test the effects of 12-week physical activity intervention on a range of physical and psychological outcomes among AYA cancer survivors, we conducted a two-arm, mixed-methods pilot RCT to assess the feasibility and acceptability of our methods and intervention.

Methods: Participants were randomized to a 12-week individualized physical activity program comprised of 4 weekly sessions (intervention group) or a wait-list control group. For the intervention, two weekly sessions included strength activities (supervised weeks 1-6, unsupervised weeks 7-12) and two weekly sessions included aerobic activities (unsupervised weeks 1-12). Feasibility measures included numbers of AYA cancer survivors referred, eligible, recruited/not recruited, adherence to the physical activity program, and percentage of missing data at baseline (week 0), mid- (week 6), and post-intervention (week 12). The acceptability of trial methods (all participants) and the intervention (intervention group only) was assessed via qualitative interviews post-intervention (week 12).

Results: Over a 12-month period, 31 AYA cancer survivors were referred or self-referred and 16 were eligible and consented to participate. Retention to the trial was 94% and adherence to the physical activity program ranged from 50-92%. Missing data were minimal, with the exception of two measures, which had 29% and 53% missing data. In general, participants reported being satisfied with the methods and intervention; however, key issues related to delivery of the physical activity program were identified (e.g., lack of behaviour change support).

Conclusions: The methods and intervention require modification and further piloting before deeming them feasible and acceptable. Specifically, making the trial multi-site, using multiple recruitment strategies, refining assessments of directly-measured physical activity behaviour and aerobic capacity, and incorporating behavioural support into the intervention may improve feasibility and acceptability. This study highlights the value of doing pilot work and provides critically useful data that can be used to refine studies seeking to prove causation and optimize physical activity interventions for this population.

Trial registration: clinicaltrials.gov, NCT03016728. Registered January 11, 2017, clinicaltrials.gov/ct2/show/NCT03016728.

Background

There is considerable evidence from experimental studies showing that participation in physical activity yields numerous physical and psychological health benefits for adult cancer survivors [1-3]. Commonly reported benefits include improved muscular strength and endurance, aerobic capacity, physical functioning, mood, self-esteem, and quality of life [1-3]. Whereas some studies suggest the physical benefits of physical activity may extend to adolescent and young adult (AYA) cancer survivors [4, 5], collectively, published studies do not provide a strong link between physical activity and psychological outcomes (e.g., self-efficacy, self-esteem; [6-8]) in this population. As such, researchers are calling for more studies to demonstrate that physical activity can provide both physical and psychological health benefits to AYA cancer survivors [9-11].

The Need for a Trial

Definitive randomized controlled trials (RCTs) are considered the gold standard and would be required to show whether or not physical activity has a meaningful effect on physical and psychological outcomes among AYA cancer survivors. However, there are key limitations common to studies with this population that prevent the conduct of a definitive RCT at this time. First, studies with AYA cancer survivors have examined a narrow range of outcomes and have primarily used cross-sectional study designs grounded in the positivist paradigm. This is not surprising as experimental mixed-methods studies wherein AYA cancer survivors are randomly assigned to receive an intervention and complete questionnaires and/or objective assessments alongside interviews are time and resource consuming. Second, key indicators of feasibility (e.g., recruitment, retention, adherence) and acceptability (e.g., satisfaction with trial methods and intervention components) for physical activity interventions in AYA cancer survivors remain

unknown. Understanding population-specific barriers to recruitment and adherence to a physical activity intervention is vital to conserve valuable research resources and enhance the likelihood of successful definitive RCTs. Third, potential mediators and moderators of the relationship between physical activity and physical and psychological health outcomes remain unexplored, which prevents an understanding of how physical activity might be beneficial and under what circumstances desired outcomes may be maximized.

Mediators and Moderators of the Relationship Between Physical Activity and Health

Identifying the mechanisms through which physical activity exerts its benefits can provide researchers with meaningful targets to optimize intervention effects. The Exercise and Self-Esteem Model (EXSEM; [12]) has been used to achieve these aims and test how physical activity impacts physical and psychological health in samples drawn from the general population [13-15]. In the EXSEM, Sonstroem and Morgan [12] suggest that participating in physical activity leads to changes in one's physical fitness (i.e., physical measures such as weight status, muscular strength and endurance, aerobic capacity, etc.) and self-efficacy (i.e., confidence regarding one's ability to successfully engage in physical activity). Improved physical fitness and self-efficacy then lead to improved physical self-perceptions (i.e., self-evaluation of one's overall physical condition and fitness), which enhance physical self-esteem (i.e., subjective evaluation of the function and appearance of one's body) and subsequently global self-esteem (i.e., subjective evaluation of one's self-worth). Among older breast cancer survivors, physical fitness, self-efficacy, and physical self-perceptions have been shown to mediate the relationships between physical activity and physical and global self-esteem [16-18]. These findings may extend to AYA cancer survivors as well. Researchers have shown that AYA cancer survivors who are more active report greater self-esteem [19, 20] and that participating in physical activity

may positively impact one's confidence to overcome barriers to physical activity and confidence to engage in physical activity in their current environment [21], and improve appearance satisfaction [22]. Moderation hypotheses can also be drawn based on a forthcoming cross-sectional study [23]. Specifically, self-efficacy for physical activity may interact with physical self-perceptions to further promote psychological health.

Current Study

Definitive RCTs testing outcomes of physical activity among AYA cancer survivors and seeking to identify mediators and moderators embedded in the EXSEM could generate useful information to guide physical activity recommendations and identify targets for physical activity interventions seeking to promote health in this cohort. As such, we developed a two-arm, mixed-methods RCT to test the effects of a 12-week physical activity intervention. To lay the foundation for our RCT, we first conducted a pilot RCT to assess the feasibility (defined as recruitment over a 12-month period, retention, adherence, and completeness of data) and acceptability (defined as satisfaction) of our methods (e.g., randomization, procedures) and intervention (e.g., intervention delivery).

Methods

Study Design

This study was a two-arm, mixed-methods pilot RCT designed to test a 12-week physical activity intervention on a range of physical and psychological outcomes among AYA cancer survivors. The protocol was registered in the ClinicalTrials.gov database (NCT03016728), and was approved by the Ottawa Health Science Network, Children's Hospital of Eastern Ontario, University of Ottawa, and Royal Ottawa Mental Health Centre Research Ethics Boards. The reporting standards put forward by Consolidated Standards of Reporting Trials (CONSORT;

[24]) extension for randomized pilot and feasibility trials were followed in the preparation of this manuscript.

Sample

Our target sample consisted of AYA cancer survivors who: (1) were diagnosed with cancer between the ages of 15-39 years; (2) had completed cancer treatment within the past 5 years; (3) showed no evidence of progressive or recurrent disease or of secondary or second cancers; (4) were inactive or insufficiently active (assessed using a single-item screening question: "*Are you currently engaging in moderate physical activity, that is activity that increases your heart rate and causes you to sweat, >3 days/week?*"); (5) were medically cleared to participate in physical activity; (6) lived within 100 km of the University of Ottawa, and; (7) were able to read, understand, and provide informed consent in English. AYA cancer survivors were not eligible if they: (1) had physical impairments precluding participation in physical activity; (2) received a diagnosis of brain or thyroid cancer, and/or; (3) were unwilling or unable to provide informed consent.

Procedures

AYA cancer survivors were recruited across a 12-month period starting in September 2017 through healthcare provider referral (wherein eligible AYA cancer survivors were first screened and then approached by their healthcare provider to obtain consent for the first author to contact) and snowball sampling (wherein potential and past participants shared study-related information with their networks and potentially eligible AYA cancer survivors self-screened and then contacted the first author). A 12-month period was specified a priori so as to capture seasonal variation that may affect trial and intervention feasibility and/or acceptability, and thus better inform the timeline for a definitive RCT. It also allowed for the timely completion of

follow-up measures. All trial participants were completed assessments by October 2018. Following confirmation of eligibility and obtaining informed consent, participants completed a baseline assessment (week 0) comprised of physical tests, a survey, a qualitative interview, and wearing an accelerometer for 7 consecutive days. Afterwards, participants were randomly assigned to either to the intervention group or to a wait-list control group by an independent researcher using a random number generator without an established allocation ratio. Participants then completed mid- (week 6) and post-intervention assessments (week 12), which resembled the baseline assessment. All assessments were conducted by the first author at a private location of participants' choosing and all participants were entered into a draw to win a $250.00 gift card.

Physical Activity Intervention

The physical activity intervention was developed across a 6-month period. Intervention components were first selected based on recent systematic reviews [1-3, 25, 26], clinical guidelines [27], physical activity recommendations [28], behaviour change literature [29-31], and population-specific preferences for physical activity [32-35]. We then augmented this by eliciting opinions from an advisory board comprised of three AYAs diagnosed with cancer, three allied healthcare providers (i.e., Kinesiologist, Certified Exercise Physiologists), and two oncologists. The result was a 12-week physical activity intervention using a pragmatic approach, wherein flexibility was prioritized to minimize participant burden.

Participants assigned to the intervention group received a 12-week individualized physical activity program and were lent equipment for weeks 1-12 (i.e., hand weights, resistance bands). They were also provided with a fitness bag that had a water bottle, socks, sweat towel, and yoga mat that they could keep. The program consisted of 4 weekly sessions lasting for 25-45 minutes/session (see Table 1 for an overview). Two of these sessions focused on strength

activities and were supervised by the first author, who is a certified personal trainer and has 6 years of experience working with cancer survivors, for weeks 1-6 (e.g., squats, lunges, shoulder press, bicep curls). Sessions took place at participants' homes (*n*=40 sessions), a local cancer survivorship centre (*n*=15 sessions), or the University of Ottawa (*n*=4 sessions), based on participant preference. In weeks 7-12, participants were instructed to continue engaging in strength training two times per week unsupervised. Throughout weeks 1-12, participants were asked to participate in two unsupervised sessions per week focused on aerobic activities (e.g., walking, rowing, indoor/outdoor bicycling, jogging) between 40-75% of their estimated heart rate reserve. Participants were provided with a Polar A300 activity monitor with a heart rate strap and taught how to use a 10-point *Perceived Exertion Scale* as a means of verifying aerobic session prescription and teaching participants how to self-monitor. Each aerobic and strength training session was modifiable (e.g., volume, intensity) depending on how the participant felt that day and was progressed over the course of the 12-week intervention on an individual basis.

Throughout the intervention, participants were taught proper form and technique and were provided rationale for each intervention component to enhance their knowledge. They were also offered various modifications and supported in choosing intensities that were right for them to enhance their feelings of confidence and competence. Participants received the fitness bag to enhance adherence and were provided equipment to minimize barriers related to access. Finally, progression was important so as to ensure participants experienced success with the program while acquiring new skills.

Table 1
Overview of the 12-week physical activity program.

	Aerobic training						Strength training	
Week	1-2	3-4	5-6	7-8	9-10	11-12	1-6	7-12
Days/week	2						2 (non-consecutive)	
Warm up (minutes)	5						5	
Training (minutes)	15	20	25	30	30	30	15-20	15-20
Target intensity (% HRR)	40-60	40-60	40-60	40-60	60-75	60-75	1-2 sets 8-12 RM	2-3 sets 6-10 RM
Type	Any self-selected aerobic physical activity (e.g., walking, rowing, indoor/outdoor bicycling, jogging)						8-10 full body exercises	
Cool down (minutes)	5						8-10 full body flexibility exercises	
Supervised	No						Yes	No

Note. [a]comprised of 8-10 full body flexibility activities.
HRR=heart rate reserve; RM=repetition maximum.

Wait-List Control Group

Participants assigned to the wait-list control group were advised to continue with their usual routine for weeks 1-12. After their post-intervention assessment (week 12), participants received the same 12-week intervention and materials and were provided the same equipment as the intervention group.

Measures

Feasibility [throughout the trial]. To assess feasibility, the number of AYA cancer survivors referred, eligible, recruited/not recruited (reasons for non-recruitment), adherence to the physical activity program, and percentage of missing data were collected. Source of referrals were tracked and recruitment rate was defined as the number of eligible participants who enrolled in the trial out of the number of eligible AYA cancer survivors who were referred. Retention rate was defined as the number of participants completing all three assessments. Adherence rates were defined as adherence to the physical activity program. As such,

participants in the intervention group completed weekly physical activity logbooks in weeks 1-12. The number of supervised strength sessions engaged in out of 12 (weeks 1-6), unsupervised strength sessions engaged in out of 12 (weeks 1-6), and unsupervised aerobic sessions engaged in out of 24 (weeks 1-12) were extracted. Completeness of quantitative data and participation in interviews were also examined. Missingness was defined as percentage of missing data.

As recommended for pilot studies [36, 37], a priori targets for each feasibility outcome were set using relevant literature: (1) 36 to 48 AYAs referred/self-referred over 12 months, (2) >70% of eligible AYA cancer survivors agree to be enrolled, (3) ≥75% of participants complete baseline, mid- and post-intervention assessments, (4) each participant completes >75% of prescribed physical activity sessions, and (5) <10% missing data.

Acceptability [week 12]. All participants answered questions related to the acceptability of trial methods (e.g., satisfaction with randomization, assessments, procedures) at their post-intervention assessment (week 12). For those in the intervention group, this was commensurate with when they finished the intervention. For those in the waitlist control group, this was commensurate with the end of their 12-week waiting period (before they received the intervention and materials). Further, additional questions related to intervention acceptability (e.g., satisfaction with intervention components [delivery, modality, length, duration]) were asked to participants in the intervention group only at their post-intervention assessment (week 12).

Adverse event monitoring [throughout the trial]. Participants' were instructed to self-report adverse events to the first author who had a standardized reporting form (e.g., date, severity, timing, site/location, duration, clinical action taken, outcome). None were reported.

Personal and medical factors [week 0]. Participants self-reported their age, sex, cancer diagnosis, treatment protocol, time since treatment, and medical history as a means of describing the sample and tailoring/individualizing participants' physical activity program.

Physical activity behaviour [week 0, week 6, week 12]. *Self-reported physical activity* was assessed using a modified version of the Leisure Time Exercise Questionnaire [38, 39] that has been described elsewhere [23]. *Directly-measured physical activity* was assessed using an accelerometer (Actigraph wGT3XP-BT; Actigraph, LLC, Pensacola, Florida) and ActiLife v6.13.3 software using established wear time criteria [40] and activity count cut-points [41].

Physical outcomes [week 0, week 6, week 12]. Participants' physical functioning was assessed via a battery of physical tests measuring *body composition* using a Portable HR-200 height rod and Tanita TBF-310 GS scale using bioelectrical impedance, *musculoskeletal strength* using the combined grip strength of the right and left hands assessed with a handheld dynamometer [42], *muscular endurance* using the 30-second sit to stand test [43], *resting blood pressure* using a blood pressure monitor (HealthSmart Digital Blood Pressure Monitor)[a], and *aerobic capacity* using the 6-minute walk test (6MWT; [42]).

Psychological outcomes [week 0, week 6, week 12]. Psychological outcomes were assessed using a self-reported survey measuring *self-efficacy for physical activity* using a modified single-item version of the Exercise Self-Efficacy scale [44] described elsewhere [23], *physical self-perceptions* using the Physical Self Description Questionnaire Short Form (PSDQ-S) subscales of strength, endurance, appearance, and body fat [45], *physical self-esteem* using the PSDQ-S subscale of physical self-esteem (3-items; [45]), and *global self-esteem* using the Rosenberg Global Self-Esteem Scale (10-items; [46]).

[a] When systolic blood pressure was ≥160 mmHg and/or diastolic blood pressure ≥90 mmHg, medical clearance was required and the test of aerobic capacity was skipped to reduce the risk of myocardial infarction.

Qualitative interviews [week 0, week 12]. Data on the development of, and changes noticed (if any), in EXSEM variables (i.e., physical activity, self-efficacy, physical self-perceptions, physical self-esteem, and global self-esteem) from all participants' perspectives were obtained through semi-structured interviews at baseline (week 0) and post-intervention (week 12). For participants in the intervention group, this was commensurate with the time immediately prior to and after receiving the intervention. For participants in the waitlist control group, this was commensurate the time immediately prior to and after their waiting period. Interviews were guided by an interview schedule containing a series of open-ended questions and probes to encourage participants to provide more detail or clarify what they were saying. Data pertaining to perceived changes in EXSEM variables are not reported herein as they are outside of the scope of the present study, which was to assess the feasibility and acceptability of our methods and intervention.

Sample Size

No formal sample size calculation was performed based on the study objectives.

