Prevalence and Correlates of Exercise in Testicular Cancer Survivors

by

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ABSTRACT

Background: The diagnosis and treatment of testicular cancer is associated with the development of several physical and psychosocial adverse health outcomes in testicular cancer survivors (TCS). Exercise is one positive health behaviour that may address health concerns resulting from the diagnosis and treatment of testicular cancer. However, a significant portion of TCS appear to be insufficiently active and may benefit from further adherence to the combined aerobic and resistance exercise guidelines. No previous studies have examined the correlates of meeting the combined exercise guidelines in TCS using a theory of behaviour. **Objective**: The purpose of The INTENT Study was to examine the prevalence and correlates of meeting the combined exercise guidelines in TCS using the theory of planned behavior (TPB). **Methods:** A web-based cross-sectional survey assessing self-reported exercise prevalence (Godin Leisure-Time Exercise Questionnaire) and exercise correlates (demographic, clinical, behavioural, TPB and perceived physical fitness variables) was administered to TCS in Alberta, Canada. Hierarchical multivariable logistic regression was used to examine the correlates of meeting the combined exercise guidelines in TCS. Hierarchical multiple linear regression was used to examine the correlates of intentions to meet the combined exercise guidelines in TCS. **Results:** Of 2,065 mailed survey invitations, 158 (7.7%) TCS provided complete responses and were included in the analysis. Self-reported exercise prevalence indicated 58% of TCS failed to meet the combined exercise guidelines. Intention to meet the combined guidelines (OR=1.71, p=0.035) and a history of a retroperitoneal lymph node dissection (RPLND) (OR=5.15, p=0.016) were independent correlates of meeting the combined exercise guidelines in multivariable analysis. The TPB variables explained 63% of the variance in intention to meet the combined exercise guidelines with higher instrumental attitude (ß =0.42, p<0.001), self-efficacy (ß =0.40,

p<0.001) and affective attitude (ß=0.18, p=0.019) being independent correlates. **Conclusion:** Findings from the INTENT Study indicate that a significant portion of TCS are insufficiently active and fail to meet the combined exercise guidelines. The TPB appears to be a useful model for understanding the motivational correlates of exercise in TCS. Future intervention studies aiming to increase adherence to the combined exercise guidelines in TCS should focus on developing strong intentions by targeting instrumental attitudes, self-efficacy and affective attitudes.

PREFACE

This thesis document is an original work by Spencer J. Allen. The research project designed in conjunction with this thesis work received research ethics approval from the Health Research Ethics Board of Alberta - Cancer Committee (HREBA-CC) under the project name: "Exercise in Testicular Cancer Survivors: A Motivation Study (The INTENT Study)."

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CHAPTER ONE

GENERAL INTRODUCTION

General Introduction

Testicular cancer (TC) is the most commonly diagnosed malignancy in young men between the ages of 15 and 44 in North America [1]. TC incidence in Canada has steadily increased since the early 1970s, with rates nearly doubling since 1971 [2]. The aetiology of TC remains poorly elucidated, and few preventative strategies exist [1,3]. Testicular germ cell tumors account for approximately 95% of malignant tumors arising in the testes [4]. These tumors can be classified into two main histologic sub-categories: seminomatous and non-seminomatous testicular germ cell tumors. Seminomas, arising from the epithelium of the seminiferous tubules, are the most common histologic subtype and represent approximately 50% of diagnosed testicular cancers. Non-seminomas may include pure or mixed combinations of embryonal carcinoma, teratoma, yolk sac tumor and choriocarcinoma and are often more aggressive [3,4].

TC staging follows the American Joint Committee on Cancer's (AJCC) tumor, node, metastases (TMN) staging system, determined by the extent of disease post-orchiectomy and serum tumor marker elevation as a distinct category (S) [5]. At initial presentation, approximately 70% of TCS are diagnosed with stage I disease [3].

A radical inguinal orchiectomy (surgical removal of the testicle and spermatic cord) is the primary treatment for both seminomas and non-seminomas. Further management is determined by cancer histology and stage, with common options including surveillance, chemotherapy, radiotherapy or retroperitoneal lymph node dissection (RPLND) [5]. RPLND is an invasive surgical procedure to remove the para-aortic, inter-aortocaval and paracaval lymph nodes from deep within the abdomen [6]. Minimally invasive RPLND procedures have been introduced recently to reduce the subsequent morbidity from surgery.

Prior to 1960, radiotherapy and RPLND were the primary adjuvant treatment options following orchiectomy for TCS [7,8]. The emergence of platinum-based chemotherapy in the mid-1970s revolutionized treatments for TC and significantly improved 5-year net survival estimates to currently exceed 96% in Canada[7,9]. Standard chemotherapy regimens for good or intermediate risk disease most frequently include one to two cycles of carboplatin, three to four cycles of bleomycin, etoposide and cisplatin (BEP) or three to four cycles of etoposide and cisplatin (EP) [5]. Second and third-line chemotherapy regimens may also include etoposide, mesna, ifosfamide and cisplatin (VIP), vinblastin, mesna ifosfamide and cisplatin (VeIP) or paclitaxel, ifosfamide and cisplatin (TIP).

Current recommendations for the management of-stage I seminomas propose surveillance as the preferred post-orchiectomy strategy [5]. However, one to two cycles of single agent carboplatin or radiotherapy treatments may be used to reduce the risk of relapse in select patients [5]. Stage I non-seminomas are preferably managed with surveillance unless invasion of the spermatic cord or scrotum are present, which expand treatment preferences to include RPLND and/or treatment with BEP or EP chemotherapy [5].

Stage II and III seminomas are primarily treated with three to four cycles of BEP or EP chemotherapy following orchiectomy. Similarly, recommendations for treating stage II and III non-seminomas include three to four cycles of BEP/EP chemotherapy or RPLND. Following systemic treatment, additional surgical removal of residual disease may be required [5]. Overall, approximately 50% of testicular cancer survivors (TCS) will receive chemotherapy during the course of their TC management [3].

Despite the success of modern treatments, TCS are susceptible to a host of late physical and psychosocial adverse health conditions resulting from the diagnosis and treatment of cancer

[10,11]. TCS treated with chemotherapy experience significant risk of developing various organ related toxicities, including pulmonary toxicity, ototoxicity, nephrotoxicity and neurotoxicity [11]. Several studies have reported adverse metabolic changes in TCS following treatment with chemotherapy, highlighted by elevated levels of hypertension, body mass index, hypogonadism and metabolic syndrome [12-14]. TCS treated with RPLND may experience a variety of surgical complications, such as chylous ascites ileus (leaking of lymphatic fluid into the peritoneal cavity), small bowel blockage, pulmonary complications, vascular injury, infection, neurological injuries (retrograde ejaculation) and venous thromboembolism [6]. However, modern RPLND procedures only result in major complications in approximately 14% of patients [15].

Many late effects from treatment such as neuropathy, ototoxicity, hypogonadism and CVD risk factors such as hypercholesterolemia and hypertension are associated with long-term retention of circulating serum platinum following treatment with cisplatin-based chemotherapy [16,17]. Serum platinum levels remain elevated in TCS for over 20 years post-treatment and are associated with cumulative cisplatin dose [18].

Treatment for TC is further associated with increased cardiovascular disease (CVD) and secondary malignancy (SM) (the diagnosis of a second primary cancer other than TC) incidence and mortality rates [11]. TCS experience a significantly increased risk of life-threatening CVD during and 10 years following treatment with BEP chemotherapy [11]. Data from the Surveillance, Epidemiology and End Results (SEER) program suggest that CVD mortality has surpassed TC-specific mortality amongst US TCS [19]. The mechanisms underlying higher CVD incidence have been hypothesized to result from orchiectomy-induced hypogonadism and chemotherapy-induced vascular insult [20].