Data Analysis

We conducted quantitative and qualitative analyses. Descriptive statistics, consisting of means, standard deviations [*SD*], and frequencies and were estimated using IBM SPSS (Version 25; [47]). These data were used to describe the sample and report on feasibility outcomes. Content analysis of the transcribed acceptability data from the post-intervention (week 12) interview was conducted to ascertain acceptability outcomes [48].

Results

Participants

The medical and demographic characteristics of participants at baseline are presented in Table 2, alongside their baseline scores for physical activity behaviour and physical and psychological outcomes. On average, participants were 32.84 years (*SD*=7.93). The most common type of cancer diagnosed was breast cancer (*n*=7; 44%), and 50% (*n*=8) of participants reported managing at least one other physical or psychological health condition (e.g., asthma, neurofibromatosis, blood clots, hypothyroidism, anxiety, depression). Participants self-reported engaging in 71.41 (*SD*=102.63) minutes of moderate-to-vigorous (MVPA) per week, whereas the directly-measured physical activity captured that participants were engaging in 84.34 (*SD*=129.97) minutes of MVPA per week. On average, they were classified as overweight (M_{BMI}=29.03, *SD*=9.26). Participants' scores on the 30-second sit to stand test were below average as compared to normative values for adults >60 years [49] and nearly half of participants' grip strength scores were rated as 'poor' (*n*=7; 44%). Blood pressure was within the 'normal' range for most participants (*n*=10; 63%). Aerobic capacity scores could not be computed due to significant differences in the walking track measured [50]. Finally, participants' scores on psychological outcomes were 'moderate' relative to scale ranges.

Table 2
Participants' baseline demographic, medical, and outcome characteristics.

Variable	Scale range	Intervention (*n*=7) [Mean (*SD*) or *n*(%)]	Control (*n*=9) [Mean (*SD*) or *n*(%)]	Total (*n*=16) [Mean (*SD*) or *n*(%)]
Demographic information				
Age (years)	--	33.78 (5.81)	32.11 (9.55)	32.84 (7.93)
Age at diagnosis (years)	--	30.33 (6.23)	29.10 (9.06)	29.64 (7.73)
Sex (female)	--	6 (86%)	8 (89%)	14 (88%)
Medical information				
Time since treatment (years)	--	2.30 (0.86)	2.17 (1.41)	2.23 (1.15)
Cancer type (breast)	--	2 (29%)	5 (56%)	7 (44%)
≥ Co-morbid condition(s)	--	3 (43%)	5 (56%)	8 (50%)
Physical activity behaviour[a]				
Self-reported				
MVPA (min/week)	0-∞	102.13 (148.66)	47.50 (41.31)	71.41 (102.63)
Directly-measured				
MVPA (min/week)	0-∞	140.85 (184.86)$^{n=5}$	37.25 (24.34)$^{n=6}$	84.34 (129.97)$^{n=11}$
Physical outcomes				
BMI (kg/m^2)[b]	0-∞	31.86 (8.16)	28.43 (10.25)	29.93 (9.26)
Grip strength (kg)	0-∞	56.71 (15.83)	51.00 (9.67)	53.50 (12.60)
Sit to stand (repetitions)	0-∞	12.00 (2.16)	11.22 (2.11)	11.56 (2.10)
Blood pressure (normal)	--	4 (57%)	6 (57%)	10 (63%)
Psychological outcomes				
Self-efficacy for MVPA	0-100	85.71 (13.97)	68.89 (24.21)	76.25 (21.56)
Physical self-perceptions				
Strength	1-6	3.95 (0.85)	3.01 (1.02)	3.46 (1.02)
Endurance	1-6	2.67 (1.02)	2.26 (1.21)	2.44 (1.11)
Body fat	1-6	1.86 (0.94)	3.30 (2.26)	2.67 (1.91)
Appearance	1-6	3.86 (0.50)	3.78 (0.44)	3.81 (0.45)
Physical self-esteem	1-6	3.38 (0.68)	2.70 (1.16)	3.00 (1.01)
Global self-esteem	10-40	29.14 (2.19)	28.11 (5.51)	28.56 (4.29)

Notes. [a]light, moderate, and vigorous intensity physical activity data is available upon request; [b]percent body fat, fat mass, and fat free mass data is available upon request; Min=minutes; MVPA=moderate-to-vigorous physical activity.

Quantitative Results

Feasibility

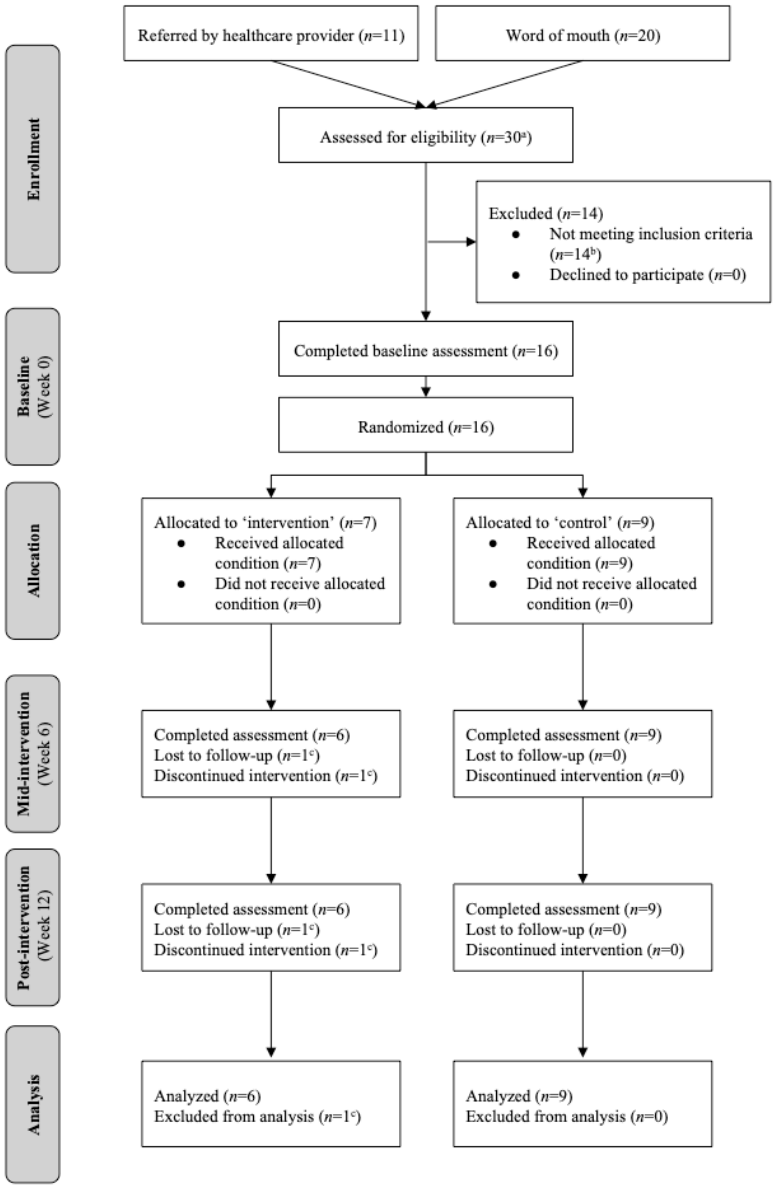
Referrals and recruitment. In total, 31 AYAs were referred or self-referred (see Figure 1 for referral sources) across the 12-month period. Of these, 30 were assessed for eligibility (one individual could not be reached after five contact attempts) and 14 were not eligible. All who were eligible consented to participate (recruitment rate=100%). Seven participants were

allocated to the intervention group and nine were allocated to the wait-list control group. One participant allocated to the intervention group withdrew from the trial in week 3 and was lost to follow-up (retention rate=94%).

Adherence to physical activity program. During weeks 1-6, participants' adherence to the supervised strength sessions was 82% (range=58-92%), with five of six participants adhering to ≥75% of the sessions. Thirteen sessions were cancelled due to travel for holidays (*n*=5), illness (*n*=6), and work/appointment conflicts (*n*=2); however, in seven of these 13 instances participants still completed strength sessions on their own (i.e., unsupervised). During weeks 7-12, adherence to the unsupervised strength sessions was 69% (range=50-92%), with three of six participants adhering to ≥75% of sessions. Most sessions were missed due to being too busy, tired, or 'lazy' (*n*=21); one session was missed due to illness. Adherence to unsupervised aerobic sessions was 76% (range=54-88%). Four of six participants adhered to ≥75% of sessions over the 12-week intervention. The main reasons sessions were missed were being too busy or tired (*n*=23), illness (*n*=7), work conflicts (*n*=2), holidays (*n*=2), and unrelated injury (*n*=1).

Missing data. There were no missing data on self-reported physical activity behaviour and psychological outcomes. For physical tests, participants completed all measures of body composition, musculoskeletal strength, muscular endurance, and resting blood pressure. There were 29% missing data for directly-measured physical activity behaviour. The missing data in these cases was due to insufficient wear time (*n*=8), accelerometer dysfunction (*n*=1), and participant error (*n*=4). There was 53% missing data for the test of aerobic capacity as six participants could not complete the test at any time-point due to high blood pressure (a skipping criteria for this assessment, which was stipulated by the study protocol), and three participants

elected to not complete the test of aerobic capacity at a single time-point due to weather (n=2)[b] or feeling unwell (n=1). Combined, there were <10% missing quantitative data. All participants completed both qualitative interviews.



Notes. [a]after referral, one individual could not be reached; [b]meeting physical activity guidelines (n=2), age at diagnosis (n=3), time since treatment (n=5), treatment status (n=4); [c]one participant withdrew due to family issues that were personally distressing.

Figure 1. CONSORT flow diagram.

[b] Due to space constraints in their home, two participants completed the aerobic assessment outdoors.

Qualitative Results

Acceptability

During the interviews conducted to ascertain acceptability, no issues surrounding acceptability with trial methods were raised. Participants said they accepted to be randomized and were highly satisfied with the opportunity to receive a 12-week physical activity program (either immediately or after a waiting period). Participants did not identify any issues related to assessments or trial procedures. In other words, the number, timing, and duration of assessments and trial-related procedures were deemed acceptable.

Participants randomized to the intervention group had positive regard for the individualized, pragmatic, and progressive nature of the intervention, which was highlighted by [P4] when she said: "*I liked that we could focus so much on what I needed, like what I really needed help with was the core stuff because of how damaged it was through my treatment and recovery*" and [P1] when she stated "*I thought it was good for adaptation and modification. I also liked the fact it was at our own leisure, and I liked the flexibility of it*". Moreover, participants valued the usefulness of the skills they learned and positively evaluated the performance and skills of the person delivering the intervention.

However, participants expressed challenges integrating physical activity into their lives because they had difficulty planning for and overcoming barriers (e.g., busy schedules, travel). Further, participants expressed difficulty transitioning from supervised (weeks 1-6) to unsupervised (weeks 7-12) strength training and suggested a more gradual stepped down approach: "*…instead of going cold turkey at the 6 weeks if we had gone to one time a week, tapering off to me being on my own. At some point I know I have to be responsible, so I feel it is a 2-way street as well, but if that was built in, it couldn't hurt*" [P14]. As well, participants

commented that more instruction and support for the unsupervised aerobic training (weeks 1-12) would have been helpful: "*I also felt if we would have had, maybe, I don't know, like a sheet that would give us ideas of what to do for the aerobic sessions. I know, at least for me, I get bored with just running or walking*" [P7].

Discussion

The purpose of this two-arm, mixed-methods pilot RCT was to lay the foundation for high quality research examining if/how and under what circumstances physical activity effects physical and psychological outcomes in AYA cancer survivors. Though recruitment, retention, and missing data rates were better than targets set a priori, and superior to other trials testing lifestyle interventions with AYA cancer survivors [51, 52], the number of AYA cancer survivors referred (and who self-referred) and participants' adherence to the intervention were below targets. As such, several modifications are warranted before a definitive RCT can be considered.

The higher than anticipated recruitment and retention rates observed are promising for those seeking to deliver physical activity interventions to AYA cancer survivors. In contrast, the lower than anticipated referrals/self-referrals highlights the difficulty researchers are likely to encounter when seeking to conduct physical activity trials with AYA cancer survivors in timely fashion. Though this may be due in part to the rarity of cancer among AYAs [53, 54] and documented difficulty recruiting this population [55], it is also possible that physical activity interventions are a deterrent to some and that only those who were motivated to initiate physical activity consented to being contacted for this study or self-referred via snowball sampling. Regardless, funding organizations typically provide 2 to 5 years of support, which significantly limits the number of AYA cancer survivors that can be recruited and enhances the likelihood of underpowered trials. This re-iterates the importance of conducting multi-site trials and of

identifying additional recruitment strategies beyond those used herein (i.e., healthcare provider referral, snowball sampling). For example, researchers could consider mailing/emailing trial brochures using tumour registries, attending hospital rounds and recruiting in-person, and/or attending cancer-related events/groups [56]. Partnering with organizations that include AYA cancer survivors in their network and using Internet and social networking are other low-/no-cost options [56]. Findings also suggest that funders may wish to consider population-specific challenges/barriers when specifying grant time frames. Nevertheless, findings re-affirm reports that some AYA cancer survivors are eager to participate lifestyle interventions [34, 57] and want access to health promoting services during this time (i.e., <5 years post-treatment; [58]) – widely considered a *teachable moment* in the general cancer literature [59, 60].

Missing data is inevitable in trials, yet there were only two assessments on which any missing data were documented in this pilot RCT. This shows the feasibility and acceptability of assessing AYA cancer survivors at multiple times (i.e., baseline, mid-intervention, post-interventions) using a combination of quantitative (directly-measured physical activity, physical tests, surveys) and qualitative tools (interview). Moreover, this was found despite the assessments taking >1.5 hours to complete. This may be because the survey and interview included questions previously deemed to be clear, appropriate, and relevant to AYA cancer survivors [61]. However, six participants could not complete the 6MWT at any time, as they were not cleared (based on their blood pressure) to complete the assessment, and three participants did not complete the test at a single time-point, resulting in 53% missing data. Moreover, the distance of the walking track could not be standardized across participants due to the pragmatic approach of this trial [50]. Researchers and practitioners may wish to omit this assessment or conduct it within a research or healthcare centre to ensure standardization and

appropriate supervision. Second, there were 29% missing accelerometer data, despite employing recommended strategies to enhance accelerometer compliance (i.e., modelling proper accelerometer use, providing verbal and written instructions, sending reminder messages; [62]) and most participants self-reporting in their logbook that they had worn the accelerometer for the required amount of time. This discrepancy highlights that the missing data may not be related to participants' unwillingness to complete this assessment, but may be related to the process by which missing data points are identified. There is considerable controversy and discussion in the literature with regards to protocols to determine non-wear (i.e., missing data) and wear periods and to estimate sedentary time. In response, researchers suggest protocols be developed and tested with specific populations to ensure appropriate estimates [63]. Yet, no protocols have been developed with/for AYA cancer survivors. Examining the frequency, pattern, and duration of non-wear and wear periods in this population is required. In the meantime, those wishing to include accelerometers in their studies with AYA cancer survivors might consider decision rules least affected by wear time and monitor inactivity (e.g., 120 minutes; [64]).

Though participants appreciated the pragmatic nature of the physical activity intervention, adherence was lower than expected. Data from participants' interviews provided insight into reasons underlying these findings and suggests modifications to the intervention should be incorporated. Specifically, this sample had a hard time scheduling and overcoming barriers to engage in physical activity. To help individuals successfully change their behaviour, researchers and practitioners have taught older adult cancer survivors about the importance of planning physical activity sessions (e.g., physical activity 'appointments') and have helped them identify barriers to physical activity (e.g., travel) and personally relevant strategies to overcome them (e.g., packing a resistance band when travelling). Such strategies/skills are known as

behaviour change techniques (BCTs; [65]). Trials including BCTs have reported greater adherence and behaviour change compared to those that do not [66-68]. Examining the feasibility and acceptability of integrating BCTs into physical activity interventions for AYA cancer survivors could be explored as a means of improving adherence.

Findings also underscore that more work is necessary to optimize the stepped down model of physical activity delivery tested (i.e., transitioning from supervised to unsupervised physical activity). Testing more gradual stepped down approaches and/or exploring triaged approaches, wherein survivors receive support that is matched to their needs [69], might be worthwhile. Among older adult cancer survivors such models/approaches are effective and cost-effective means to identify individuals requiring more/less support and offer appropriate care [70-72]. Considering current resource constraints (e.g., personnel, infrastructure) and limited funding available, such approaches may also lower costs needed to translate successful models into care. Moving forward, refining, piloting, and testing stepped down models using triaged approaches with AYA cancer survivors will be necessary to ensure this population receive appropriate levels of support.

Though this pilot RCT provides useful information for researchers wishing to conduct physical activity interventions with AYA cancer survivors, there are limitations that should be considered. The first author performed the intervention and all assessments (including the acceptability interviews), which may have influenced participants' responses, such that they responded more positively than they actually wanted to. Moreover, the acceptability interviews were conducted post-intervention (week 12) only; wait-list control group participants were therefore not asked about their experiences with the physical activity intervention since they had not yet started the intervention. Including perspectives of wait-list control group participants

might have resulted in additional insights. Fidelity, though tracked by the first author, was not objectively assessed. This has implications and calls to question whether the findings are due to the trial methods/intervention content or other factors. With regards to our sample, the eligibility criteria sought to identify inactive or insufficiently active AYA cancer survivors. However, baseline assessments suggested that some participants were engaging in physical activity (with one participant meeting current guidelines). Although this criterion was put in place to limit ceiling effects in a definitive RCT and to explore whether inactive/insufficiently active AYA cancer survivors could be recruited, we certainly did not reach all AYA cancer survivors. As with other age cohorts, it is likely that highly motivated survivors consented to be contacted and subsequently enrolled in the trial. Finally, the results presented herein are only applicable to the trial design and individualized 12-week physical activity program piloted and could be different based on other frequencies, intensities, delivery styles, and/or contexts. Modifications to each may result in additional challenges/barriers to feasibility and acceptability.

Conclusions

In conclusion, the methods and intervention comprising this two-arm, mixed-methods pilot RCT require modifications before being deemed feasible and acceptable. Findings underscore the necessity of conducting pilot RCTs to identify problems in advance of time- and resource-consuming definitive RCTs. Further, results suggest fostering collaborations, working across sites, and using multiple and varied sources of recruitment are necessary to increase the number of AYA cancer survivors referred, approached, and enrolled. Researchers should also ensure study assessments are appropriate and relevant for AYA cancer survivors, and should carefully consider assessments of aerobic capacity and protocols for directly-measured physical activity behaviour to reduce missing data. Finally, adding behavioural support and testing other

stepped down models using triaged approaches may help some AYA cancer survivors overcome barriers to physical activity, ensure appropriate allocation of resources, and enhance adherence and acceptability. Taken together, this study provides critically useful data that can be used to refine trials seeking to establish feasibility and acceptability, with the ultimate goal of proving causation and optimizing physical activity interventions to enhance physical and psychological health for AYA cancer survivors – a population that has been underrepresented in the literature.

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Ethical Approvals and Consent to Participate

Informed consent was obtained from all individual participants included in the study.

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Competing Interests

The authors declare that they have no competing interests.

References

1. Cormie P, Zopf EM, Zhang X, Schmitz KH. The impact of exercise on cancer mortality, recurrence, and treatment-related adverse effects. Epidemiol Rev. 2017;39(1):71-92.
2. Segal R, Zwaal C, Green E, Tomasone JR, Loblaw A, Petrella T et al. Exercise for people with cancer: a systematic review. Curr Oncol. 2017;24(4):e290-315.
3. Stout NL, Baima J, Swisher AK, Winters-Stone KM, Welsh J. A systematic review of exercise systematic reviews in the cancer literature (2005-2017). PM R. 2017;9(9):S347-84.
4. Gundle KR, Punt SE, Mattioli-Lewis T, Conrad EU. Can a made-for-consumer activity monitor assess physical activity in adolescents and young adults after lower extremity limb salvage for osseous tumors? J Pediatr Ortho. 2016;37(3):e192-96.
5. Erickson JM, Adelstein KE, Letzkus LC. A feasibility study to measure physical activity, fatigue, sleep-wake disturbances, and depression in young adults during chemotherapy. Journal of Adolescent and Young Adult Oncology. 2014;3(1):37-41.
6. Brunet J, Love C, Ramphal R, Sabiston CM. Stress and physical activity in young adults treated for cancer: the moderating role of social support. Support Care Cancer. 2014;22(3):689-95.
7. Love C, Sabiston CM. Exploring the links between physical activity and posttraumatic growth in young adult cancer survivors. Psycho-Oncology. 2011;20(3):278-86.
8. Valle CG, Tate DF, Mayer DK, Allicock M, Cai J. Exploring mediators of physical activity in young adult cancer survivors: evidence from a randomized trial of a facebook-based physical activity intervention. J Adolesc Young Adult Oncol. 2015;4(1):26-33.

9. Brunet J, Wurz A, Shallwani SM. A scoping review of studies exploring physical activity among adolescents and young adults diagnosed with cancer. Psychooncology. 2018;27(8):1875-88.

10. Bradford NK, Chan RJ. Health promotion and psychological interventions for adolescent and young adult cancer survivors: A systematic literature review. Cancer Treat Rev. 2017;55:57-70.

11. Pugh G, Gravestock HL, Hough RE, King WM, Wardle J, Fisher A. Health behavior change interventions for teenage and young adult cancer survivors: a systematic review. J Adolesc Young Adult Oncol. 2016;5(2):91-105.

12. Sonstroem RJ, Morgan WP. Exercise and self-esteem: rationale and model. Med Sci Sports Exerc. 1989;21(3):329-37.

13. Moore JB, Mitchell NG, Beets MW, Bartholomew JB. Physical self-esteem in older adults: a test of the indirect effect of physical activity. Sport Exerc Perform Psychol. 2012;1(4):231-41.

14. Dodd RK, Vetter, R.E. College females' self-perceptions of their overall self-worth. Am J Health Stud. 2015;30(3):110-18.

15. Lemoyne J, Valois P, Guay F. Physical self-concept and participation in physical activity in college students. Med Sci Sports Exerc. 2015;47(1):142-50.

16. Musanti R. A study of exercise modality and physical self-esteem in breast cancer survivors. Med Sci Sports Exerc. 2012;44(2):352-61.

17. Awick EA, Phillips SM, Lloyd GR, McAuley E. Physical activity, self-efficacy and self-esteem in breast cancer survivors: a panel model. Psychooncology. 2017;26(10):1625-31.

18. Baldwin MK, Courneya, K.S. Exercise and self-esteem in breast cancer survivors: an application of the exercise and self-esteem model. J Sport Exerc Psychol. 1997;19:347-58.

19. Belanger LJ, Plotnikoff RC, Clark A, Courneya KS. Physical activity and health-related quality of life in young adult cancer survivors: a Canadian provincial survey. J Cancer Surviv. 2011;5(1):44-53.

20. Belanger LJ, Plotnikoff RC, Clark A, Courneya KS. Prevalence, correlates, and psychosocial outcomes of sport participation in young adult cancer survivors. Psychol Sport Exerc. 2013;14:298-304.

21. Gill E, Goldenberg M, Starnes H, Phelan S. Outdoor adventure therapy to increase physical activity in young adult cancer survivors. J Psychosoc Oncol. 2016;34(3):184-99.

22. Adamsen L, Andersen C, Midtgaard J, Moller T, Quist M, Rorth M. Struggling with cancer and treatment: young athletes recapture body control and identity through exercise: qualitative findings from a supervised group exercise program in cancer patients of mixed gender undergoing chemotherapy. Scand J Med Sci Sports. 2009;19(1):55-66.

23. Wurz A, Brunet, J. Exploring the relationships between physical activity, self-efficacy, physical self-perceptions, and self-esteem among survivors of adolescent and young adult cancer. Submitted to a peer reviewed journal.

24. Eldridge SM, Chan CL, Campbell MJ, Bond CM, Hopewell S, Thabane L et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. Pilot Feasibility Stud. 2016;2:64.

25. Kilka R, Tamburini A, Galanti G, Mascherini G, Stefani L. The role of exercise in pediatric and adolescent cancers: a review of assessments and suggestions for clinical implementation. J Funct Morph Kines. 2018;3(7):1-19.

26. Rustler V, Hagerty M, Daeggelmann J, Marjerrison S, Bloch W, Baumann FT. Exercise interventions for patients with pediatric cancer during inpatient acute care: a systematic review of literature. Pediatr Blood Cancer. 2017;64(11).

27. Segal R, Zwaal C, Green E, Tomasone JR, Loblaw A, Petrella T et al. Exercise for people with cancer: a clinical practice guideline. Curr Oncol. 2017;24(1):40-6.

28. Schmitz KH, Courneya KS, Matthews C, Demark-Wahnefried W, Galvao DA, Pinto BM et al. American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. Med Sci Sports Exerc. 2010;42(7):1409-26.

29. McCorkle R, Ercolano E, Lazenby M, Schulman-Green D, Schilling LS, Lorig K et al. Self-management: Enabling and empowering patients living with cancer as a chronic illness. CA Cancer J Clin. 2011;61(1):50-62.

30. Howell D, Harth T, Brown J, Bennett C, Boyko S. Self-management education interventions for patients with cancer: a systematic review. Support Care Cancer. 2017;25(4):1323-55.

31. Ferrer RA, Huedo-Medina TB, Johnson BT, Ryan S, Pescatello LS. Exercise interventions for cancer survivors: a meta-analysis of quality of life outcomes. Ann Behav Med. 2011;41(1):32-47.

32. Belanger LJ, Plotnikoff RC, Clark A, Courneya KS. A survey of physical activity programming and counseling preferences in young-adult cancer survivors. Cancer Nurs. 2012;35(1):48-54.

33. Murnane A, Gough K, Thompson K, Holland L, Conyers R. Adolescents and young adult cancer survivors: exercise habits, quality of life and physical activity preferences. Support Care Cancer. 2015;23(2):501-10.

34. Pugh G, Hough RE, Gravestock HL, Jackson SE, Fisher A. The health behavior information needs and preferences of teenage and young adult cancer survivors. J Adolesc Young Adult Oncol. 2017;6(2):318-26.

35. Tsangaris E, Johnson J, Taylor R, Fern L, Bryant-Lukosius D, Barr R et al. Identifying the supportive care needs of adolescent and young adult survivors of cancer: a qualitative analysis and systematic literature review. Support Care Cancer. 2014;22(4):947-59.

36. Schulz KF, Grimes DA. Sample size slippages in randomised trials: exclusions and the lost and wayward. Lancet. 2002;359(9308):781-5.

37. Thabane L, Ma J, Chu R, Cheng J, Ismaila A, Rios LP et al. A tutorial on pilot studies: the what, why and how. BMC Med Res Methodol. 2010;10:1.

38. Godin G, Shephard, R.J. Godin Leisure-Time Exercise Questionnaire. Med Sci Sport Exerc. 1997;29 S36-8.

39. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. Can J Appl Sport Sci. 1985;10(3):141-6.

40. Choi L, Liu Z, Matthews CE, Buchowski MS. Validation of accelerometer wear and nonwear time classification algorithm. Med Sci Sports Exerc. 2011;43(2):357-64.

41. Freedson PS, Melanson E, Sirard J. Calibration of the Computer Science and Applications, Inc. accelerometer. Med Sci Sports Exerc. 1998;30(5):777-81.

42. Canadian Society for Exercise Physiology. Canadian Society for Exercise Physiology - Physical Activity Training for Health (CSEP-PATH). Ottawa, ON: Canadian Society for Exercise Physiology; 2013.

43. Rikli R, Jones, J. Senior fitness test manual. Champaign, IL: Human Kinetics; 2001.

44. McAuley E. Self-efficacy and the maintenance of exercise participation in older adults. J Behav Med. 1993;16(1):103-13.

45. Marsh HW, Martin AJ, Jackson S. Introducing a short version of the physical self description questionnaire: new strategies, short-form evaluative criteria, and applications of factor analyses. J Sport Exerc Psychol. 2010;32(4):438-82.

46. Rosenberg M. Society and adolescent self-image. Princeton, NJ: Princeton University Press; 1965.

47. IBM Corp. IBM SPSS Statistics for Macintosh. Armonk, NY: IBM Corp. Released 2017.

48. Krippendorff K. Content analysis: an introduction to its methodology. Thousand Oaks, CA: SAGE; 2013.

49. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport. 1999;70(2):113-9.

50. Scivoletto G, Tamburella F, Laurenza L, Foti C, Ditunno JF, Molinari M. Validity and reliability of the 10-m walk test and the 6-min walk test in spinal cord injury patients. Spinal Cord. 2011;49(6):736-40.

51. Valle CG, Tate DF, Mayer DK, Allicock M, Cai J. A randomized trial of a Facebook-based physical activity intervention for young adult cancer survivors. J Cancer Surviv. 2013;7(3):355-68.

52. Rabin C, Pinto B, Fava J. Randomized trial of a physical activity and meditation intervention for young adult cancer survivors. J Adolesc Young Adult Oncol. 2016;5(1):41-7.

53. American Cancer Society. Cancer Facts & Figures 2015. Atlanta, GA; 2015

54. Canadian Cancer Society's Advisory Committee on Cancer Statistics. Canadian Cancer Statistics 2015. Toronto, Ontario; 2015.

55. Barr RD, Ries R, Ferrari A, Whelan J, Bleyer A. Adolescent and young adult oncology: historical and global perspectives. In: Bleyer A, Barr R, Ries L, Whelan J, Ferrari A, editors. Cancer in adolescents and young adults. 2nd ed. Cham, Switzerland: Springer International Publishing AG (Springer Nature); 2017. p. 1-7.

56. Rabin C, Horowitz S, Marcus B. Recruiting young adult cancer survivors for behavioral research. J Clin Psychol Med Settings. 2013;20(1):33-6.

57. Pugh G, Hough R, Gravestock H, Haddrell JB, Beeken RJ, Fisher A. The lifestyle information and intervention preferences of teenage and young adult cancer survivors: a qualitative study. Cancer Nurs. 2018;41(5):389-98.

58. Wong JN, McAuley E, Trinh L. Physical activity programming and counseling preferences among cancer survivors: a systematic review. Int J Behav Nutr Phys Act. 2018;15(1):48.

59. Frazelle ML, Friend PJ. Optimizing the teachable moment for health promotion for cancer survivors and their families. J Adv Pract Oncol. 2016;7(4):422-33.

60. Bellizzi KM, Smith A, Schmidt S, Keegan TH, Zebrack B, Lynch CF et al. Positive and negative psychosocial impact of being diagnosed with cancer as an adolescent or young adult. Cancer. 2012;118(20):5155-62.

61. Wurz A, Brunet J. Evaluating questionnaires used to assess self-reported physical activity and psychosocial outcomes among survivors of adolescent and young adult cancer: a cognitive interview study. J Adolesc Young Adult Oncol. 2017;6(3):482-8.

62. Trost SG, McIver KL, Pate RR. Conducting accelerometer-based activity assessments in field-based research. Med Sci Sports Exerc. 2005;37(11):S531-43.

63. Chudyk AM, McAllister MM, Cheung HK, McKay HA, Ashe MC. Are we missing the sitting? Agreement between accelerometer non-wear time validation methods used with older adults' data. Cogent Med. 2017;4:1313505.

64. King WC, Li J, Leishear K, Mitchell JE, Belle SH. Determining activity monitor wear time: an influential decision rule. J Phys Act Health. 2011;8(4):566-80.

65. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. Ann Behav Med. 2013;46(1):81-95.

66. Hallward L, Patel N, Duncan LR. Behaviour change techniques in physical activity interventions for men with prostate cancer: a systematic review. J Health Psychol. 2018:1359105318756501.

67. Stacey FG, James EL, Chapman K, Courneya KS, Lubans DR. A systematic review and meta-analysis of social cognitive theory-based physical activity and/or nutrition behavior change interventions for cancer survivors. J Cancer Surviv. 2015;9(2):305-38.

68. Bluethmann SM, Vernon SW, Gabriel KP, Murphy CC, Bartholomew LK. Taking the next step: a systematic review and meta-analysis of physical activity and behavior change interventions in recent post-treatment breast cancer survivors. Breast Cancer Res Treat. 2015;149(2):331-42.

69. Santa Mina D, Sabiston CM, Au D, Fong AJ, Capozzi LC, Langelier D et al. Connecting people with cancer to physical activity and exercise programs: a pathway to create accessibility and engagement. Curr Oncol. 2018;25(2):149-62.

70. Dalzell MA, Smirnow N, Sateren W, Sintharaphone A, Ibrahim M, Mastroianni L et al. Rehabilitation and exercise oncology program: translating research into a model of care. Curr Oncol. 2017;24(3):e191-8.