Treatment with radiotherapy and/or chemotherapy is associated with a dose-dependent increase in SM incidence [11]. In a large trial of over 40,000 TCS from North America and Europe, survivors treated with chemotherapy, radiotherapy or both displayed a 1.9-fold, 2-fold and 2.9-fold increased risk of developing SMs respectively [21]. Treatment with radiotherapy and/or chemotherapy is associated with increased risks of leukemia and various solid cancers [10]. In particular, treatment with cisplatin-based chemotherapy is associated with an increased incidence of kidney, thyroid, soft tissue and gastrointestinal cancers in TCS [10]. Treatment with chemotherapy and/or radiotherapy is also associated with excess SM-mortality in TCS compared to the general population, with evidence of a dose-dependent association [22,23]. In a cohort of over 5,000 Norwegian TCS, an overall excess SM-mortality rate of 53% was observed [22]. Treatment with chemotherapy, radiotherapy or both treatments was associated with a standardized mortality ratio of 1.43, 1.59 and 3.24 respectively [22].

The diagnosis of TC during adolescence and young adulthood has the potential to impact many important developmental milestones and disrupt psychosocial functioning. TCS experience significant levels of anxiety, cancer-related stress symptoms, fear of cancer recurrence and cancer-related fatigue [11,24]. Clinical levels of anxiety are present in 20% of TCS, while between 14% and 33% experience significant stress symptoms, each higher than population norms [24,25]. Fear of cancer recurrence is reported in 33% of TCS across six studies, which is similar to levels reported in other cancer survivor groups [24,25]. TCS also experience elevated levels of fatigue compared to the general population [11]. Cancer-related fatigue is present in approximately 15% to 27% of TCS [11]. Across each of the psychosocial comorbidities addressed, no association with treatment history has been established [11,24,25].

As most TCS are expected to live free of TC for several decades post-treatment, late effects represent a major health burden for a growing population of survivors [7,10]. Therefore, strategies are urgently required to reduce the impact of physical and psychosocial morbidities in TCS.

Exercise, defined as planned and structured physical activity with the purpose of maintaining or improving physical fitness, is a well-established positive health behaviour with the potential to improve many aspects of physical and psychosocial health [26,27]. Exercise has demonstrated efficacy in improving several health outcomes in cancer survivors, including improving symptoms of anxiety, depression and cancer-related fatigue [28]. Exercise is a well-established treatment for CVD in the general population and is recommended as a strategy to combat the direct and indirect effects of cancer treatments on CVD risk [29]. Although research into the prevention of SMs through exercise training is scarce, exercise has the potential to reduce the risk of several primary cancers, such as cancers of the breast, colon, endometrium, bladder, stomach, esophagus and kidney [30].

Although exercise research in TCS is more limited, evidence of the benefits from physical activity and exercise are beginning to accumulate [31]. Accumulating higher levels of vigorous exercise is associated with lower rates of hypogonadism, fewer long-term adverse health outcomes, a lower cumulative burden of morbidity and a lower Framingham Risk Score (indicating a lower risk for experiencing a cardiac event) in a large cohort of TCS [32-35]. Physically active Norwegian TCS report a lower prevalence of Hospital Anxiety and Depression Scale (HADS) defined depression than non-active TCS [36]. In addition, one study of US TCS found the accumulation of adequate aerobic exercise to be positively associated with the mental health component of the 12-item Short Form Health Survey (SF-12) and all components of the

Functional Assessment of Cancer Therapy - General (FACT-G) minus social well-being [37]. Adequate strength/flexibility exercise was also positively associated with the physical health component of the SF-12 and all components of the FACT-G. In contrast, a study of Canadian TCS found aerobic exercise to be positively associated with self-rated physical health but not mental health [38]. Perhaps most significant, TCS who reported meeting the World Health Organization's physical activity recommendations (10-12 metabolic equivalent task hours per week (MET-h/wk), at a mean of 12 years postdiagnosis, had an approximate 50% reduced risk of overall mortality compared to inactive men [39]. Later in survivorship, even TCS reporting low-activity (2-6 MET-h/wk) experienced a 37% reduced risk of overall mortality compared to inactive men.

Structured exercise training has demonstrated a substantial benefit in reducing CVD risk factors and improving psychosocial outcomes in TCS. Following a 12-week randomized controlled trial (RCT) of high intensity interval training (HIIT), important surrogate markers and risk factors of CVD mortality were reduced by 20%, while significant improvements in measures of cancer-related fatigue, self-esteem and health-related quality of life (HRQoL) were observed [40,41]. In addition, cardiorespiratory fitness improved by 3.7 mL/kg/minute [41]. This magnitude of improvement in cardiorespiratory fitness corresponds with a relative risk reduction in overall mortality by 10-25%. Although no research exists specifically in TCS, physical fitness is generally inversely associated with all-cause mortality in males [42]. Previous studies in TCS have demonstrated improvements in cardiorespiratory fitness were shown to mediate improvements in patient-reported functioning [40], suggesting the importance of physical fitness in TCS.

Despite the benefits of exercise for cancer survivors, a significant portion of TCS are insufficiently active (Appendix A, Table 1). In two previous studies, TCS were found to be more

active than age and sex-matched relatives [43] and the Norwegian general population [44]. However, US TCS were no more likely to engage in regular exercise than age, sex, income and education-matched Center for Disease Control (CDC) controls [43]. Approximately 34-57% of TCS engage in insufficient aerobic exercise [37,38,43,44] while 72% engage in insufficient resistance/flexibility exercise [37]. Several papers published by the Platinum Study, consisting of a cohort of cisplatin-treated TCS throughout North America and the United Kingdom, report over 90% of survivors participate in at least one moderate intensity activity weekly [32-35,45]. In addition, over 60% of TCS participate in at least one vigorous intensity activity weekly, which is significantly higher than sex, race, age and education-matched National Health and Nutrition Examination Survey (NHANES) controls. However, previous estimates of exercise prevalence in TCS are limited by small samples [37,38,43], unstandardized exercise measures [44], heterogenous characterizations of "adequate" exercise levels and limited data on strength exercise.

The American College of Sports Medicine (ACSM) recommends cancer survivors accumulate a minimum of 150 minutes of moderate or 75 minutes of vigorous aerobic exercise every week [46]. Additionally, cancer survivors should perform strength exercises for major muscle groups at least twice weekly. The combined exercise guidelines are defined as meeting both the aerobic and resistance exercise guideline concurrently. These guidelines have also recently been endorsed by the American Cancer Society (ACS) [47], the National Comprehensive Cancer Network (NCCN) [48] and align with the Canadian Society for Exercise Physiology (CSEP) guidelines for adults [49]. One previous study assessing exercise preferences found approximately 33% of TCS were interested in engaging in a physical activity program, while a further 37% were "maybe" interested [50]. Despite interest in activity programming, between 34-57% and 72% of TCS are insufficiently active and may benefit from increasing aerobic and strength/flexibility

exercise respectively. This discrepancy highlights the need for strategies to enhance exercise motivation and increase adherence to the combined exercise guidelines in TCS.