71. Egan MY, McEwen S, Sikora L, Chasen M, Fitch M, Eldred S. Rehabilitation following cancer treatment. Disabil Rehabil. 2013;35(26):2245-58.

72. Mewes JC, Steuten LM, Ijzerman MJ, van Harten WH. Effectiveness of multidimensional cancer survivor rehabilitation and cost-effectiveness of cancer rehabilitation in general: a systematic review. Oncologist. 2012;17(12):1581-93.

Chapter Five

Global Discussion

Considering the number of adolescents and young adults (AYAs) diagnosed with cancer each year and their age at diagnosis, the global burden of cancer among survivors of AYA cancer exceeds that reported for other age groups [1]. Identifying interventions to improve the negative effects of cancer and its treatments in this population is of utmost importance as it can have substantial personal, societal, and economic benefits. There is robust evidence that physical activity confers a range of benefits among child and adult survivors of cancer [2-5] and emerging evidence suggesting survivors of AYA cancer may also benefit from physical activity [6-8]. However, considerable gaps in knowledge remain as few researchers have focused on understanding how (i.e., mediators) and under what circumstances (i.e., moderators) physical activity is related to physical and psychological outcomes for cancer survivors generally, and in particular survivors of AYA cancer. Identifying the mediators and moderators underlying the relationships between physical activity and physical and psychological outcomes is important so as to tailor and optimize interventions seeking to mitigate the negative effects of cancer and its treatments. The Exercise and Self-Esteem Model (EXSEM) is one framework that may be useful to address this gap. Yet, the lack of research conducted with survivors of AYA cancer necessitates several precursory steps in advance of a definitive randomized controlled trial (RCT) testing if/how and under what circumstances physical activity is related to physical and psychological outcomes in this population. Specifically, it is important to establish whether previously validated and popular questionnaires can be used with survivors of AYA cancer, explore relationships between EXSEM variables, and answer questions regarding the feasibility and acceptability of a physical activity intervention designed for this population, as well as the

methods proposed to test the effects of such interventions. This research program was developed to achieve these aims, thereby laying a strong foundation for the continued examination of physical activity among survivors of AYA cancer.

Collectively, all three studies presented in this thesis advance knowledge and provide a starting point for understanding if/how and under what circumstances physical activity and physical and psychological outcomes are related among survivors of AYA cancer. In particular, they make noteworthy theoretical, conceptual, methodological, and practical contributions, and thus have implications for informing future research and care. Each type of contribution is considered in turn.

Theoretical Contributions

Though the EXSEM has been used to examine the relationships between physical activity and physical and psychological outcomes in samples drawn from the general population (e.g., [9-20]), there is a need for research examining the proposed pathways in clinical populations in order to validate the relationships and provide support for the generalizability of the model. To date, no researchers have tested the EXSEM among survivors of AYA cancer, nor have they sought to explore the mechanisms underlying the relationship between physical activity and physical and psychological outcomes in this population. After ensuring measures used to assess EXSEM constructs developed for the general population could be used with survivors of AYA cancer in Study One, Study Two represents the first attempt to test select EXSEM constructs among survivors of AYA cancer and Study Three lays the foundation for a definitive RCT that will be the first to empirically evaluate the EXSEM in its entirety in this population.

Specifically, Study Two provided evidence that physical self-perceptions and self-esteem (physical and global) are positively related cross-sectionally. This is similar to findings from

studies with breast cancer survivors [21, 22] and adolescents without a history of cancer [17]. Moreover, these findings corroborate Rosenberg et al.'s [23] and Shavelson, Hubner, and Stanton's [24] theorizing about the hierarchical nature of self-esteem and are inline with the relationships proposed within the EXSEM [25]. As such, Study Two suggests the relationships between one's physical functioning and appearance and more global self-evaluations may be similar in survivors of AYA cancer to their older and healthy counterparts.

Furthermore, few researchers have explored the conditions under which the associations between physical activity and physical and psychological outcomes differ in magnitude or direction among individuals diagnosed with cancer. For theoretical and practical reasons, it is important to identify moderators in order to determine when desired psychological outcomes are more or less likely. Although physical activity and self-efficacy for physical activity are two of the first processes within the EXSEM (see Chapter One, Figure 1), they were selected as potential moderators of the relationship between physical self-perceptions and self-esteem (physical and global) on the basis of relevant empirical work [26-28]. They were also selected based on research showing that the same variable can mediate and moderate an outcome [29], both within the same study [30] and across studies and populations (e.g., [31, 32]). Based on the findings from Study Two, when self-efficacy for physical activity was high, the magnitude of the association between physical self-perceptions and physical self-esteem was greater. In contrast, physical activity was not found to be a moderator of the association between physical self-perceptions and self-esteem (physical and global) and was also not related to physical self-perceptions, physical self-esteem, or global self-esteem. The lack of research in this area makes it difficult to properly evaluate whether the non-significant findings are sample-specific or indicative of a larger pattern – underscoring the necessity of replicating and confirming these

findings. Nevertheless, the lack of relationship between physical activity and psychological outcomes raises important questions, which when answered may provide insight as to why physical activity interventions do not always (appear to) improve psychological outcomes among cancer survivors [33].

It is possible that physical activity has different effects for different subgroups of survivors (i.e., positive vs. negative), which could be cancelling one another out in correlation analyses. For some, physical activity might help with the management of symptoms, side effects, and health, which may lead them to feel their body is (or is getting) strong(er). For others, physical activity may draw attention to the negative effects treatment had (e.g., physical deconditioning, weight gain), which may lead them to feel their body is (or is getting) weak(er). In such cases, physical activity may lead to perceptions that one's body is not performing well resulting in negative physical self-evaluations and subsequently self-esteem. Another potential explanation for the lack of relations observed may have to do with participants' reasons for engaging in physical activity, which could affect their psychological response to physical activity. For some, engaging in physical activity as means of taking control over their health may bolster positive feelings and evaluations of physical and global self-esteem, whereas those engaging in physical activity out of fear of cancer recurrence, secondary or second cancers, and/or other health conditions may feel less positively about themselves. To tease apart whether this is the case, further research investigating the underlying reasons and whether this impacts the effect physical activity has on self-perceptions and other psychological outcomes is warranted.

Taken together, Study Two provides evidence that select relationships between EXSEM variables are similar among survivors of AYA cancer. However, it also provides preliminary evidence that self-efficacy for physical activity (one of the first processes in the EXSEM) may

moderate the relationships between desired psychological outcomes suggesting the EXSEM in its current form may not be generalizable to this population. This carries substantial implications for extending the EXSEM to potentially incorporate additional variables and suggests there may be value in exploring alternative pathways and relationships. Theoretically integrated models can provide more complete explanations of health behaviours and the underlying processes involved [34] and may be worth consideration in future research. An important next step would be to confirm these findings using longitudinal study designs to establish directionality/reciprocity over time and to consider including other groups of survivors of AYA cancer who potentially have self-esteem concerns. Moreover, experimental studies providing evidence for causation among survivors of AYA cancer are needed. While this research program did not do this explicitly, Study Three (Article Three, Chapter Two) was a preparatory step for a future definitive RCT for this purpose (among others).

As well, since global self-esteem is influenced by the degree to which specific facets of oneself are valued [23], studies using qualitative methods to better understand the role of the physical self (or body) for survivors of AYA cancer would be valuable. To this end, qualitative data pertaining to perceived changes in physical activity, physical fitness, self-efficacy, physical self-perceptions, and self-esteem (physical and global) was collected in Study Three. Though not reported herein, as it was outside of the scope of the research program, this data re-affirms that the variables contained within the EXSEM are meaningful to survivors of AYA cancer (as evidenced by participants' willingness to complete the interviews). When analyzed, this data will provide preliminary insights as to how participants' self-perceptions of physical functioning and appearance influence their global self-evaluations (i.e., physical and global self-esteem). These qualitative findings will provide early evidence confirming or challenging the current structure of

the EXSEM when tested with survivors of AYA cancer. A next step in this line of inquiry would be to continue exploring the perceived physical and psychological changes survivors experience when participating in physical activity to identify meaningful targets for interventions and to better understand how they may develop over time in this population.

Combined, whereas no relationships between EXSEM variables were tested in Study One, ensuring questionnaires designed to assess theoretical constructs were clear, appropriate, and relevant for survivors of AYA cancer was necessary to enhance confidence in the results emanating from this program of research. Following this, Study Two was the first empirical test of the EXSEM with survivors of AYA cancer. Findings offer partial support for the model and highlight important areas of future inquiry. Finally, Study Three highlighted specific modifications that are required to refine and improve the methods and intervention of a RCT designed to test the effects of physical activity on the EXSEM constructs. All three studies contribute to current research and practice as well as my own future research program, which is aimed at establishing the benefits of physical activity among survivors of AYA cancer, identifying the mechanisms though which ameliorative and positive effects of physical activity are exerted, and elucidating factors that contribute to desired outcomes.

Conceptual Contributions

The importance of the physical self among cancer survivors is increasingly being acknowledged [35, 36] with several organizations now providing online resources to help this population manage the psychological ramifications that co-occur with changed appearance and functioning [37, 38]. Irrespective of the advancements in this area, most studies have included breast cancer survivors and have focused on global constructs of body image (e.g., body dissatisfaction, appearance concerns; [35, 39]). Fewer studies have explored physical self-

evaluation constructs (e.g., physical self-perceptions, physical self-esteem; see [21, 22, 40] for notable exceptions), which has likely hindered progress in this area and may be impeding interventions aimed at relieving distress and promoting psychological health. Though preliminary, the findings from Study One, Study Two, and Study Three highlight the importance of including physical self-perceptions and related psychological outcomes. In Study One, survivors of AYA cancer reported that the questionnaires assessing physical self-perceptions and related psychological outcomes were relevant to them. In Study Two, findings suggest physical self-perceptions were related to important psychological health outcomes. As such, including these variables may allow researchers to capture the complex issues facing survivors of AYA cancer – a population for whom evaluations of appearance and competencies are paramount [41]. In Study Three, the completeness of quantitative data and participants' willingness to answer all qualitative questions on the topic of physical self-perceptions and related psychological outcomes further supports the notion that these concepts are important to survivors of AYA cancer. Moving forward, it will be important to continue including quantitative and qualitative assessments (as was done in Study Three) to capture survivors of AYA cancers' perceptions of and experiences with the physical self so as to extend knowledge in this area.

Methodological Contributions

Although there is a growing interest in exploring physical activity among survivors of AYA cancer, a key limitation associated with published studies is that most of the questionnaires used were not developed with or for this population, but rather for the general population. Ensuring questionnaires are clear, appropriate, and relevant for survivors of AYA cancer is crucial and cognitive interviews are one way to achieve this aim [42]. Whereas studies employing cognitive interviews are becoming popular to better understand how questionnaires

perform across a range of populations (e.g., [43, 44]), Study One is among the first to use cognitive interviews to explore how survivors of AYA cancer interpret and respond to questionnaires. Thus, it makes progress on the measurement of self-reported physical activity and physical and psychological outcomes in this population. Importantly, it shows that questionnaires assessing EXSEM variables may be used with or without slight modifications in survivors of AYA cancer. However, since findings from cognitive interviews are not meant to confirm score validity or reliability [42], further testing of score reliability and validity for these questionnaires is required in larger quantitative studies [45].

To date, the majority of research on physical activity among survivors of AYA cancer has been cross-sectional in nature [6], which is limited insofar as such designs can only explore between-person associations [46] and cannot establish directionality/reciprocity over time. The general conclusion drawn from these studies is that physical activity may serve to enhance physical and psychological health; though recent reviews conclude that physical activity is not a well-studied topic in this population [6-8]. Moreover, in the studies that have been conducted, mixed results have been reported within and across studies [6-8]. Indeed, adding to mixed findings, Study Two showed that physical activity was not related to self-esteem, which is in contrast to Belanger et al. [47, 48], who showed that physical activity was positively related to self-esteem. Such mixed results underscore the importance of conducting experimental tests to ascertain mediators and moderators so as to better understand when and for whom self-esteem benefits may or may not occur.

Finally, many agree that using qualitative and quantitative methods within the same study can yield more valuable information than a single method alone [49]. The pervasive use of quantitative approaches with survivors of AYA cancer may be masking survivor's unique

perceptions and experiences with physical activity and physical and psychological outcomes. Incorporating qualitative methods into this research program via the convergent parallel design piloted in Study Three not only ensured participants' feedback on the acceptability of our methods and intervention could be obtained, but it will enable a first look at how survivors of AYA cancer experience EXSEM variables. As, findings from Study Three suggested the interviews were both feasible and acceptable to participants, researchers can feel confident including qualitative interviews in their own pilot RCTs, and eventually definitive RCTs, so that quantitative and qualitative results can be compared and contrasted. Ultimately, this will provide a greater understanding of if/how and when EXSEM variables are related among survivors of AYA cancer.

Practical Contributions

There are some important practical contributions that emerged from this research program. Though physical activity has been shown to be safe and feasible for survivors of AYA cancer in Study Three, and previous empirical studies (e.g., [50, 51]), most survivors decrease their physical activity during treatment and remain inactive following treatment [52, 53]. Based on the physical activity levels reported in Study Two and Study Three, there is a need for efforts to address the state of physical inactivity in this population. To test the EXSEM and ultimately promote physical and psychological health, finding ways to help survivors of AYA cancer acquire and maintain physical activity will be important. Drawing on the findings from both Study Two and Study Three, interventions that enhance survivors self-efficacy for physical activity may be a viable way to not only develop more positive physical self-perceptions and subsequently physical self-esteem but to increase adherence to interventions [54]. Bandura's [55] self-efficacy theory may be well suited to inform interventions in this population. In Bandura's

[55] view, the extent to which survivors' perceptions of self-efficacy are fostered depends on their physical activity history and personal mastery experiences, physiological cues/responses to physical activity, environment, and access to vicarious experiences. Helping survivors of AYA cancer develop positive outcome expectations, set meaningful goals, plan/schedule physical activity, and reduce perceived barriers (i.e., behaviour change techniques; [56]) could address the challenges encountered among participants in Study Three and promote self-efficacy, which was shown to enhance positive physical self-evaluations in Study Two.

Beyond requiring additional support to change their behaviour, participants in Study Three also provided feedback on the stepped down model of intervention delivery (i.e., transitioning from supervised to unsupervised physical activity). Findings highlighted that some survivors of AYA cancer struggled during and after this transition. Exploring more gradual stepped down and triaged approaches to care, wherein survivors of AYA cancer receive tapered care matched to their need may be worthwhile to ensure survivors' receive appropriate levels of support. Among older adult cancer survivors, more gradual stepped down and triaged approaches are being piloted and efficacy and cost-effectiveness is being established [57-59]. Refining, piloting, and testing such models with survivors of AYA cancer could be explored as a means of enhancing adherence and acceptability.

Finally, Study One and Study Three provide practical guidance for those seeking to refine studies and optimize trials and physical activity interventions. Specifically, findings underscore the critical nature of conducting work to identify problems in advance with the methods (i.e., measures, Study One; methods and intervention, Study Three) of time- and resource-consuming definitive RCTs. Moreover, fostering collaborations, working across sites, and using multiple

and varied sources of recruitment is necessary to increase the number of AYA cancer survivors referred, approached, and enrolled.

Limitations

Although the studies comprising this research program make a number of theoretical, conceptual, methodological, and practical contributions, there are some limitations. As with most studies conducted with survivors of AYA cancer, the studies included in this thesis are limited by their small sample size, convenience samples, and overrepresentation of self-identified White participants. It is possible that including the perspectives of larger and more culturally/racially diverse samples might have resulted in different results. Moreover, participation in each study was limited to those who were '*able to participate in physical activity*', which was done to ensure survivors' perspectives on the topic of physical activity and physical and psychological outcomes could be obtained and to ensure safety in Study Three. Consequently, perspectives of survivors suffering from more severe symptoms and side effects are not included herein and would be a worthwhile avenue of future inquiry. In regards to more specific study limitations, each has been described within relevant chapters (i.e., Chapter Two, Chapter Three, and Chapter Four).

Conclusions

In conclusion, all three studies presented in this thesis make valuable contributions to the literature. In the broadest sense, they advanced knowledge on the relationships between physical activity and physical and psychological outcomes among survivors of AYA cancer – a topic that until this time has been understudied. Evidence on the clarity, relevance, and appropriateness of questionnaires to test EXSEM variables was found in Study One, ensuring these questionnaires could be used in the present research program and by other researchers in the future. Furthermore,

the cross-sectional research design drawing on the EXSEM in Study Two helped expand current knowledge of the associations between model variables and has laid the foundation for testing mechanisms and identifying factors that may enhance/mitigate desired outcomes. To move this line of research forward, Study Three explored the feasibility and acceptability of a two-arm, mixed-methods RCT testing a physical activity intervention. Data obtained underscore the critical nature of pilot work to identify problems in advance of time- and resource-consuming definitive RCTs. Combined findings from this research program offer guidance for others seeking to tailor and optimize physical activity interventions for survivors of AYA cancer and contribute to a burgeoning field seeking to mitigate the lasting negative effects of the disease. In sum, this thesis not only fits nicely within funding organization mandates (e.g., Canadian Institutes of Health Research) because of its patient-oriented approach, but it represents a first step towards building an evidence base upon which researchers and practitioners will one day be able put forward recommendations and arguments for integrating physical activity into practice.

References

1. Bleyer A, Ferrari A, Whelan J, Barr RD. Global assessment of cancer incidence and survival in adolescents and young adults. Pediatr Blood Cancer. 2017;64(9).
2. Baumann FT, Bloch W, Beulertz J. Clinical exercise interventions in pediatric oncology: a systematic review. Pediatric research. 2013;74(4):366-74.
3. Mishra SI, Scherer RW, Geigle PM, Berlanstein DR, Topaloglu O, Gotay CC et al. Exercise interventions on health-related quality of life for cancer survivors. Cochrane Database Syst Rev. 2012;8:CD007566.
4. Albrecht TA, Taylor AG. Physical activity in patients with advanced-stage cancer: a systematic review of the literature. Clin J Oncol Nurs. 2012;16(3):293-300.
5. Wurz A, Brunet, J. The effects of physical activity on health and quality of life in adolescent cancer survivors: a systematic review. JMIR Cancer. 2016;2(1):e6.
6. Brunet J, Wurz A, Shallwani SM. A scoping review of studies exploring physical activity among adolescents and young adults diagnosed with cancer. Psychooncology. 2018;27(8):1875-88.
7. Pugh G, Gravestock HL, Hough RE, King WM, Wardle J, Fisher A. Health behavior change interventions for teenage and young adult cancer survivors: a systematic review. J Adolesc Young Adult Oncol. 2016;5(2):91-105.
8. Richter D, Koehler M, Friedrich M, Hilgendorf I, Mehnert A, Weissflog G. Psychosocial interventions for adolescents and young adult cancer patients: A systematic review and meta-analysis. Crit Rev Oncol Hematol. 2015;95(3):370-86.
9. Elavsky S. Longitudinal examination of the exercise and self-esteem model in middle-aged women. J Sport Exerc Psychol. 2010;32(6):862-80.

10. Elavsky S, McAuley E. Exercise and self-esteem in menopausal women: a randomized controlled trial involving walking and yoga. Am J Health Promot. 2007;22(2):83-92.

11. Gothe NP, Mullen SP, Wojcicki TR, Mailey EL, White SM, Olson EA et al. Trajectories of change in self-esteem in older adults: exercise intervention effects. J Behav Med. 2011;34(4):298-306.

12. Levy SS, Ebbeck, V. The exercise and self-esteem model in adult women: the inclusion of physical acceptance. Psychology of Sport and Exercise. 2005;6:571-84.

13. Martin Ginis KA, McEwan D, Josse AR, Phillips SM. Body image change in obese and overweight women enrolled in a weight-loss intervention: the importance of perceived versus actual physical changes. Body Image. 2012;9(3):311-7.

14. Martin Ginis KA, Strong HA, Arent SM, Bray SR, Bassett-Gunter RL. The effects of aerobic- versus strength-training on body image among young women with pre-existing body image concerns. Body Image. 2014;11(3):219-27.

15. Moore JB, Mitchell NG, Beets MW, Bartholomew JB. Physical self-esteem in older adults: A test of the indirect effect of physical activity. Sport Exerc Perform Psychol. 2012;1(4):231-41.

16. Moore JB, Mitchell NG, Bibeau WS, Bartholomew JB. Effects of a 12-week resistance exercise program on physical self-perceptions in college students. Res Q Exerc Sport. 2011;82(2):291-301.

17. Noack P, Kauper T, Benbow AE, Eckstein K. Physical self-perceptions and self-esteem in adolescents participating in organized sports and religious groups. Eur J Dev Psychol. 2013;10(6):663-75.

18. Opdenacker J, Delecluse C, Boen F. The longitudinal effects of a lifestyle physical activity intervention and a structured exercise intervention on physical self-perceptions and self-esteem in older adults. Journal of Sport & Exercise Psychology. 2009;31(6):743-60.

19. McAuley E, Blissmer B, Katula J, Duncan TE, Mihalko SL. Physical activity, self-esteem, and self-efficacy relationships in older adults: a randomized controlled trial. Ann Behav Med. 2000;22(2):131-9.

20. McAuley E, Elavsky S, Motl RW, Konopack JF, Hu L, Marquez DX. Physical activity, self-efficacy, and self-esteem: longitudinal relationships in older adults. J Gerontol B Psychol Sci Soc Sci. 2005;60(5):268-75.

21. Musanti R. A study of exercise modality and physical self-esteem in breast cancer survivors. Med Sci Sports Exerc. 2012;44(2):352-61.

22. Baldwin MK, Courneya, K.S. Exercise and self-esteem in breast cancer survivors: an application of the exercise and self-esteem model. J Sport Exerc Psychol. 1997;19:347-58.

23. Rosenberg SM, Tamimi RM, Gelber S, Ruddy KJ, Kereakoglow S, Borges VF et al. Body image in recently diagnosed young women with early breast cancer. Psychooncology. 2013;22(8):1849-55

24. Shavelson RJ, Hubner JJ, Stanton GC. Self-concept: validation of construct interpretations. Rev Educ Res. 1976;46(3):401-41.

25. Sonstroem RJ, Morgan, W.P. Exercise and self-esteem: rationale and model. Medicine and Science in Sport and Exercise. 1989;21(3):329-37.

26. Babic MJ, Morgan PJ, Plotnikoff RC, Lonsdale C, White RL, Lubans DR. Physical activity and physical self-concept in youth: systematic review and meta-analysis. Sport Med. 2014;44(11):1589-601.

27. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. Br J Sports Med. 2011;45(11):886-95.

28. Niemiec T, Lachowicz-Tabaczek K. The moderating role of specific self-efficacy in the impact of positive mood on cognitive performance. Motiv Emot. 2015;39(4):498-505.

29. Judd C, Kenny D, McClelland G. Estimating and testing mediation and moderation in within-subjects designs. Psychol Methods. 2001;6:115-34.

30. Beauchaine TP, Webster-Stratton C, Reid MJ. Mediators, moderators, and predictors of 1-year outcomes among children treated for early-onset conduct problems: a latent growth curve analysis. J Consult Clin Psychol. 2005;73(3):371-88.

31. Tang F, Jang H, Lingler J, Tamres LK, Erlen JA. Stressors and caregivers' depression: multiple mediators of self-efficacy, social support, and problem-solving skill. Soc Work Health Care. 2015;54(7):651-68.

32. Liu L, Xu N, Wang L. Moderating role of self-efficacy on the associations of social support with depressive and anxiety symptoms in Chinese patients with rheumatoid arthritis. Neuropsychiatr Dis Treat. 2017;13:2141-50.

33. Craft LL, Vaniterson EH, Helenowski IB, Rademaker AW, Courneya KS. Exercise effects on depressive symptoms in cancer survivors: a systematic review and meta-analysis. Cancer Epidemiol Biomarkers Prev. 2012;21(1):3-19.

34. Hagger MS. Theoretical integration in health psychology: unifying ideas and complementary explanations. Br J Health Psychol. 2009;14(2):189-94.

35. Muzzatti B, Annunziata MA. Body image assessment in oncology: an update review. Support Care Cancer. 2017;25(3):1019-29.

36. Fingeret MC, Teo, I. Body image care for cancer patients. New York, New York: Oxford University Press; 2018.

37. Canadian Cancer Society. Self-esteem and body image. Canadian Cancer Society. 2018. http://www.cancer.ca/en/cancer-information/cancer-journey/living-with-cancer/dealing-with-change/self-esteem-body-image/?region=on. Accessed September 17 2018.

38. Fred Hutchinson Cancer Research Center. Body image after cancer. Fred Hutchinson Cancer Research Center. 2018. https://www.fredhutch.org/en/treatment/survivorship/survival-strategies/body-image-after-cancer.html. Accessed September 17 2018.

39. Lehmann V, Hagedoorn M, Tuinman MA. Body image in cancer survivors: a systematic review of case-control studies. J Cancer Surviv. 2015;9(2):339-48.

40. Awick EA, Phillips SM, Lloyd GR, McAuley E. Physical activity, self-efficacy and self-esteem in breast cancer survivors: a panel model. Psychooncology. 2017;26(10):1625-31.

41. Bucchianeri MM, Arikian AJ, Hannan PJ, Eisenberg ME, Neumark-Sztainer D. Body dissatisfaction from adolescence to young adulthood: findings from a 10-year longitudinal study. Body Image. 2013;10(1):1-7.

42. Willis GB. Cognitive interviewing a tool for improving questionnaire design. Thousand Oaks, California: Sage Publications Ltd.; 2005.

43. Hales S, Gagliese L, Nissim R, Zimmermann C, Rodin G. Understanding bereaved caregiver evaluations of the quality of dying and death: an application of cognitive

interviewing methodology to the quality of dying and death questionnaire. J Pain Symptom Manage. 2012;43(2):195-204.

44. Aiken CR, Gray M, Clifton S, Tanton C, Field N, Sonnenberg P et al. Improving questions on sexual partnership: lessons learned from cognitive interviews for Britain's third national survey of sexual attitudes and lifestyles ("Natsal-3"). Arch Sex Behav. 2013;42:173-85.

45. Messick S. Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. American Psychologist. 1995;50(9):741-9.

46. Fields A. Discovering statistics using IBM SPSS statistics. 4 ed. Thousand Oaks, California: SAGE Publications Ltd.; 2013.

47. Belanger LJ, Plotnikoff RC, Clark A, Courneya KS. Physical activity and health-related quality of life in young adult cancer survivors: a Canadian provincial survey. J Cancer Surviv. 2011;5(1):44-53.

48. Belanger LJ, Plotnikoff RC, Clark A, Courneya KS. Prevalence, correlates, and psychosocial outcomes of sport participation in young adult cancer survivors. Psychol Sport Exerc. 2013;14:298-304.

49. Creswell JW, Plano Clark, V.L. Designing and conducting mixed methods research. Thousand Oaks, California: SAGE Publications Ltd.; 2013.

50. Gill E, Goldenberg M, Starnes H, Phelan S. Outdoor adventure therapy to increase physical activity in young adult cancer survivors. J Psychosoc Oncol. 2016;34(3):184-99.

51. Rabin C, Pinto B, Fava J. Randomized trial of a physical activity and meditation intervention for young adult cancer survivors. J Adolesc Young Adult Oncol. 2016;5(1):41-7.

52. Murnane A, Gough K, Thompson K, Holland L, Conyers R. Adolescents and young adult cancer survivors: exercise habits, quality of life and physical activity preferences. Support Care Cancer. 2015;23(2):501-10.

53. Collins RH, McGowan EL. Exploring associations of sedentary behavior and physical activity with quality of life in young adult cancer survivors. J Adolesc Young Adult Oncol. 2018.

54. Stacey FG, James EL, Chapman K, Courneya KS, Lubans DR. A systematic review and meta-analysis of social cognitive theory-based physical activity and/or nutrition behavior change interventions for cancer survivors. J Cancer Surviv. 2015;9(2):305-38.

55. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. 1977;84(2):191-215.

56. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. Ann Behav Med. 2013;46(1):81-95.

57. Dalzell MA, Smirnow N, Sateren W, Sintharaphone A, Ibrahim M, Mastroianni L et al. Rehabilitation and exercise oncology program: translating research into a model of care. Curr Oncol. 2017;24(3):e191-e8.

58. Egan MY, McEwen S, Sikora L, Chasen M, Fitch M, Eldred S. Rehabilitation following cancer treatment. Disabil Rehabil. 2013;35(26):2245-58.

59. Mewes JC, Steuten LM, Ijzerman MJ, van Harten WH. Effectiveness of multidimensional cancer survivor rehabilitation and cost-effectiveness of cancer rehabilitation in general: a systematic review. Oncologist. 2012;17(12):1581-93.

Appendix A: Research Ethics Board Approval Notices

Study One (Chapter Two)

Université d'Ottawa University of Ottawa
Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

Ethics Approval Notice

Health Sciences and Science REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

First Name	Last Name	Affiliation	Role
Jennifer	Brunet	Health Sciences / Human Kinetics	Supervisor
Amanda	Wurz	Health Sciences / Human Kinetics	Student Researcher

File Number: H04-16-02

Type of Project: PhD Thesis

Title: Ensuring Adolescent and Young Adult Cancer Survivors Understand Questionnaires Used in Research

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)	Approval Type
06/06/2016	06/05/2017	Approved

Special Conditions / Comments:
N/A

550, rue Cumberland, pièce 154 550 Cumberland Street, room 154
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www.recherche.uottawa.ca/deontologie/ www.research.uottawa.ca/ethics/

Université d'Ottawa University of Ottawa
Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

This is to confirm that the University of Ottawa Research Ethics Board identified above, which operates in accordance with the Tri-Council Policy Statement (2010) and other applicable laws and regulations in Ontario, has examined and approved the ethics application for the above named research project. Ethics approval is valid for the period indicated above and subject to the conditions listed in the section entitled "Special Conditions / Comments".

During the course of the project, the protocol may not be modified without prior written approval from the REB except when necessary to remove participants from immediate endangerment or when the modification(s) pertain to only administrative or logistical components of the project (e.g., change of telephone number). Investigators must also promptly alert the REB of any changes which increase the risk to participant(s), any changes which considerably affect the conduct of the project, all unanticipated and harmful events that occur, and new information that may negatively affect the conduct of the project and safety of the participant(s). Modifications to the project, including consent and recruitment documentation, should be submitted to the Ethics Office for approval using the "Modification to research project" form available at: http://www.research.uottawa.ca/ethics/forms.html

Please submit an annual report to the Ethics Office four weeks before the above-referenced expiry date to request a renewal of this ethics approval. To close the file, a final report must be submitted. These documents can be found at: http://www.research.uottawa.ca/ethics/forms.html

If you have any questions, please do not hesitate to contact the Ethics Office at extension 5387 or by e-mail at: ethics@uOttawa.ca.

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Study Two (Chapter Three)

Université d'Ottawa University of Ottawa
Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

Certificate of Ethics Approval

Health Sciences and Science REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

First Name	Last Name	Affiliation	Role
Jennifer	Brunet	Health Sciences / Human Kinetics	Supervisor
Amanda	Wurz	Health Sciences / Human Kinetics	Student Researcher

File Number: H06-16-25

Type of Project: PhD Thesis

Title: Exploring the relationship between physical activity and quality of life in adolescent and young adult cancer survivors

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)
11/08/2016	11/07/2017

Special Conditions / Comments:

N/A

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Université d'Ottawa University of Ottawa
Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

This is to confirm that the University of Ottawa Research Ethics Board identified above, which operates in accordance with the Tri-Council Policy Statement and other applicable laws and regulations in Ontario, has examined and approved the application for ethical approval for the above named research project as of the Ethics Approval Date indicated for the period above and subject to the conditions listed the section above entitled "Special Conditions / Comments".

During the course of the study the protocol may not be modified without prior written approval from the REB except when necessary to remove participants from immediate endangerment or when the modification(s) pertain to only administrative or logistical components of the study (e.g. change of telephone number). Investigators must also promptly alert the REB of any changes which increase the risk to participant(s), any changes which considerably affect the conduct of the project, all unanticipated and harmful events that occur, and new information that may negatively affect the conduct of the project and safety of the participant(s). Modifications to the project, information/consent documentation, and/or recruitment documentation, should be submitted to this office for approval using the "Modification to research project" form available at: http://research.uottawa.ca/ethics/submissions-and-reviews.

Please submit an annual status report to the Protocol Officer 4 weeks before the above-referenced expiry date to either close the file or request a renewal of ethics approval. This document can be found at: http://research.uottawa.ca/ethics/submissions-and-reviews.