Among studies reporting exercise prevalence in TCS, few studies have examined the demographic and clinical correlates of exercise (Appendix A, Table 1). Education (n=2) and employment (n=1) were positively associated with activity levels in large samples of Norwegian TCS, while smoking (n=2), comorbidities (n=1) and age (n=1) were inversely associated [39,44]. Thorsen et al. [44] found no association between activity levels and age, BMI, "living as a couple" or treatment history. Similarly, two previous studies found no association between exercise and age (n=2), race (n=1), marital status, education (n=1), employment (n=1), cancer stage (n=1) or time since diagnosis (n=1) in samples of US [37] and Canadian [38] TCS. Two additional studies of US TCS found no association between activity levels and treatment regimens among participants [34,51]. One previous study of Canadian TCS examining the correlates of self-rated health using basic psychological needs theory found exercise to mediate the association between psychological needs satisfaction and physical health but not mental health [38]. However, no previous studies have aimed to comprehensively examine the correlates of physical activity or exercise in TCS using a theory of behaviour. Given the inconsistent and unclear pattern of exercise correlates in TCS, a structured, comprehensive exploration of the determinants of exercise guided by theory may provide greater clarity on the relative contribution of hypothesized motivational correlates in explaining exercise. An examination of the motivational correlates of exercise may improve the precision of future behaviour change interventions by identifying the key theoretical constructs hypothesized to drive exercise [52,53]. Although it is unclear whether theoretically developed behaviour change interventions produce superior results compared to those developed without the use of theory, several reviews highlight the benefits of

former [54]. Theory provides a system for classifying and explaining the relationships between antecedents of behaviour [54]. Using a theory provides an opportunity to test a predetermined structure of causal determinants that can inform further theory refinement and development. Early research into the determinants of exercise was largely atheoretical and lacked cohesion [52]. The emergence of social cognitive models of behaviour integrated cognitive evaluation and social learning processes to understand why individuals perform behaviours and saw considerable attention in the exercise domain [55]. This advancement significantly contributed to understanding exercise across a range of diverse populations. Several other classifications of models have emerged and stimulated research in physical activity motivation. Social-ecological frameworks propose that physical activity results from the interplay of environmental, biological and psychosocial influences represented at multiple levels of influence spanning from individuals to social policy [55,56]. Theories embodying a humanistic perspective, such as Self-Determination Theory, recognize an inherent drive to grow and flourish and the role of intrinsic and extrinsic motivation in guiding physical activity [55,57]. Recently, dual process models have been applied to understand and predict physical activity [55]. These models incorporate reflective processes, which involve purposeful cognitive evaluations and non-conscious processes, which are spontaneous automatic responses. Although several models of behaviour and behaviour change may advance the current understanding of exercise in TCS, the theory of planned behavior (TPB) [58], a prevalent social cognitive theory has received particular attention in understanding and changing exercise in cancer survivors [59-63].

Briefly, the TPB proposes that behavioural intentions are the proximal determinant driving behaviour [58]. The TPB identifies attitude, subjective norm and perceived behavioural control (PBC) as the three determinants of behavioural intentions. Attitudes toward the

behaviour are composed of behavioural beliefs and reflect an individual's positive or negative evaluation of the behaviour. Attitude can be subdivided into instrumental and affective attitudes, or the perceived benefits and enjoyment of the behaviour respectively. Subjective norms represent the perceived social pressure from others and can be subdivided into injunctive and descriptive norms. Injunctive norms refer to how important others view the individual in-question performing the behaviour, while descriptive norms refer to whether important others engage in the behaviour themselves. Subjective norms are influenced by normative beliefs of important others. PBC represents the control individuals feel over their own behaviours. PBC can be divided into the subcomponents of self-efficacy and perceived control and are influenced by control beliefs. The construct of self-efficacy represents an individual's perceived belief in their ability to perform the behaviour, where perceived control refers to individual perceptions of control over the behaviour. Therefore, the TPB proposes that individuals will intend to perform a behaviour if they believe it will be beneficial and enjoyable, that important others will approve and support them, that they have control over the behavior and are confident they can perform it. Extensions of the TPB have included the construct of planning to assist in the translation of intentions into behaviour [64]. Planning has been included in TPB studies in previous cancer research and has been previously operationalized as having specific plans for where, when and how the behaviour will be carried out. [65].

The TPB has been successfully applied to predict and understand exercise in various cancer populations [59,61-63]. A review of studies examining the correlates of exercise in cancer survivors using the TPB is presented in Appendix A, Table 2. Overall, the TPB explained between 11-54% and 23-69% of the variance in behaviour and intention respectively across cancer survivor groups. Intention, planning and PBC (or its subcomponent of self-efficacy) were

frequent correlates of exercise, while attitude (instrumental and affective) and PBC (or self-efficacy) were common correlates of intention across studies. Only a single study among those reviewed [66] examined the correlates of meeting the aerobic and resistance guidelines within a single analysis. This study separated participants into four exercise guideline categories (FEGs) based on meeting the aerobic-only, resistance-only, combined or neither exercise guideline. Interestingly, no previous studies have examined the correlates of meeting the dichotomized combined exercise guidelines (meeting the combined exercise guidelines versus not meeting the combined exercise guidelines) using the TPB in any cancer survivor group.

A recent meta-analysis of TPB-based behaviour change studies found interventions to produce moderate effects on a range of behavioural outcomes across populations [67]. In a systematic review and meta-analysis of the motivational correlates of exercise adherence in cancer survivors, intention and PBC were found to be moderate, statistically significant predictors of adherence, while subjective norm was a weak, statistically significant predictor [63]. A narrative review of theoretically developed exercise studies in urological cancer survivors found the TPB to be the most frequently used theory to understand and predict exercise [61].

To date, however, no previous studies have examined the correlates of exercise in TCS using a theory of behaviour. In a previous study of cancer survivors, Forbes et al. [68] found the TPB correlates of exercise and intention to vary by cancer site, with breast, prostate and colorectal cancer survivors each demonstrating unique associations. Therefore, the study of exercise correlates in discrete cancer populations is required to best inform the relative contribution of TPB constructs in explaining exercise. Several characteristics of TCS make this population unique among cancer survivors, including the young age at diagnosis, exclusive male sex, excellent prognosis, specific treatments and associated late effects. A comprehensive

examination of the correlates of exercise using the TPB will inform and stimulate future behaviour change intervention research among TCS. Recommendations from the ACSM, suggest optimal exercise prescriptions should include weekly accumulation of aerobic and resistance exercise [46]. Understanding how to motivate TCS to meet the combined exercise guidelines may optimise the potential health benefits from concurrent aerobic and resistance training. Therefore, the ExercIse iN TEsticular CaNcer Survivors: A MoTivation (INTENT) Study was designed to examine the correlates of meeting the combined exercise guidelines in TCS using the TPB. The TPB was selected to guide the INTENT Study due to extensive empirical testing across a range of behaviours and populations [69,70], with substantial use among cancer survivor populations (Appendix A, Table 2) [59,61-63]. In addition, the TPB has readily accessible measurement tools and guidelines for the development of interventions [71-73]. Finally, the TPB has demonstrated particular efficacy in the physical activity/exercise domain [67,70,74-76].

CHAPTER TWO

PAPER

Correlates of meeting the combined exercise guidelines in testicular cancer survivors: An application of the theory of planned behaviour

Introduction

Testicular cancer (TC) is the most common malignancy diagnosed in men between the ages of 15 and 44 in North America [1]. Although the introduction of modern treatment strategies has significantly improved 5-year survival rates to exceed 95% in many developed countries [1], testicular cancer survivors (TCS) face significant risks of developing a host of physical and psychosocial adverse health outcomes from the diagnosis and treatment of TC [10,11,34]. In particular, TCS face increased risks of developing adverse cardiometabolic profiles and increased incidence and mortality from cardiovascular disease and secondary malignancies. In addition, the diagnosis and treatment of TC during adolescence and young adulthood may lead to the disruption of significant developmental milestones and elevated levels of anxiety, cancer related stress, fear of cancer recurrence and cancer related fatigue [11,24,25]. As most TCS will live free of TC for many decades following treatment, late-effects represent a significant health burden for a growing population of survivors.

Exercise is recommended for cancer survivors to address several physical and psychosocial side effects from the diagnosis and treatment of various cancers [28,46,47]. The American College of Sports Medicine (ACSM) recommends cancer survivors accumulate 150 minutes per week of moderate intensity aerobic activity or 75 minutes per week of vigorous intensity aerobic activity, while also performing resistance exercises on two or more days per week. [46]. Recently, research has begun to demonstrate the unique benefits of exercise for TCS [31]. Higher levels of exercise are associated with fewer long term adverse health outcomes [34], a lower cumulative burden of morbidity [33], a lower Framingham Risk Score [35], a lower prevalence of depression [36] and lower cardiometabolic risk [77] in TCS. Additionally, a longitudinal study of Norwegian TCS found a 51% reduction in overall mortality among long-term TCS reporting 10-

12 metabolic equivalent task hours per week [39]. Further, TCS completing 12 weeks of high intensity interval training improved surrogate markers of CVD mortality, measures of cardiorespiratory fitness, fatigue and quality of life [40,41]

Despite the emerging benefits of exercise for TCS, a significant portion of survivors remain insufficiently active [37,38,43,44] and fail to meet exercise guidelines. However, few studies have examined the correlates of exercise in TCS. Higher education levels were associated with greater exercise, while comorbidities and smoking were associated with lower levels of exercise in one study of Norwegian TCS [44]. Few other demographic or clinical variables have emerged as significant correlates of exercise in other studies [37,38,44]. Overall, no study to date has examined the correlates of the combined exercise guidelines or applied a theory of behaviour in TCS.

Theories of behaviour provide systems for understanding and contextualizing the myriad of potential antecedents to exercise and may improve the effectiveness of behaviour change interventions [52,55,78]. The theory of planned behavior (TPB) [58] is a social cognitive theory used to explain and predict exercise in various cancer populations [59,61]. The TPB proposes that behaviours are determined by behavioural intentions, which are in-turn determined by an individual's attitudes toward the behaviour (positive or negative evaluation), subjective norm (perceived social pressures) and perceived behavioural control (perceptions of one's control over a behaviour). Therefore, the TPB asserts that an individual will form positive behavioural intentions if a behaviour is evaluated as enjoyable and beneficial, perceived as socially desirable and perceived as within one's control. The construct of planning has been added to the TPB previously as a mediator aiming to bridge the intention-behaviour gap [64].

Therefore, the primary purpose of this study was to comprehensively examine the demographic, medical, and social cognitive correlates of meeting the combined exercise

guidelines in TCS using the TPB. Based on the TPB and previous research, we hypothesized that intention, planning and PBC would have independent associations with meeting the combined exercise guidelines, while instrumental attitude, affective attitude and self-efficacy would have independent associations with intention.

Methods

Participants and Procedures

The ExercIse iN TEsticular CaNcer Survivors: A MoTivation (INTENT) Study was a web-based cross-sectional survey among TCS in Alberta, Canada. Ethics approval for this study was granted by the Health Research Ethics Board of Alberta - Cancer Committee (HREBA-CC). Participants were considered eligible if they had a diagnosis of invasive testicular cancer, were over the age of 18 at diagnosis, were diagnosed between 2004 and up to three months prior to the study mailout, had completed cancer treatments, were registered with the Alberta Cancer Registry (ACR) and were residents of Alberta at the time of diagnosis and mailout. Cancer survivors were excluded from study participation by the ACR if diagnosed with any morphology present in Appendix B. The ACR is a provincially managed cancer registry mandated to record data on cancer incidence and mortality within Alberta [79]. The survey was designed and managed with REDCap, a secure web-based application for developing online studies and databases, hosted by the Women & Children's Health Research Institute at the University of Alberta [80].

Packages were mailed to eligible TCS in Alberta by the ACR. The packages contained an introduction letter and pamphlet from the ACR, along with an INTENT Study recruitment letter detailing the purpose of the study and three options for accessing the survey. Option one provided participants with a quick response (QR) code directly linked to the REDCap survey.

Option two provided participants with a uniform resource locator (URL) directly linking to the INTENT Study website, where further study information and access to the survey were provided. Finally, participants were also provided with an option to request a mailed paper copy of the survey, with all postage costs covered.

Measures

Standard demographic variables were measured by self-report and included assessments of age, relationship status, marital status, living situation, locality (rural vs urban), education, ethnicity/race, employment status, income, gender and identifying as lesbian, gay, bisexual, trans, queer, intersex, asexual and two-spirit (LGBTQIA2).

Self-reported clinical variables included date of diagnosis, tumor characteristics, treatments and chronic medical conditions of participants. Body mass index (BMI) was calculated from self-reported body height and body weight.

Alcohol consumption was assessed using a single item with cut points modified from the Canadian Centre on Substance Use and Addiction's alcohol guidelines, published in 2023 [81].

Cannabis use was assessed using a single item from the revised Cannabis Use Disorders Identification Test [82].

Self-reported exercise was measured using a modified version of the Godin Leisure-Time Exercise Questionnaire (GLTEQ) [83]. The GLTEQ has been frequently used to assess exercise in various cancer populations [84] and reported moderate correlations of 0.53 and 0.57 between objective accelerometry and self-report data in breast cancer and leukemia survivors [85,86]. Participants were asked to report the average frequency and duration of light intensity aerobic, moderate intensity aerobic, vigorous intensity aerobic and resistance leisure-time exercise

completed for a typical week over the last month lasting at least 10 minutes. Relevant examples of each exercise intensity were provided. Following standard procedures, vigorous intensity aerobic exercise minutes were double-weighted and summed with moderate intensity aerobic minutes to create a moderate plus vigorous exercise variable. Participants were categorized into the four exercise guideline categories (FEGs): aerobic only, resistance only, combined and neither. Participants were further dichotomized into meeting the combined exercise guidelines versus not meeting the combined exercise guidelines.

Perceived physical fitness (PPF) was assessed using the Perceived Physical Fitness Scale (PPFS). The scale consists of 12 items on a 5-point Likert scale measuring perceptions of various physical fitness components [87]. A meta-analysis of PPF concluded males and females of all ages possessed moderately accurate perceptions of their fitness levels [88]. The PPFS demonstrated acceptable test-retest reliability (ICC=0.92) in a sample of participants between 21 and 68 years of age [89]. PPFS scores range from 12 (low perception of fitness) to 60 (high perception of fitness).

TPB constructs were assessed using standard items and methods proposed by Ajzen [72]. The survey defined regular exercise as achieving the ACSM's combined exercise guidelines for cancer survivors. Two component models of attitude, subjective norm and PBC were utilized [72]. All TPB constructs were assessed on seven-point Likert scales. Affective and instrumental attitudes towards regular exercise were assessed by three items each. Injunctive and descriptive norms were assessed by three and two items respectively, while controllability and self-efficacy were assessed by three items each. Intentions to exercise regularly over the next month were assessed by two items, and planning was assessed by a single item. Affective and instrumental

beliefs towards exercising regularly were assessed by eight and 13 items respectively, while injunctive and control beliefs were assessed by seven and 12 items respectively.