If you have any questions, please do not hesitate to contact the Ethics Office at extension 5387 or by e-mail at: ethics@uOttawa.ca.

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Study Three (Chapter Four)

Research Ethics Board approval notices are presented in the order they were obtained:

(1) Children's Hospital of Eastern Ontario Research Ethics Board

(2) Ottawa Health Science Network Research Ethics Board

(3) University of Ottawa Research Ethics Board

(4) Royal Ottawa Mental Health Centre Research Ethics Board

As well, appropriate contracts were obtained (not presented herein) and were finalized on September 7, 2017.

RESEARCH INSTITUTE
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CHEO Research Ethics Board
Approval - Delegated Review

Principal Investigator: Dr. Mylene Bassal
REB Protocol No: 16/110X
Romeo File No: 20160377
Project Title: CHEOREB# 16/110X - Exploring the feasibility, safety, and potential benefits of a 12-week home-based physical activity intervention
Primary Affiliation: Clinical Research\Hematology/Oncology
Protocol Status: Active
Approval Date*: December 14, 2016
Valid Until:** August 15, 2017
Annual Renewal Submission Deadline: 15 July 2017

Documents Reviewed & Approved:

Document Name	Comments	Version Date
Consent Form	Consent	2016/11/11
Investigator Response	PI Response	2016/11/11
Other Document	Study Material PARmed-X	2016/11/02
Other Document	Study Material SocioDemographicMedical Clean	2016/10/13
Other Document	Study Material Psychological Assessment Clean	2016/10/13
Other Document	Study Material Physical Data Collection Clean	2016/10/13
Other Document	Study Material Logbooks Clean	2016/10/12
Other Document	Study Material Cognitive Assessment Clean	2016/10/13
Other Document	Study Material Accelerometer Clean	2016/10/13

Other Document	Study Material Behavioural Assessments Clean	2016/10/13
Protocol	Protocol	2016/11/11
Recruitment Materials	Recruitment Script	2016/11/11

This is to notify you that the Children's Hospital of Eastern Ontario Research Ethics Board has granted approval to the above named research study on the date noted above. Your project was reviewed under the delegated review stream, which is reserved for projects that involve no more than minimal risk to human subjects.

Final approval is granted for the above noted study, with the understanding that the investigator agrees to comply with the following requirements:

1. The investigator must conduct the study in compliance with the protocol and any additional conditions set out by the Board.
2. Investigators must submit an annual renewal report to the REB 30 days prior to the expiration date stated above.
3. The investigator must not implement any deviation from, or changes to, the protocol, consents or assents without the approval of the REB.
4. The investigator must, prior to use, submit to the Board changes to the study documentation, e.g., changes to the informed consent letters, recruitment materials.
5. Investigators must provide the Board with French versions of the consent form, unless a waiver has been granted. An interpreter should be offered to participants as required or at the request of the participant throughout the course of research.
6. The investigator must promptly report to the REB all unexpected and untoward occurrences (including the loss or theft of study data and other such privacy breaches).
7. Investigators must notify the REB of any study closures (closed to accrual, temporary, premature or permanent).
8. Investigators must submit a final report at the conclusion of the study.

Should you have any questions or concerns, please do not hesitate to contact the Research Ethics Board Office at 613-737-7600 ext. 3350 or 2128.

*The final approval date for initial delegated study applications approved with or without modifications will be the date the REB has determined that the conditions of approval have been satisfied.

**The expiry date of REB approval for initial study application that required no modifications will be as follows:

- If the date of review and approval was **on or before** the 15th of the month, the expiry date will be the 15th of the month prior to the date of review and approval by the Chair and/or delegate *in the following year*;
- If the date of review and approval was **after** the 15th the expiry date will be the 15th of the month in which the date of review and approval by the REB *in the following year*.

The expiry date of REB approval for initial study applications that **require modifications** will be as follows:

- If the initial feedback was sent **on or before** the 15th of the month, the expiry date will be the 15th of the month prior to the date the letter of REB feedback is issued to the investigator(s) *in the following year*;
- If the initial feedback was sent **after** the 15th the expiry date will be the 15th of the month in which the feedback was sent *in the following year*.

Ottawa Hospital Research Institute
Institut de recherche de l'Hôpital d'Ottawa

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INSTITUT DE CARDIOLOGIE DE L'UNIVERSITÉ D'OTTAWA

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Civic Box 411 725 Parkdale Avenue, Ottawa, Ontario K1Y 4E9 613-798-5555 ext. 14902 Fax : 613-761-4311
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January 25, 2017

Dr. Mylene Bassal
Children's Hospital of Eastern Ontario

Dear Dr. Bassal:

Re: Protocol #	**20160612-01H**	**Exploring the feasibility, safety, and potential benefits of a 12-week home-based physical activity intervention**
Protocol approval valid until -		**January 24, 2018**

I am pleased to inform you that this protocol underwent delegated review by the Ottawa Health Science Network Research Ethics Board (OHSN-REB) and is approved for the recruitment of English speaking participants only. No changes, amendments or addenda may be made to the protocol or the consent form without the OHSN-REB's review and approval.

PLEASE NOTE: THE APPROVAL OF THIS PROTOCOL IS CONDITIONAL UPON A FULLY-SIGNED STUDY CONTRACT/AGREEMENT BETWEEN THE OTTAWA HOSPITAL RESEARCH INSTITUTE, THE PRINCIPAL INVESTIGATOR AND THE SPONSOR (OR AS OTHERWISE REQUIRED). YOU CANNOT START THE STUDY, OR BEGIN TO RECRUIT RESEARCH PARTICIPANTS INTO THE STUDY UNTIL THE STUDY CONTRACT/AGREEMENT HAS BEEN SIGNED BY ALL PARTIES, AND HAS BEEN RECEIVED BY THE OTTAWA HOSPITAL RESEARCH INSTITUTE'S CONTRACTS OFFICE. FOR FURTHER DETAILS, PLEASE CONTACT CONTRACTS ADMINISTRATION AT CONTRACTS@OHRI.CA OR AT 613-798-5555 EXT. 19843.

Approval is also conditional upon receipt of approvals from the Children's Hospital of Eastern Ontario Research Ethics Board, the University of Ottawa Research Ethics Board and the Royal Ottawa Research Ethics Board.

Approval is for the following:
- Protocol dated December 15, 2016
- Physical Assessments Data Collection Form dated October 13, 2016
- Cognitive Assessments dated October 13, 2016
- PARmed-X Form, uploaded October 20, 2016
- English Recruitment Script dated November 11, 2016
- English Accelerometer Instructions dated October 13, 2016
- English Behavioral Assessments dated October 13, 2016
- English Physiological Assessments (undated) uploaded October 20, 2016
- English Socio-Demographic and Medical Assessment (undated) uploaded October 20, 2016
- English Interview Guide dated October 13, 2016
- English Logbooks dated October 13, 2016
- English Participant Informed Consent Form dated January 25, 2017

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Your request for a French exemption is approved; the study may proceed in English only.

The REB no longer requires a 'valid until' date at the bottom of all approved informed consent forms. The consent forms currently approved for use by the REB are listed above.

If the study is to continue beyond the expiry date noted above, a Renewal Form should be submitted to the REB approximately six weeks prior to the current expiry date. If the study has been completed by this date, a Termination Report should be submitted.

The OHSN-REB complies with the membership requirements and operates in compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans; the International Conference on Harmonization - Good Clinical Practice: Consolidated Guideline, and the provisions of the Personal Health Information Protection Act 2004.

Université d'Ottawa University of Ottawa
Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

March 13th, 2017

Mylène Bassal
CHEO

Amanda Wurz, PhD Student
University of Ottawa

Co-Investigators: Lesleigh Abbott, CHEO

Jennifer Brunet, University of Ottawa
Raveena Ramphal, CHEO
Andra Smith, University of Ottawa

Re: U of O Ethics file no. A03-17-06 – "Exploring the feasibility, safety and potential benefits of a 12-week home-based physical activity intervention"

Dear Dr. Bassal, Ms. Wurz, Professor Brunet and colleagues,

Thank you for the protocol documents and Certificates of Approval from the OHSN-REB (# 20160612-01H) and the CHEO REB (# 16/110X) for your project named above.

This is to confirm that, in accordance with the agreement between the University of Ottawa and OHSN-REB and CHEO REB, the University of Ottawa has authorized this board to act as Board of Record for the review and oversight of research involving human subjects conducted at or through the hospital.

We remind you of your obligation to:
- Follow all procedures of the OHSN and CHEO REB including reporting and renewal procedures;
- Submit to the authority of the OHSN and CHEO REB and that you are subject to OHSN and CHEO REB requirements, including, without limitation, the requirement to modify or stop the research on demand of the OHSN and CHEO REB.

If you have any questions, please contact our ethics office at 562-5387.

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http://www.research.uottawa.ca/ethics/

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RESEARCH ETHICS BOARD

May 30, 2017

Amanda Wurz. MSc (PhD candidate)
Principal Investigator

Re: REB# 2017013
Exploring the Feasibility, Safety and Potential Benefits of a 12-week Home-Based Physical Intervention.

Dear Ms. Wurz,

This letter is to acknowledge receipt via e-mail of your letter (dated May 10, 2017) which included the School of Psychology Brain Imaging Utilization Committee's approval letter and protocol item commentaries in response to points expressed to you in our letter (dated April 26, 2017) for the above-titled protocol.

Further elaborated responses to our questions have been reviewed and **your protocol has now received approval for the period of one (1) year from the date of this letter.**

This approval is contingent upon maintaining adherence to the normal approval process, namely,

- Reporting to the Board any adverse events of the project in progress
- Seeking prior approval from the Board of any direct use of public media to recruit research participants

Approval will be reconsidered if Hospital/Institute resources are used beyond those specified on the Checklist of Resources and/or if Grant funding applied for is not received. However, in either case the protocol can be re-submitted with revised Checklist and funding information and will be reconsidered.

Annual progress reports must be submitted to the Board for continuation of Research Ethics approval. Failure to provide annual reports by the due date specified will result in suspension of participant recruitment and ongoing operation of the study. A *termination report* is required at the conclusion of the study.

Appendix B: Questionnaires and Assessment Tools Used

Study One (Chapter Two)

Questionnaires

Socio-Demographic and Medical Information

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

1. Age (years): _____

2. Date of birth (day/month/year): _____

3. Sex:
☐ Male
☐ Female
☐ You do not have an option that applies to me. I identify as (please specify): _____

4. Civil status (i.e., relationship status):
☐ Never married ☐ Married ☐ Common law ☐ Dating
☐ Widowed ☐ Divorced ☐ Separated ☐ In a relationship

5. Education (please check highest level attained):
☐ Some high school ☐ Completed high school
☐ Some university/college ☐ Completed university/college
☐ Some graduate school (e.g., master's degree, PhD) ☐ Completed graduate school (e.g., master's degree, PhD)

6. Annual household income in dollars:

☐ < 20,000 ☐ 20-39,999 ☐ 40-59,999 ☐ Do not know
☐ 60-79,999 ☐ 80-99,999 ☐ >100,000

7. Employment status (please select all those that apply):

☐ Student ☐ Disability ☐ Other (please specify):
☐ Full-time work ☐ Homemaker _____
☐ Part-time work ☐ Unemployed _____

8. Has a doctor or nurse ever told you that you have the following?

a.	Angina	☐ Yes	☐ No
b.	Heart attack	☐ Yes	☐ No
c.	Stroke	☐ Yes	☐ No
d.	Diabetes	☐ Yes	☐ No
e.	High blood pressure	☐ Yes	☐ No
f.	High blood cholesterol	☐ Yes	☐ No

9. Has a doctor or nurse ever told you that you have any other health condition(s) that were not listed above?
☐ Yes, I have been told I have (please specify):_____
☐ No

10. People living in Canada come from many different cultural and racial backgrounds. Which of the following best describes your background?

☐ Aboriginal (Inuit, Metis, North American Indian)
☐ Korean
☐ Japanese
☐ Chinese (e.g., Chinese, Taiwanese)
☐ South Asian (e.g., Bangladeshi, Punjabi, Sri Lankan)
☐ South East Asian (e.g., Vietnamese, Cambodian, Malaysian, Laotian)
☐ West Asian (e.g., Afghan, Assyrian, Iranian)
☐ Arab (e.g., Egyptian, Kuwaiti, Libyan)
☐ Black (e.g., African, Nigerian, Somali)
☐ Latin American (e.g., Chilean, Costa Rican, Mexican)
☐ Filipino
☐ White (Caucasian)
☐ Other visible minority not included above (please specify): _____
☐ Multiple visible minorities (please specify): _____

11. What was the date of your cancer diagnosis (month/year)? _____

12. What type of cancer were you diagnosed with (please select those that apply)?

☐ Leukemia (please specify type; e.g., acute lymphoblastic leukemia, chronic myeloid leukemia): _____ _____
☐ Germ cell tumour (please specify type and location): _____ _____
☐ Lymphoma (please specify type; e.g., Burkitt's lymphoma, Hodgkin's lymphoma): _____ _____
☐ Breast cancer (please specify type): _____ _____
☐ Soft tissue sarcoma (please specify type and location): _____ _____
☐ Melanoma (please specify type and location): _____ _____
☐ Osteosarcoma (please specify type and location): _____ _____
☐ Other cancer not listed (please specify; e.g., cervical cancer, colon cancer): _____ _____

13. What stage of cancer were you diagnosed with?

☐ Stage 0
☐ Stage I
☐ Stage II
☐ Stage III
☐ Stage IV
☐ Do not know
☐ Not applicable, staging does not apply to my cancer

14. When did you complete active treatment (month/year)? _____ ☐ Do not remember

15. Are you still receiving treatment (e.g., hormonal therapy)? ☐ Yes ☐ No
If you are still receiving treatment, please specify: _____

16. Please indicate which medical treatments you received for cancer and the date (month/year) of the last treatment, if applicable.

a. Surgery ☐ Yes ☐ No
If you received surgery, please indicate the date of your last surgery.
Date (month/year): _____
☐ Do not remember

b. Chemotherapy ☐ Yes ☐ No
If you received chemotherapy, please indicate the date of your last chemotherapy treatment.
Date (month/year): _____
☐ Do not remember

c. Radiotherapy ☐ Yes ☐ No
If you received radiotherapy, please indicate the date of your last radiotherapy treatment.
Date (month/year): _____
☐ Do not remember

d. Hormonal therapy ☐ Yes ☐ No
If you received hormonal therapy (or are still receiving hormonal therapy), please indicate the date of your last hormonal therapy treatment.
Date: _____
☐ Do not remember

e. Other treatment ☐ Yes, I also received (please specify): _____ ☐ No
If you received "other treatment please indicate the date of your last "other" treatment.
Date: _____
☐ Do not remember

17. Are you currently on any medications?
☐ Yes, I am on (please specify): _____
☐ No

Self-Reported Physical Activity

1. Considering a 7-day period (a week), how many times on the average do you do the following kind of exercise for more than 10 minutes during your free time (enter your number in space provided)?

Type of activity	**Times per week**	**Average number minutes per session**
Strenuous exercise (heart beats rapidly) This includes things like: running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling.		
Moderate exercise (not exhausting) This includes things like: fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing.		
Mild exercise (minimal effort) This includes things like: yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking.		

2. During a typical 7-day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)? Check only one answer.

☐ Often ☐ Sometimes ☐ Never/rarely

3. What is the most common physical activity you do? If there is more than one, please list them too.

_____

_____

4. Add up all of the time you spend in physical activity each day. Over the past 7 days, on how many days were you physically active to the point where you were out of breath and were sweating for a total of at least 30 minutes per day?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

5. Over a typical or usual week, on how many days are you physically active to the point where you are out of breath and are sweating for a total of at least 30 minutes per day?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

Body Composition

1. Please list your current height: _____(feet)_____ (inches)

2. Please list your current weight: _____ (pounds)

Self-Efficacy

Assuming you are planning on beginning, or are already engaging in physical activity regularly, the item below is designed to assess your beliefs in your ability to begin or continue engaging in physical activity for 150 minutes per week at moderate to vigorous intensities for the next 12 weeks.

Moderate to vigorous activities include a moderate to large amount of effort and noticeably increase your heart rate and breathing.

> **Moderate activities include things like**: fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing.
>
> **Vigorous intensity activities include things like**: running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling.

Using the scale, please indicate how confident you are that you will be able to begin or continue engaging in physical activity for 150 minutes per week at moderate to vigorous intensity for the next 12 weeks.