Statistical analysis

All analyses were performed on SPSS Statistics Version 28 [90]. Descriptive statistics were used to examine the distributions of demographic, clinical and behavioural variables across participants in the FEGs and combined exercise guideline categories. Chi-squared tests were used to analyze the univariable associations between categorical demographic, clinical and behavioural variables and the exercise guidelines. Analyses of variance (ANOVAs) were conducted to examine mean differences in continuous demographic, clinical and behavioral variables among the exercise guideline groups. Hierarchical multivariable logistic regression with forced entry was used to examine the associations between the combined exercise guideline categories and TPB variables, PPF, demographic and clinical variables. Only significant ($p<0.05$) demographic and clinical variables were used in the analysis (with the exception of current age), while all TPB constructs and PPF were entered hierarchically based on a theoretical order of causality. Associations between intention and second-order theoretical constructs were examined using hierarchical multiple linear regression with forced entry. Pearson correlations and stepwise multiple linear regression were used to examine the associations between individual exercise beliefs and global TPB constructs. Small amounts of missing data (<5%) were addressed by insertion of the mean or mode.

Results

Figure 1 represents the flow of participants through the INTENT Study. The ACR

identified and mailed recruitment packages to 2,065 eligible TCS in Alberta. The REDCap version of the INTENT Study survey received 195 responses. Seven requests were made for a paper survey format, six of which were completed. Therefore, 201 total surveys (9.7% response rate) were completed. Of the REDCap surveys, 41 responses contained a significant amount of missing data (more than one full section missing) and were removed. Of the six returned paper surveys, two were excluded due to concerns of validity (caregivers providing responses for participants with cognitive impairments). Therefore, in total 158 responses were used in this analysis.

Descriptive Analysis

Self-reported demographic and clinical characteristics of INTENT Study participants are displayed overall and across the FEGs in Tables 1 and 2 respectively. Overall, the mean age of participants at the time of study completion was 46.7±12.4 years. Participants were predominantly in relationships (83.5%), married (68.4%), living with others (87.3%) and living in urban neighbourhoods (81.6%). The majority of participants did not identify as LGBTQIA2 (94.3%), while most reported male gender (99.4%) and white ethnicity/race (89.2%). Most participants had completed university/college (64.6%), were working full time (69.6%) and had a family income of $100,000 or more (60.8%). Approximately one third were previous/current smokers (30.4%) or regularly used cannabis (28.5%). Nearly one-half of participants consumed three or more alcoholic drinks per week (40.5%).

Overall, the mean age at diagnosis for participants was 37.9±12.4 years, while the mean time since diagnosis was 8.4±5.7 years. Seminoma, non-seminoma and uncertainty of morphology were self-reported by 46.2%, 14.6% and 39.2% of participants respectively. Nearly

all participants (98.1%) reported only a single testicle affected. Unilateral orchiectomy was the most common treatment (94.3%), while 14.6% underwent a retroperitoneal lymph node dissection (RPLND), 17.7% received radiation therapy and 29.1% received chemotherapy. Metastases, recurrences and a second cancer diagnosis were reported by 36.1%, 7.6% and 8.9% of participants respectively. The mean body weight of participants was 90.8±15.4kgs and BMI was 27.7±4.7kg/m^2, with 50.0% falling into the overweight category. Almost one-third of participants reported one or more chronic health conditions (26.6%).

Exercise prevalence of Albertan TCS is reported in Table 5. Overall, participants performed a median of 90.0 minutes of light aerobic exercise (IQR= 0.0-185.0), 60.0 minutes of moderate aerobic exercise (IQR=0.0-180.0), 60.0 minutes of vigorous aerobic exercise (IQR=0.0-150.0), 42.5 minutes of resistance exercise (IQR=0.0-142.5) and 240.0 minutes of moderate plus vigorous aerobic exercise (IQR=87.5-480.0) per week. When categorized into the FEGs, 66 participants (41.8%) were meeting the combined exercise guidelines, 38 participants (24.1%) were meeting the aerobic-only guidelines, 15 participants (9.5%) were meeting the resistance-only exercise guidelines and 39 participants (24.7%) were meeting neither exercise guideline. When dichotomized into the combined exercise guidelines, 66 (41.8%) participants were meeting the combined exercise guidelines, while 92 participants (58.2%) were not meeting the combined exercise guidelines (Tables 3 and 4).

Preliminary Analysis

Chi-squared/ANOVA results indicated statistically significant differences for BMI (p=0.008) and chronic medical conditions (p=0.015) between participants across the FEGs (Table 2). Significant differences in employment (p=0.034), RPLND (p=0.044), recurrence

(p=0.015) and chronic medical conditions (p=0.043) were observed between participants in the combined exercise guideline categories (Tables 3 and 4).

Mean TPB and PPF scores are reported overall, by FEGs (Table 6) and by combined exercise guideline categories (Table 7). Statistically significant differences in mean scores were observed for PPF and all TPB variables excluding descriptive norm, injunctive norm and injunctive beliefs between the FEG groups (Table 6). Similarly, statistically significant differences were observed in mean PPF and all TPB scores excluding descriptive norm, injunctive norm, controllability and injunctive beliefs across the combined exercise guideline categories (Table 7).

Table 8 reports mean scores of individual exercise beliefs overall and categorized into the FEGs. Statistically significant differences in mean scores were observed for five of eight individual affective beliefs, nine of 13 instrumental beliefs and all 13 control beliefs. However, no statistically significant differences were observed in any of the seven individual injunctive beliefs across the FEGs.

Pearson and point-biserial correlations between individual exercise beliefs, global TPB constructs and the combined exercise guideline categories are presented in Tables 9-11. Briefly, affective beliefs exhibited small to medium associations [91] with affective attitude and intention (Table 9). Four affective beliefs retained statistically significant small associations with the combined exercise guidelines. The majority of instrumental beliefs displayed medium to large statistically significant associations with instrumental attitude and intention (Table 10). Nine instrumental beliefs retained small to medium statistically significant associations with the combined exercise guideline categories. All associations between the 12 control beliefs and controllability, self-efficacy and intention were statistically significant (Table 11). Control belief

associations were greater in magnitude with self-efficacy and intention (medium to large) than with controllability (small to medium). Nearly all control beliefs retained small to medium statistically significant associations with the combined exercise guideline categories.

Primary Analysis

Table 12 displays the results from the hierarchical multivariable logistic regression analysis between the combined exercise guideline categories, TPB variables, PPF and significant demographic and clinical variables. In the final model containing all variables, intention (OR=1.71, p=0.035) and RPLND (OR=5.15, p=0.016) emerged as statistically significant independent correlates of meeting the combined exercise guideline categories. Nagelkerke pseudo-R-squared values increased sequentially with each model (R^2=0.28; R^2=0.34; R^2=0.36; R^2=0.45).

Hierarchical multiple linear regression analyses between intention, second order TPB constructs, PPF and significant demographic and clinical variables are presented in table 13. Affective attitude (ß =0.18, p=0.019), instrumental attitude (ß =0.42, p<0.001) and self-efficacy (ß =0.40, p<0.001) emerged as the sole independent correlates of intention, explaining 65.3% of the variance in the final model (p<0.001).

Stepwise multiple linear regression analyses between exercise beliefs and global TPB constructs are presented in Tables 14 and 15. Three affective beliefs emerged as independent statistically significant correlates of affective attitude (Table 14): "do an activity that is fun or enjoyable" (ß=0.36, p<0.001), "do a variety of activities" (ß=0.20, p=0.009), "participate in team sports" (ß=0.16, p=0.029). The final model explained 28% of the variance in affective attitude (p<0.001). Three instrumental beliefs emerged as independent statistically significant correlates

of instrumental attitude (Table 14): "live longer" (ß=0.22, p=0.001), "relieve stress" (ß=0.31, p<0.001), "feel better and improve your well-being" (ß=0.29, p<0.001). The final model explained 44% of the variance in instrumental attitude (p<0.001).

Two control beliefs emerged as independent statistically significant correlates of controllability (Table 15): "you had additional family responsibilities" (ß=0.41, p<0.001), "you had limited or no access to recreation facilities or gyms" (ß=0.16, p=0.04). The final model explained 25% of the variance in controllability (p<0.001). Four control beliefs emerged as independent statistically significant correlates of self-efficacy (Table 15): "you felt tired or fatigued" (ß=0.32, p=0.001), "you got very busy and had limited time" (ß=0.23, p<0.001), "you were diagnosed with a second type of cancer" (ß=0.32, p<0.002), "you had a recurrence of your cancer" (ß=-0.22, p=0.039). The final model explained 44% of the variance in self-efficacy (p<0.001).

Discussion

The INTENT Study was the first study to explore the correlates of meeting the combined exercise guidelines in TCS using theory. The findings partially supported our hypotheses, with intention emerging as a significant independent correlate of meeting the combined exercise guidelines. In particular, TCS with higher intentions had 71% greater odds of achieving the combined exercise guidelines. This aligns well with the theoretical tenants of the TPB, which describe behavioural intention as the proximal determinant of behaviour [58]. Previous studies in other cancer populations generally support intention as a significant independent correlate of general physical activity, aerobic exercise specifically, or strength exercise specifically (Appendix A, Table 2). In particular, of the 24 studies reporting the correlates of exercise using

the TPB in cancer survivors, 21 report intention to be a significant correlate of exercise. However, the strength of these associations has varied between cancer populations.

A cross-sectional study of kidney cancer survivors found higher intention to engage in 150 minutes per week of moderate-to-vigorous physical activity (MVPA) and planning scores to be associated with survivors meeting the combined, aerobic-only and resistance-only guidelines compared to neither guideline [66]. However, intention and planning did not distinguish between meeting the aerobic-only, resistance-only and combined guidelines. Forbes et al. [92] examined the correlates of meeting the resistance exercise guidelines in a sample of breast, prostate and colorectal cancer survivors and found intention to engage in 150 minutes per week of MVPA to be the only significant independent TPB correlate in multivariable analysis. The association between intention and meeting the guidelines in the INTENT study (OR=1.71, p=0.035) is similar in magnitude to those reported by Forbes (OR=1.61, p<0.001) and Tabaczynski for combined versus neither (OR=2.10, p<0.01), aerobic-only versus neither (OR=1.53, p<0.01) and resistance versus neither (OR=1.48, p=0.02).

In contrast to the majority of studies reviewed, planning did not emerge as an independent correlate of meeting the combined exercise guidelines. Planning has been proposed as a mediator of the intention-behaviour gap, assisting in the volitional translation of intentions into actions [64]. Among the studies reviewed (Appendix A, Table 2), planning emerged as a significant correlate of behaviour in several studies. Forbes et al. [68] studied the correlates of aerobic exercise in a sample of breast, prostate and colorectal cancer survivors. Planning was a significant independent correlate of aerobic exercise for breast and prostate cancer survivors. However, colorectal cancer survivors reported intention to engage in 150 minutes per week of MVPA and not planning as the sole independent correlate. Two studies using exercise guideline

endpoints provided conflicting results on the role of intention and planning. Forbes et al. [92] reported intention to engage in 150 minutes per week of MVPA as the sole TPB correlate of meeting the resistance exercise guidelines across breast, prostate and colorectal cancer survivors. However, in all three guideline comparisons, Tabaczynski et al. [66] reported intention to engage in 150 minutes per week of MVPA and planning as independent correlates, with intention emerging with greater magnitude. Although they may be conceptually distinct, the inclusion of intention and planning constructs in the TPB may result in measurement redundancy due to semantic ambiguity and the overlap of intention constructs onto motivation and planning [93]. Results from the INTENT Study appear to indicate that forming intentions alone may be adequate to increase adherence to the combined exercise guidelines in TCS.

Surprisingly, the strongest correlate of meeting the combined exercise guidelines in TCS was a history of RPLND, which is an invasive and complex surgery involving the surgical removal of lymph nodes from deep within the abdomen of TCS with metastatic disease [6]. In contrast to the propositions of the TPB, clinical characteristics were not entirely mediated by the constructs of the TPB, and a history of RPLND emerged as a strong independent correlate of meeting the guidelines. The sufficiency hypothesis of the TPB suggests that background factors such as clinical and demographic variables will be mediated by TPB variables [71]. Previous studies of exercise prevalence in TCS have examined a select number of demographic and clinical correlates of exercise absent of theory. Thorsen et al. [44] examined exercise prevalence by cancer treatment and found no significant differences (p=0.98). However, treatments were categorized into surgery only (orchiectomy and/or RPLND), radiotherapy only or cisplatin-based chemotherapy (with or without RPLND). The results from our study suggest that RPLND may be a significant independent predictor of exercise adherence and warrants independent

categorization from orchiectomy alone. Only two additional studies examined differences in exercise prevalence between treatment modality history in TCS [34,51]. Neither study found any differences in exercise by treatment category. However, none of the reviewed studies categorized RPLND independently from orchiectomy. Overall, the underlying mechanisms of greater exercise adherence following this surgery are uncertain. Previous research has identified the diagnosis and treatment of cancer as a possible "teachable moment" in the lives of cancer survivors [94]. This phenomenon is characterized by a significant or threatening life event triggering greater motivation to engage in positive health behaviours. In the first characterization of exercise prevalence in TCS, Thorsen et al. [44] reported higher exercise levels in TCS than controls and postulated this difference may result from a teachable moment. However, exercise is the only health behaviour to see a positive shift following the diagnosis and treatment of TC [44]. Behaviours such as smoking, vegetable intake and risky drinking habits appear unchanged or worse than the general population in previous reports of TCS [37,43,44,95]. Further study into the underlying mechanisms of exercise guideline adherence in TCS, particularly after RPLND is required. Perhaps, if RPLND is perceived as a significant, life-threatening surgery but results in minimal adverse effects following treatment, it may trigger motivation to adopt healthy lifestyle behaviours. Considering the magnitude of treatment, a relatively small proportion (14%) of TCS experience major complications from surgery [15]. Further research into the perceptions of TCS following RPLND is warranted. Elucidating the differential motivational characteristics in this active subset of TCS may provide additional insight into the unique motivational profile of these survivors and highlight targets for future intervention in non-RPLND survivors.

Overall, the TPB performed well in explaining exercise in TCS. Previous studies using the TPB in cancer survivors have reported models explaining 11-54% of the variance in exercise.