For example, if you have complete confidence that you could begin or continue engaging in 150 minutes per week at moderate to vigorous intensities for the next 12 weeks without quitting, you would choose 100%. However, if you had no confidence at all that you could continue engaging in physical activity for the next 12 weeks without quitting (that is, confident you would not begin or continue engaging in physical activity), you would choose 0%.

Please remember to answer honestly and accurately. There are no right or wrong answers.
Mark your answer by choosing a %:

1. I am able to begin, or continue engaging, in physical activity for 150 minutes per week at moderate to vigorous intensities without quitting for the NEXT 12 WEEKS.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Not confident **Moderately confident** **Highly confident**

Physical Competence and Physical Self-Esteem

When you are ready to begin, please read each sentence and decide your answer. There are six possible answers for each question – "true", "false", and four answers in between.

There are six numbers for each sentence, one for each of the answers.

Before you start there are three examples below. I have provided you with what I would select as my answer for two of the three sentences to show you how to do it.

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
1. I like to read comic books.	1	2	3	4	5	(6)

I would select the number 6 under the answer "true". This means that I like to read comic books. If I did not like to read comic books very much, I would have answered 1 "false" or 2 "mostly false".

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
2. In general, I am neat and tidy.	1	2	(3)	4	5	6

I would select 3, "more false than true" because I am definitely not very neat, but I am not really messy either.

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
3. I like to watch TV.	1	2	3	4	5	6

For this sentence you have to choose that answer that is best for you. First you must decide if the sentence is "true" or "false" for you, or somewhere in between. If you really like to watch TV a lot you would answer "true" by selecting the number 6. If you hate watching TV, you would answer "false" by selecting the first number 1. If you do not like TV very much, but you watch it sometimes, you might decide to select 2 "most false" or 3 "more false than true".

	False	Mostly false	More false than true	More true than false	Mostly true	True
1. I am too fat.	1	2	3	4	5	6
2. I am satisfied with the kind of person I am physically.	1	2	3	4	5	6
3. I am attractive for my age.	1	2	3	4	5	6
4. I am a physically strong person.	1	2	3	4	5	6
5. I can run a long way without stopping.	1	2	3	4	5	6
6. My waist is too large.	1	2	3	4	5	6
7. Physically, I am happy with myself.	1	2	3	4	5	6
8. I have a nice looking face.	1	2	3	4	5	6
9. I have a lot of power in my body.	1	2	3	4	5	6
10. I would do well in a test of physical endurance and stamina.	1	2	3	4	5	6
11. I have too much fat on my body.	1	2	3	4	5	6
12. I feel good about the way I look and what I can do physically.	1	2	3	4	5	6
13. I'm better looking than most of my friends.	1	2	3	4	5	6
14. I am stronger than most people my age.	1	2	3	4	5	6
15. I could jog 5 kilometers without stopping.	1	2	3	4	5	6
16. I am overweight.	1	2	3	4	5	6

	False	Mostly false	More false than true	More true than false	Mostly true	True
17. Physically I feel good about myself.	1	2	3	4	5	6
18. I am ugly.	1	2	3	4	5	6
19. I am weak and have no muscles.	1	2	3	4	5	6
20. I think I could run a long way without getting tired.	1	2	3	4	5	6
21. My stomach is too big.	1	2	3	4	5	6
22. I feel good about who I am and what I can do physically.	1	2	3	4	5	6
23. I am good looking.	1	2	3	4	5	6
24. I would do well in a test of strength.	1	2	3	4	5	6
25. I can be physically active for a long period of time without getting tired.	1	2	3	4	5	6
26. Other people think that I am fat.	1	2	3	4	5	6
27. I feel really good about who I am physically.	1	2	3	4	5	6
28. Nobody thinks I am good looking.	1	2	3	4	5	6
29. I am good at lifting heavy objects.	1	2	3	4	5	6
30. I am good at endurance activities like distance running, aerobics, bicycling, swimming, or cross-country skiing.	1	2	3	4	5	6

Global Self-Esteem

Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement by selecting the appropriate column.

	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
1. On the whole I am satisfied with myself.	4	3	2	1
2. At times I think I am no good.	4	3	2	1
3. I feel that I have a number of good qualities.	4	3	2	1
4. I am able to do things as well as most other people.	4	3	2	1
5. I feel I do not have much to be proud of.	4	3	2	1
6. I certainly feel useless at times.	4	3	2	1
7. I feel that I'm a person of worth, at least on an equal plane with others.	4	3	2	1
8. I wish I could have more respect for myself.	4	3	2	1
9. All in all, I am inclined to feel that I am a failure.	4	3	2	1
10. I take a positive attitude toward myself.	4	3	2	1

Thank you for taking time to complete this questionnaire for us!

Cognitive Interview Guide

For each question the following probes were used as applicable.

1. What does this question mean to you?

2. How did you arrive at your answer?
    - What did you think about when you were answering this question?

3. How did you remember that?

4. How did you document your response?

For example, when probing participants about their response to the Physical Activity Questionnaire, which asks: *Considering a 7-day period (a week), how many times on the average do you do the following kind of exercise for more than 10 minutes during your free time (enter your number in space provided)?*

Participants were asked:

1. What does this question mean to you?
    - Can you describe how you interpreted the question?
    - Can you rephrase this question in your own words?

2. How did you arrive at your answer?
    - What did you think about when you were answering this question?
    - What sorts of physical activities did you think about?

3. How did you remember that?
    - Did you have any difficultly remembering?
        - If so, how did you overcome that?

4. Did you have any difficult documenting your question in the space provided to respond?

Study Two (Chapter Three)

Questionnaires

Socio-Demographic and Medical Information

The following questions are going to ask you about yourself. This part of the questionnaire is needed to help understand the characteristics of the people participating in the study. For this reason, it is very important information.

1. Age (years): _____

2. Date of birth (month/day/year): _____

3. Sex:
☐ Male
☐ Female
☐ You do not have an option that applies to me. I identify as (please specify): _____

4. Civil status (i.e., relationship status):
☐ Single ☐ Married ☐ Common law ☐ Dating/in a relationship
☐ Widowed ☐ Divorced ☐ Separated

5. Education (please check highest level attained):
☐ Some high school ☐ Completed high school
☐ Some university/college ☐ Completed university/college
☐ Some graduate school (e.g., master's degree, PhD) ☐ Completed graduate school (e.g., master's degree, PhD)

6. Annual **household** income in dollars:
☐ < 20,000 ☐ 20-39,999 ☐ 40-59,999 ☐ Do not know
☐ 60-79,999 ☐ 80-99,999 ☐ >100,000

7. Employment status (please select all those that apply):
☐ Student ☐ Disability ☐ Other (please specify):
☐ Full-time work ☐ Homemaker _____
☐ Part-time work ☐ Unemployed _____

8. Has a doctor or nurse ever told you that you have the following?

a.	Angina	☐ Yes	☐ No
b.	Heart attack	☐ Yes	☐ No
c.	Stroke	☐ Yes	☐ No
d.	Diabetes	☐ Yes	☐ No
e.	High blood pressure	☐ Yes	☐ No
f.	High blood cholesterol	☐ Yes	☐ No

9. Has a doctor or nurse ever told you that you have any other health condition(s) that were not listed above?
☐ Yes, I have been told I have (please specify):_____
☐ No

10. People living in Canada come from many different cultural and racial backgrounds. Which of the following best describes your background?

☐ Aboriginal (Inuit, Metis, North American Indian)
☐ Korean
☐ Japanese
☐ Chinese (e.g., Chinese, Taiwanese)
☐ South Asian (e.g., Bangladeshi, Punjabi, Sri Lankan)
☐ South East Asian (e.g., Vietnamese, Cambodian, Malaysian, Laotian)
☐ West Asian (e.g., Afghan, Assyrian, Iranian)
☐ Arab (e.g., Egyptian, Kuwaiti, Libyan)
☐ Black (e.g., African, Nigerian, Somali)
☐ Latin American (e.g., Chilean, Costa Rican, Mexican)
☐ Filipino
☐ White (Caucasian)
☐ Other visible minority not included above (please specify): _____
☐ Multiple visible minorities (please specify): _____

11. What was the date of your cancer diagnosis (month/year)? _____

12. What type of cancer were you diagnosed with (please select those that apply)?

☐ Leukemia (please specify type; e.g., acute lymphoblastic leukemia, chronic myeloid leukemia): _____
☐ Germ cell tumour (please specify type and location): _____
☐ Lymphoma (please specify type; e.g., Burkitt's lymphoma, Hodgkin's lymphoma, Non-Hodgkin's Lymphoma): _____
☐ Breast cancer (please specify type): _____
☐ Soft tissue sarcoma (please specify type and location): _____
☐ Melanoma (please specify type and location): _____
☐ Osteosarcoma (please specify type and location): _____
☐ Other cancer not listed (please specify; e.g., cervical cancer, colon cancer): _____

13. What stage of cancer were you diagnosed with?

☐ Stage 0
☐ Stage I
☐ Stage II
☐ Stage III
☐ Stage IV
☐ Do not know
☐ Not applicable, staging does not apply to my cancer

14. When did you complete **active treatment** (i.e., chemotherapy, radiation, surgery, immunotherapy)?
Month: _____
Year: _____
☐ Do not remember

15. Are you currently receiving any ongoing treatment (e.g., hormonal therapy)? ☐ Yes ☐ No
If yes, please specify: _____

16. Please indicate which medical treatments you received for cancer and the date (month/year) of the last treatment, if applicable.

a. Surgery ☐ Yes ☐ No
If you received surgery, please indicate the date of your last surgery.
Date (month/year): _____
☐ Do not remember

b. Chemotherapy ☐ Yes ☐ No
If you received chemotherapy, please indicate the date of your last chemotherapy treatment.
Date (month/year): _____
☐ Do not remember

c. Radiotherapy ☐ Yes ☐ No
If you received radiotherapy, please indicate the date of your last radiotherapy treatment.
Date (month/year): _____
☐ Do not remember

d. Hormonal therapy ☐ Yes ☐ No
If you received hormonal therapy (or are still receiving hormonal therapy), please indicate the date of your last hormonal therapy treatment.
Date: _____
☐ Do not remember

e. Other treatment ☐ Yes, I also received (please specify): _____ ☐ No
If you received "other treatment please indicate the date of your last "other" treatment.
Date: _____
☐ Do not remember

17. Are you currently on any medications?
☐ Yes, I am on (please specify): _____
☐ No

Self-Reported Physical Activity

In this part of the questionnaire we are interested in knowing how much physical activity you do during your **leisure-time** (this does not include your time at work). Please answer as honestly as possible.

1. Considering a typical **7-day period** (a week), how many times on the average do you do the following kind of exercise for more than **10 minutes** during your free time? Please enter your number in space provided, along with the average number of minutes per sessions, and the types of activities you do.

   Please see an example below if you are unsure about how to answer:

	Times per week	Average number **minutes** per session	Type of activity
Vigorous activities Include activities that require a large amount of effort and noticeably increase your heart rate and breathing and are exhausting (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)	1	20	Fast biking
Moderate activities Include activities that require a moderate amount of effort and noticeably increase your heart rate and breathing but that are not exhausting (e.g., fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	2	30	Elliptical machine
Mild activities Include activities that do not require much effort (e.g., gentle yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking)	4	10	Walking to work

	Times per week	Average number **minutes** per session	List activities
Vigorous activities Include activities that require a large amount of effort and noticeably increase your heart rate and breathing and are exhausting (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)			
Moderate activities Include activities that require a moderate amount of effort and noticeably increase your heart rate and breathing but that are not exhausting (e.g., fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)			
Mild activities Include activities that do not require much effort (e.g., gentle yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking)			

2. During a typical **7-day period** (a week), in your leisure time, how often do you engage in any regular activity long enough to noticeably increase your heart rate and breathing? Check only one answer.

☐ Often ☐ Sometimes ☐ Never/rarely

Body Composition

In this part of the questionnaire we are interested in knowing about your body weight and height.

1. Please list your current height:
   Feet:_____
   Inches:_____
   OR
   Centimeters: :_____

2. Please list your current weight:
   Pounds:_____
   OR
   Kilograms: :_____

Self-Efficacy

In this part of the questionnaire we are interested in knowing how confident you are to be active assuming you are planning on beginning, or are already engaging in physical activity regularly. We want you to take into account things like your physical ability, the time you have to be active, etc. Please remember to answer honestly and accurately. There are no right or wrong answers.

Using the scale, please indicate how confident you are that you will be able to begin or continue engaging in physical activity for **150 minutes per week** at **moderate to vigorous intensities** for the **next 12 weeks**.

Moderate to vigorous activities include a moderate to large amount of effort and noticeably increase your heart rate and breathing.

> **Moderate activities** include things like: fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing.
>
> **Vigorous intensity** activities include things like: running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling.

1. I am able to begin, or continue engaging, in physical activity for **150 minutes per week** at **moderate to vigorous intensities** without quitting for the **next 12 weeks**.

Please select your answer by choosing a %:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Not confident **Moderately confident** **Highly confident**

Physical Competence and Physical Self-Esteem

In this part of the questionnaire we are interested in knowing how you look at yourself. We will ask you some questions about how you think about yourself physically. For example, how good looking you are, how strong you are, etc. Some of the questions may sound similar, but we need you to answer each of them. There are no right answers and everyone will have different answers. Be sure that your answers show how you feel about yourself.

Answer each sentence quickly **as you feel now**. Please do not leave any sentence blank. When you are ready to begin, please read each sentence and decide your answer. There are six possible answers for each question – "True", "False", and four answers in between.

Before you start there are some examples below, in case you are unsure of how to answer.

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
1. I am a creative person	1	2	3	4	(5)	6

The "5" has been selected because the person answering believes the statement "I am a creative person" is mostly true. That is, this statement is mostly like him/her.

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
2. I am good at writing poetry.	1	(2)	3	4	5	6

The "2" has been selected because the person answering believes that the statement is mostly false as far as he/she is concerned. That is, he/she feels he/she does not write good poetry.

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
3. I enjoy playing with pets.	1	2	3	4	5	(6)

The "6" has been selected because the person answering believes that the statement is very true about him/her.

	False	Mostly false	More false than true	More true than false	Mostly true	True
1. I am a physically strong person.	1	2	3	4	5	6
2. I can run a long way without stopping.	1	2	3	4	5	6
3. My waist is too large.	1	2	3	4	5	6
4. Physically, I am happy with myself.	1	2	3	4	5	6
5. I have a nice looking face.	1	2	3	4	5	6
6. I have a lot of power in my body.	1	2	3	4	5	6
7. I have too much fat on my body.	1	2	3	4	5	6
8. I am better looking than most of my friends.	1	2	3	4	5	6
9. I am overweight.	1	2	3	4	5	6
10. Physically I feel good about myself.	1	2	3	4	5	6
11. I am good looking.	1	2	3	4	5	6
12. I could do well in a test of strength.	1	2	3	4	5	6
13. I can be physically active for a long period of time without getting tired.	1	2	3	4	5	6
14. I feel good about who I am physically.	1	2	3	4	5	6
15. I am good at endurance activities like distance running, aerobics, bicycling, swimming, or cross-country skiing.	1	2	3	4	5	6

Global Self-Esteem

In this part of the questionnaire we are interested in knowing how about you feel about yourself overall. We want you to think about all aspects of your life when answering, not just about your cancer experience. Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement by selecting the appropriate column.

	Strongly disagree	**Disagree**	**Agree**	**Strongly agree**
1. On the whole I am satisfied with myself.	1	2	3	4
2. At times I think I am no good.	1	2	3	4
3. I feel that I have a number of good qualities.	1	2	3	4
4. I am able to do things as well as most other people.	1	2	3	4
5. I feel I do not have much to be proud of.	1	2	3	4
6. I certainly feel useless at times.	1	2	3	4
7. I feel that I'm a person of worth, at least on an equal plane with others.	1	2	3	4
8. I wish I could have more respect for myself.	1	2	3	4
9. All in all, I am inclined to feel that I am a failure.	1	2	3	4
10. I take a positive attitude toward myself.	1	2	3	4

Thank you for taking time to complete this questionnaire for us!