In our study, pseudo-R^2 values progressively increased with each model, explaining approximately 45% of the variance in meeting the combined exercise guidelines in the final model (Nagelkerke R^2=0.28; 0.34; 0.36; 0.45) [96]. The coefficient of determination, R^2 represents the proportion of variance in a dependent variable explained by the independent variables in a linear regression model and is not possible to compute in a logistic regression model. As such, pseudo-R^2 indices, such as those published by Nagelkerke [97], were developed to estimate the proportion of variance explained in a dichotomized dependent variable in logistic regression analysis [98]. However, pseudo-R^2 values must be interpreted and compared with caution and should only be used to compare relative model fit within one data set [96,98]. Therefore, the pseudo-R^2 values calculated in this study indicate a progressively better fit of the logistic regression model with the addition of PPF, demographic and medical variable to the theoretical TPB constructs.

Additionally, the TPB performed very well in explaining intentions to perform the combined exercise guidelines in TCS, with theoretical variables explaining 63% of the variance in intentions to meet the combined exercise guidelines. The inclusion of PPF, demographic and clinical variables explained an additional non-significant 2% of the variance. This finding is among the highest reports of explained variance in intentions to exercise among cancer survivors using the TPB, with only kidney cancer survivors [99] and hospitalized mixed cancer patients receiving high dose chemotherapy and bone marrow transplants [100] reporting higher values. Instrumental attitude, affective attitude and self-efficacy emerged as three independent correlates of intentions to meet the combined exercise guidelines in our study, with instrumental attitude and self-efficacy making the most significant contributions. Previous reviews have found attitude and PBC to be the strongest predictors across health behaviours [70,101]. Attitude has performed as

a consistently strong predictor of intention across populations and behaviours [70,101]. In previous studies in cancer survivors, attitude or its subcomponents were consistent correlates of intention across cancer survivor groups (Appendix A, Table 2). Most studies used the two-component model of attitude, with both instrumental and affective attitude appearing significant with similar frequency across the studies reviewed. A previous study in bladder cancer survivors (mean age=70.2) found age to modify the association between the attitude constructs and intentions to engage in MVPA three to five times per week [65]. While instrumental attitude and PBC explained intentions for participants under 65, affective attitude and PBC explained intentions in participants over 65 [65]. However, two studies in young cancer populations (mean age=17.4; 38.2) reported both instrumental attitude and affective attitude as significant independent correlates of exercise intentions to be regularly active [102] and intentions to be active over the next 12 weeks [103]. The modest sample size recruited in the INTENT study did not permit the examination of demographic and clinical moderators of the associations between TPB variables and exercise guideline adherence. In TCS, the benefits of meeting the combined exercise guidelines appear to be a greater motivator to form exercise intentions compared to the enjoyment experienced by meeting the combined exercise guidelines.

PBC has been identified as an independent correlate of health behaviours in previous research [70,101]. Using the two-component model of PBC [72], we found self-efficacy and not controllability was associated with intention in our sample. This aligns with previous studies in cancer survivors [104,105]. The two-component model of PBC has received mixed support in previous research due to concerns of measurement redundancy and conceptual and semantic ambiguity [106-110]. However, our results are in line with previous studies utilizing a two-component model of PBC, finding self-efficacy to possess the greater association with intention

[101,108]. Fishbein and Ajzen [71] reconceptualized the two-component model of PBC to include the constructs of capacity and autonomy in an updated Reasoned Action Approach. If future research confirms the superiority of the updated two-component model of PBC, this approach may provide additional clarity to the role of PBC and its subcomponents in understanding and predicting exercise in TCS.

Subjective norm and its subcomponents, descriptive norm and injunctive norm, have produced mixed results in previous studies using the TPB. These theoretical constructs are generally the weakest predictors of behavioural intentions [101], and some authors have in-fact called for their removal from the model [111]. Subjective norm has made greater contributions to intention in behaviours of a protective nature, such as condom use and health screening compared to physical activity in previous reviews [70]. Similarly, among TPB studies in cancer survivors, subjective norm and its subcomponents have been inconsistent correlates of exercise intentions across cancer populations (Appendix A, Table 2). In our study, descriptive and injunctive norm did not correlate with intentions to meet the combined exercise guidelines in TCS. This is consistent with intentions to be regularly active in adolescent cancer survivors [102] and intentions to exercise over the next 12 weeks in young adult cancer survivors [103]. However, in this study, subjective norm variables did not reach statistical significance even in univariable analyses. La Barbera and Ajzen [112] suggest PBC may act as a moderator of attitude and subjective norm. In three studies designed to test the interaction of PBC, subjective norms and attitudes, subjective norms predicted intentions better when PBC was low. Theoretically, individuals with low perceptions of control or self-efficacy may be more open to the suggestions of important others. Future studies in TCS may benefit from testing interaction effects between PBC, attitudes and subjective norm.

Overall, the findings from our study indicate interventions aiming to develop intentions to meet the combined exercise guidelines may benefit from targeting the instrumental attitudes, self-efficacy, and to a lesser extent, affective attitudes of TCS. However, our understanding of the underlying accessible beliefs of TCS are more limited. Affective beliefs were poorly explained, with "fun and enjoyable activities" explaining the majority of variance in affective attitude. Instrumental beliefs explained 44% of the variance in instrumental attitude. Interestingly, the three significant beliefs were non-cancer specific benefits of meeting the combined exercise guidelines. This suggests interventions targeting the general benefits (and not cancer-specific benefits) of exercise adherence may be the most effective method to change intentions in TCS. Control beliefs explained greater variance in self-efficacy than controllability and differed between constructs. Two cancer-specific control beliefs emerged as significant predictors of self-efficacy. Specifically, greater belief in one's ability to exercise despite the diagnosis of a second type of cancer was associated with higher self-efficacy. Conversely, greater belief in one's ability to exercise following a recurrence of TC was associated with lower self-efficacy.

Overall, this study only provided a limited understanding of the underlying accessible beliefs towards the combined exercise guidelines in TCS. Ajzen recommends administering an elicitation survey to assess the salient beliefs in a particular population to gain the best reflection of beliefs underlying motivational processes [72]. Unfortunately, this was impractical in our study due to costs associated with cancer registry data extraction and mailout logistics. Therefore, common beliefs from other cancer survivor groups and assumed TC-specific beliefs were utilized to design this survey. A proper elicitation survey in future studies may significantly

improve the understanding of important beliefs related to meeting the combined exercise guidelines in TCS.

To the best of our knowledge, this is the first study to report the percentage of TCS meeting the combined, aerobic-only, resistance-only and neither exercise guideline. Previous studies of exercise prevalence report between 43-66% of TCS are sufficiently aerobically active, while 28% are achieving adequate resistance and flexibility exercise. In particular, one previous study of Canadian TCS reported 66% of participants meeting the aerobic exercise guidelines [38]. This matches the results from our study, with 66% of our sample meeting the aerobic guidelines (combined + aerobic-only guidelines). Additionally, 51% of participants in this study were meeting the resistance exercise guidelines (combined + resistance-only guidelines). The discrepancy in resistance training prevalence may result from the inclusion of flexibility exercise in the estimate by Reilley et al. [37].

Overall, TCS appear considerably more active than other cancer groups [113] and approximately as active as CDC controls [43]. However, a considerable proportion of TCS are insufficiently active and may benefit from targeted behaviour change strategies, especially considering the late effects from treatment. Over 50% of TCS in this study failed to achieve the combined exercise guidelines for cancer survivors. The exercise guidelines recommend a combination of aerobic and strength exercise due to the unique and varied physiological benefits each exercise modality provides. Therefore, although significant portions of the survivors in this study are meeting a single exercise guideline, further benefits may be obtained by meeting both aerobic and resistance guidelines concurrently.