Study Three (Chapter Four)

Questionnaires

Socio-Demographic and Medical Information

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

1. Age (years): _____

2. Date of birth (day/month/year): _____

3. Sex:
☐ Male
☐ Female
☐ You do not have an option that applies to me. I identify as (please specify): _____

4. Civil status (i.e., relationship status):
☐ Single ☐ Married ☐ Common law ☐ Dating ☐ Prefer not to answer
☐ Widowed ☐ Divorced ☐ Separated ☐ In a relationship

5. Education (please check highest level attained):
☐ Some high school
☐ Some university/college
☐ Some graduate school (e.g., master's degree, PhD)
☐ Prefer not to answer
☐ Completed high school
☐ Completed university/college
☐ Completed graduate school (e.g., master's degree, PhD)

6. Annual **household** income in dollars, this includes the combined income of the people you live with (e.g., parents, partner) in addition to your own:
☐ < 20,000 ☐ 20-39,999 ☐ 40-59,999 ☐ Do not know
☐ 60-79,999 ☐ 80-99,999 ☐ >100,000 ☐ Prefer not to answer

7. Do you currently live alone?
☐ Yes, **go to question 9**
☐ No, **go to question 8**

8. Do you live with your…? **Please select all those that apply.**

	Yes	
Biological mother	☐	
Biological father	☐	
Step-mother	☐	
Step-father	☐	
Sister(s), step-sister(s), half sister(s)	☐	If yes, how many?
Brother(s), step-brother(s), half brother(s)	☐	If yes, how many?
Husband, wife	☐	
Partner (girlfriend, boyfriend)	☐	
Son(s), step-son(s)	☐	If yes, how many?
Daughter(s), step-daughter(s)	☐	If yes, how many?
Roomate(s)	☐	If yes, how many?
Other (specify)	☐	If yes, how many?

9. Employment status, **please select all those that apply**:

☐ Student	☐ Disability	☐ Other (please specify):
☐ Full-time work	☐ Homemaker	_____
☐ Part-time work	☐ Unemployed	_____

10. Has a doctor or nurse ever told you that you have the following?

a.	Angina	☐ Yes	☐ No
b.	Heart attack	☐ Yes	☐ No
c.	Stroke	☐ Yes	☐ No
d.	Diabetes	☐ Yes	☐ No
e.	High blood pressure	☐ Yes	☐ No
f.	High blood cholesterol	☐ Yes	☐ No

11. Has a doctor or nurse ever told you that you have a mental or physical health condition, other than cancer, that was not listed above?

☐ Yes, I have been told I have (please specify):_____

☐ No

12. What was the date of your cancer diagnosis (month/year)? _____

13. What type of cancer were you diagnosed with (please select those that apply)?

☐ Leukemia (please specify type; e.g., acute lymphoblastic leukemia, chronic myeloid leukemia):
_____
_____

☐ Germ cell tumour (please specify type and location):
_____
_____

☐ Lymphoma (please specify type; e.g., Burkitt's lymphoma, Hodgkin's lymphoma, Non-Hodgkin's Lymphoma):
_____
_____

☐ Breast cancer (please specify type):
_____
_____

☐ Soft tissue sarcoma (please specify type and location):
_____
_____

☐ Melanoma (please specify type and location):
_____
_____

☐ Osteosarcoma (please specify type and location):
_____
_____

☐ Other cancer not listed (please specify; e.g., cervical cancer, colon cancer):
_____
_____

14. What stage of cancer were you diagnosed with?

☐ Stage 0
☐ Stage I
☐ Stage II
☐ Stage III
☐ Stage IV
☐ Do not know
☐ Not applicable, staging does not apply to my cancer

15. When did you complete **active treatment** (i.e., chemotherapy, radiation, surgery, immunotherapy)?
Month: _____
Year: _____
☐ Do not remember

16. Are you currently receiving any ongoing treatment (e.g., hormonal treatment)? ☐ Yes ☐ No
If yes, please specify: _____

17. Please indicate which medical treatments you received for cancer and the date (month/year) of the last treatment, if applicable.

a. Surgery ☐ Yes ☐ No
If you received surgery, please indicate the date of your last surgery.
Date (month/year): _____
☐ Do not remember

b. Chemotherapy ☐ Yes ☐ No
If you received chemotherapy, please indicate the date of your last chemotherapy treatment.
Date (month/year): _____
☐ Do not remember

c. Radiotherapy ☐ Yes ☐ No
If you received radiotherapy, please indicate the date of your last radiotherapy treatment.
Date (month/year): _____
☐ Do not remember

d. Hormonal therapy ☐ Yes ☐ No
If you received hormonal therapy (or are still receiving hormonal therapy), please indicate the date of your last hormonal therapy treatment.
Date: _____
☐ Do not remember

e. Other treatment ☐ Yes, I also received (please specify): _____ ☐ No
If you received "other treatment please indicate the date of your last "other" treatment.
Date: _____
☐ Do not remember

18. Are you currently on any medications?
☐ Yes, I am on (please specify): _____
☐ No

Self-Reported Physical Activity

In this part of the questionnaire we are interested in knowing how much physical activity you do during your **leisure-time** (this does not include your time at work). Please answer as honestly as possible.

1. Considering a typical **7-day period** (a week), how many times on the average do you do the following kind of exercise for more than **10 minutes** during your free time? Please enter your number in space provided, along with the average number of minutes per sessions, and the types of activities you do.

   Please see an example below if you are unsure about how to answer:

	Times per week	Average number **minutes** per session	Type of activity
Vigorous activities Include activities that require a large amount of effort and noticeably increase your heart rate and breathing and are exhausting (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)	1	20	Fast biking
Moderate activities Include activities that require a moderate amount of effort and noticeably increase your heart rate and breathing but that are not exhausting (e.g., fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	2	30	Elliptical machine
Mild activities Include activities that do not require much effort (e.g., gentle yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking)	4	10	Walking to work

	Times per week	Average number **minutes** per session	List activities
Vigorous activities Include activities that require a large amount of effort and noticeably increase your heart rate and breathing and are exhausting (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)			
Moderate activities Include activities that require a moderate amount of effort and noticeably increase your heart rate and breathing but that are not exhausting (e.g., fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)			
Mild activities Include activities that do not require much effort (e.g., gentle yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking)			

2. During a typical **7-day period** (a week), in your leisure time, how often do you engage in any regular activity long enough to noticeably increase your heart rate and breathing? Check only one answer.

☐ Often ☐ Sometimes ☐ Never/rarely

Body Composition

In this part of the questionnaire we are interested in knowing about your body weight and height.

1. Please list your current height:
   Feet:_____
   Inches:_____
   OR
   Centimeters: :_____

2. Please list your current weight:
   Pounds:_____
   OR
   Kilograms: :_____

Self-Efficacy

In this part of the questionnaire we are interested in knowing how confident you are to be active assuming you are planning on beginning, or are already engaging in physical activity regularly. We want you to take into account things like your physical ability, the time you have to be active, etc. Please remember to answer honestly and accurately. There are no right or wrong answers.

Using the scale, please indicate how confident you are that you will be able to begin or continue engaging in physical activity for **150 minutes per week** at **moderate to vigorous intensities** for the **next 12 weeks**.

Moderate to vigorous activities include a moderate to large amount of effort and noticeably increase your heart rate and breathing.

> **Moderate activities** include things like: fast walking, basketball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing.
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1. I am able to begin, or continue engaging, in physical activity for **150 minutes per week** at **moderate to vigorous intensities** without quitting for the **next 12 weeks**.

Please select your answer by choosing a %:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Not confident **Moderately confident** **Highly confident**

Physical Competence and Physical Self-Esteem

In this part of the questionnaire we are interested in knowing how you look at yourself. We will ask you some questions about how you think about yourself physically. For example, how good looking you are, how strong you are, etc. Some of the questions may sound similar, but we need you to answer each of them. There are no right answers and everyone will have different answers. Be sure that your answers show how you feel about yourself.

Answer each sentence quickly **as you feel now**. Please do not leave any sentence blank. When you are ready to begin, please read each sentence and decide your answer. There are six possible answers for each question – "True", "False", and four answers in between.

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	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
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The "5" has been selected because the person answering believes the statement "I am a creative person" is mostly true. That is, this statement is mostly like him/her.

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
2. I am good at writing poetry.	1	(2)	3	4	5	6

The "2" has been selected because the person answering believes that the statement is mostly false as far as he/she is concerned. That is, he/she feels he/she does not write good poetry.

	False	**Mostly false**	**More false than true**	**More true than false**	**Mostly true**	**True**
3. I enjoy playing with pets.	1	2	3	4	5	(6)

The "6" has been selected because the person answering believes that the statement is very true about him/her.

	False	Mostly false	More false than true	More true than false	Mostly true	True
1. I am a physically strong person.	1	2	3	4	5	6
2. I can run a long way without stopping.	1	2	3	4	5	6
3. My waist is too large.	1	2	3	4	5	6
4. Physically, I am happy with myself.	1	2	3	4	5	6
5. I have a nice looking face.	1	2	3	4	5	6
6. I have a lot of power in my body.	1	2	3	4	5	6
7. I have too much fat on my body.	1	2	3	4	5	6
8. I am better looking than most of my friends.	1	2	3	4	5	6
9. I am overweight.	1	2	3	4	5	6
10. Physically I feel good about myself.	1	2	3	4	5	6
11. I am good looking.	1	2	3	4	5	6
12. I could do well in a test of strength.	1	2	3	4	5	6
13. I can be physically active for a long period of time without getting tired.	1	2	3	4	5	6
14. I feel good about who I am physically.	1	2	3	4	5	6
15. I am good at endurance activities like distance running, aerobics, bicycling, swimming, or cross-country skiing.	1	2	3	4	5	6

Global Self-Esteem

In this part of the questionnaire we are interested in knowing how about you feel about yourself overall. We want you to think about all aspects of your life when answering, not just about your cancer experience. Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement by selecting the appropriate column.

	Strongly disagree	**Disagree**	**Agree**	**Strongly agree**
1. On the whole I am satisfied with myself.	1	2	3	4
2. At times I think I am no good.	1	2	3	4
3. I feel that I have a number of good qualities.	1	2	3	4
4. I am able to do things as well as most other people.	1	2	3	4
5. I feel I do not have much to be proud of.	1	2	3	4
6. I certainly feel useless at times.	1	2	3	4
7. I feel that I'm a person of worth, at least on an equal plane with others.	1	2	3	4
8. I wish I could have more respect for myself.	1	2	3	4
9. All in all, I am inclined to feel that I am a failure.	1	2	3	4
10. I take a positive attitude toward myself.	1	2	3	4

Thank you for taking time to complete this questionnaire for us!

Physical Tests

Data Collection Form

Resting blood pressure
Trial 1: _____ syst. /_____ dias. mmHg
Trial 2: _____ syst. /_____ dias. mmHg

Blood pressure within normal range? _____

Height: _____ cm =_____ m = _____ /_____ft/inch
Measured to the nearest 0.5cm

Body mass index: _____

30-second sit to stand test: _____

Grip strength using handheld dynamometer
Trial 1: Right hand: _____ kg Left hand: _____ kg
Measured to nearest kg
Trial 2: Right hand: _____ kg Left hand: _____ kg
Measured to nearest kg

6-minute walk test
Rating of perceived exertion (pre): _____
Distance measured: _____ ft
Total times walked: _____
*Total distance walked in 6 minutes: _____ /_____ft/inch = _____m
Measured to the nearest 0.5m
Heart rate (immediate post): _____ bpm
Rating of perceived exertion (post): _____
Heart rate (1-minute post 3-minute cool-down): _____ bpm
Heart rate (5-minute post 3-minute cool-down): _____ bpm

Accelerometer Instructions

What is an accelerometer? The accelerometer is a small device that records how often and how fast you move. When worn on your body, the accelerometer records all of your physical activity. When you are wearing the device, please perform your usual activities.

When do you have to wear the accelerometer? We ask that you wear the accelerometer everyday for **7 days** for at least **10 hours/day**.

What do you need to do each day?

- Put on the accelerometer right after you get out of bed in the morning and record this time in the accelerometer log.
    - You will place a belt, with the accelerometer attached, around your waist. The accelerometer should always be worn on the right side of the body. The belt and accelerometer should be worn as close to the body as possible. The accelerometer can be worn over or under clothing.
- Wear the accelerometer throughout the day during all usual activities.
    - If there are any times of the day that you do not wear the accelerometer between getting up and going to bed at night, please describe this in the accelerometer log.
- Take off the accelerometer before you go to bed at night and record this time in the accelerometer log.

Example Accelerometer Log

	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
What time did you get up this morning?	9:00am	7:00am	9:00am	7:00am	7:00am	7:00am	9:00am
What time did you put on the accelerometer?	9:15am	7: 15am	9: 15am	7: 15am	7: 15am	7: 15am	9: 15am
What time did you take off the accelerometer this evening?	10:15pm	9:30pm	10:15pm	9:00pm	9:30pm	9:30pm	10:45pm
What time did you go to bed this evening?	10:30pm	10:00pm	10:45pm	9:15pm	10:00pm	10:00pm	11:00pm
Did you perform any **physical activities** without the accelerometer? If yes, for how long	Yes I went for a 30 minute swim	No	No	No	No	No	No
Did you perform any **activities of daily living** without the accelerometer? If yes, for how long?	No	No	Yes I took a shower for 20 minutes		Yes I took a shower for 15 minutes		Yes I took a shower for 20 minutes

Accelerometer Logbook

	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
What time did you get up this morning?							
What time did you put on the accelerometer?							
What time did you take off the accelerometer this evening?							
What time did you go to bed this evening?							
Did you perform any **physical activities** without the accelerometer? If yes, for how long							
Did you perform any **activities of daily living** without the accelerometer? If yes, for how long?							

Interview Guide

1. Can you tell me a bit about your current level of physical activity?
   - What do you think physical activity is?
   - What do you do in a typical week?

2. How confident are you that you can be physically active?
   - Why do you say that?
     - What do you think will make it easy/hard?
     - What barriers do you see in your way to being physically active?

3. Can you describe to me how you feel about your body?
   - How do you feel about your muscles? The way they look? The size?
   - How do you feel about your body fat? The way you look? Your size?

4. Can you describe to me how you feel about your ability to engage in aerobic activities (this includes things like walking, rowing, and jogging)?
   - Can you expand on what you think makes you feel this way?

5. Can you describe to me how you feel about your ability to engage in strength activities?
   - This includes things like lifting weights and using your body weight.

6. When you think of your physical health, what do you think about?
   - What are the most important aspects of your physical health?
   - Why do you say those things?
   - Can you describe how you feel about yourself in that/those areas?
   - How have you noticed your physical health change since you have completed treatment for cancer?
   - Can you tell me about your physical health before cancer and your physical health now?
     - What are the differences/similarities?

7. When you look in a mirror, can you describe how you feel?
   - Specifically, what aspects of your body do you feel good/bad about?
   - Has cancer and its treatments changed how you look at your body?

8. When you think about yourself overall, how do you feel?
   - What do you think makes you feel this way?
   - Were there specific aspects of yourself or your body that you were thinking about when you gave that answer?

Additional questions for post-intervention interview (intervention group and wait-list control group):

9. In this part of the interview, we would like to get your honest feedback. Can you tell me about your thoughts regarding the study?
   - Were you willing to be randomized to one of two groups?
   - What did you think about the assessments?
     - The timing?
     - The frequency?
     - The length?

- What would like to see change?
- What would you like to see stay the same?

10. Is there anything else you would like to tell me about your experience in this study?

Additional questions for post-intervention interview (intervention group only):

11. Can you tell me about your experience in the physical activity intervention?
    - What did you like/dislike?
    - What made participating easier/harder for you?

12. Can you tell me about how you felt about the physical activity intervention content?
    - Frequency?
    - Intensity?
    - Time?
    - Type?
    - Supervised vs. unsupervised?
    - Unsupervised aerobic activity?

13. Now, can you tell me about your experiences with the supervised portion of the training?
    - What did you think about the level of support you received?
    - Do you feel you learned anything?
        - If so, what did you learn?
        - If not, why do you think you didn't learn anything?
    - Did you feel safe?
        - What made you feel safe?
        - What made you feel unsafe?
    - Is there anything else you would like to tell me about the supervision you received?

14. Can you tell me about what you most liked and disliked about the physical activity intervention?
    - What would you like to see change?
    - What would you like to see stay the same?

15. Would you recommend this to your friends? Would you do this again?

16. Is there anything else you would like to tell me about your experience in the physical activity intervention?

Weekly Physical Activity Logbook

Note, this was given to the intervention group only.

Please mark an "X" on the days you do aerobic or strength training. If you did not perform any physical activity, leave the row blank.

Week # [insert dates]

Day	Day of the week (e.g., Monday)	Aerobic Training	Strength Training
1			
2			
3			
4			
5			
6			
7			