The INTENT study had several important strengths and limitations that should be acknowledged. This is the first study to examine the correlates of exercise in TCS using a theory

of behaviour. The TPB is a well-supported social cognitive model of behaviour, with extensive use in predicting and explaining exercise in cancer survivors. This is the first study to examine the correlates of the dichotomized combined exercise guidelines using the TPB in any cancer survivor population. To enhance the predictive validity of the TPB, study measures were designed and analyzed with careful adherence to the principle of compatibility [71].

However, several limitations must also be acknowledged. The observational nature of the INTENT Study did not permit causal inferences and will require further corroboration and advancement through future prospective and experimental studies. With the poor response rate, it is unclear if participants in the INTENT study are representative of the general population of TCS. Moreover, with the modest sample size of this study, it was not possible to compare how the correlates of meeting the combined exercise guidelines differed by demographic and clinical variables. The INTENT study also relied on a retrospective assessment of exercise and self-report measures of demographic, clinical and behavioural variables. These methods may introduce response bias, which may be mitigated in future prospective studies using objective measures of behaviour. Finally, the INTENT Study was solely guided by the TPB, which has been criticized as insufficient to translate intentions into behaviours. Future studies may benefit from considering additional theories to further understand and predict exercise in TCS.

In conclusion, the INTENT Study is the first study to report the correlates of meeting the combined exercise guidelines in TCS using a theory. A substantial percentage of TCS are insufficiently active and may benefit from behaviour change interventions. Future intervention studies aiming to increase adherence to the combined exercise guidelines in TCS should focus on forming strong intentions to meet the combined exercise guidelines by targeting beliefs about the benefits and enjoyment of exercise and improving perceptions of competence in the exercise

domain. Individuals with a history of RPLND are more likely to be meeting the combined exercise guidelines following treatment for TC. Further corroboration from prospective and experimental studies is required to support these novel findings in TCS.

Table 1. Demographic and behavioural profile of INTENT Study participants overall and by exercise guideline.

	Overall (N=158)	Combined (N=66)	Aerobic Only (N=38)	Resistance Only (N=15)	Neither (N=39)	*p* value
Current age[a]	46.7 (12.4)	44.5 (11.1)	46.7 (12.6)	45.5 (15.0)	51.0 (12.5)	0.07
< 50 years old[b]	103 (65.2)	46 (69.7)	25 (65.8)	11 (73.3)	21 (53.8)	0.36
≥ 50 years old[b]	55 (34.8)	20 (30.3)	13 (34.2)	4 (26.7)	18 (46.2)	
Relationship status[b]						
Single	25 (15.8)	12 (18.2)	5 (13.2)	2 (13.3)	6 (15.4)	0.73
In a relationship	132 (83.5)	54 (81.8)	33 (86.8)	13 (86.7)	32 (82.1)	
Marital status[b]						
Married	108 (68.4)	41 (62.1)	29 (76.3)	10 (66.7)	28 (71.8)	0.72
Other	48 (30.4)	24 (36.4)	9 (23.7)	5 (33.3)	10 (25.6)	
Identify as LGBTQIA2[b]						
Yes	4 (2.5)	2 (3.0)	1 (2.6)	0 (0.0)	1 (2.6)	0.80
No	149 (94.3)	63 (95.5)	36 (94.7)	15 (100.0)	35 (89.7)	
Unsure	1 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.6)	
Gender[b]						
Male	157 (99.4)	66 (100.0)	37 (97.4)	15 (100.0)	39 (100.0)	0.37
Other	0 (0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Living arrangements[b]						
Alone	19 (12.0)	10 (15.2)	2 (5.3)	1 (6.7)	6 (15.4)	0.40
With others	138 (87.3)	56 (84.8)	36 (94.7)	14 (93.3)	32 (82.1)	
Locality[b]						
Urban	129 (81.6)	59 (89.4)	33 (86.8)	11 (73.3)	26 (66.7)	0.07
Rural	28 (17.7)	7 (10.6)	5 (13.2)	4 (26.7)	12 (30.8)	
Unsure	1 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.6)	
Education[b]						
Completed university/college	102 (64.6)	43 (65.2)	27 (71.1)	11 (73.3)	21 (53.8)	0.49
Did not complete university/college	53 (33.5)	22 (33.3)	11 (28.9)	4 (26.7)	16 (41.0)	
Employment[b]						
Full time	110 (69.6)	53 (80.3)	24 (63.2)	10 (66.7)	23 (59.0)	0.07
Less than full time	46 (29.1)	13 (19.7)	14 (36.8)	5 (33.3)	14 (35.9)	
Income[b]						
<$100,000	49 (31.0)	16 (24.2)	13 (34.2)	6 (40.0)	14 (35.9)	0.73
≥$100,000	96 (60.8)	45 (68.2)	22 (57.9)	7 (46.7)	22 (56.4)	
Ethnicity/race[b]						
White	141 (89.2)	58 (87.9)	34 (89.5)	13 (86.7)	36 (92.3)	0.67
Other	16 (10.1)	8 (12.1)	3 (7.9)	2 (13.3)	3 (7.7)	
Cigarette smoking[b]						
Never smoked	110 (69.6)	46 (69.7)	27 (71.1)	7 (46.7)	30 (76.9)	0.19
Previous/current smoker	48 (30.4)	20 (30.3)	11 (28.9)	8 (53.3)	9 (23.1)	
Cannabis use[b]						
Never used	113 (71.5)	47 (71.2)	27 (71.1)	8 (53.3)	31 (79.5)	0.30
Currently use	45 (28.5)	19 (28.8)	11 (28.9)	7 (46.7)	8 (20.5)	
Alcohol consumption (drinks per week)[b]						
0-2	94 (59.5)	35 (53.0)	25 (65.8)	7 (46.7)	27 (69.2)	0.23
≥3	64 (40.5)	31 (47.0)	13 (34.2)	8 (53.3)	12 (30.8)	

[a]Mean (standard deviation), [b]number (percentage), note: demographic information may not add up to 100% due to missing data

Table 2. Clinical profile of INTENT Study participants overall and by exercise guideline.

	Overall (N=158)	Combined (N=66)	Aerobic Only (N=38)	Resistance Only (N=15)	Neither (N=39)	*p* value
Age at diagnosis (years)[a]	37.9 (12.4)	36.2 (12.0)	37.5 (12.0)	37.9 (14.4)	41.1 (12.5)	0.28
≤ 35 years old[b]	75 (47.5)	35 (53.0)	17 (44.7)	7 (46.7)	16 (41.0)	0.66
> 35 years old[b]	83 (52.5)	31 (47.0)	21 (55.3)	8 (53.3)	23 (59.0)	
Time since diagnosis (years)[a]	8.4 (5.7)	7.8 (5.9)	8.9 (5.5)	7.0 (4.8)	9.5 (5.7)	0.35
< 5 years[b]	51 (32.3)	26 (39.4)	10 (26.3)	5 (33.3)	10 (25.6)	0.40
≥ 5 years[b]	107 (67.7)	40 (60.6)	28 (73.7)	10 (66.7)	29 (74.4)	
Morphology[b]						
Seminoma	73 (46.2)	30 (45.5)	22 (57.9)	8 (53.3)	13 (33.3)	0.11
Non-seminoma	23 (14.6)	14 (21.2)	3 (7.9)	2 (13.3)	4 (10.3)	
Unsure	62 (39.2)	22 (33.3)	13 (34.2)	5 (33.3)	22 (56.4)	
Testicles affected[b]						
One	155 (98.1)	65 (98.5)	36 (94.7)	15 (100.0)	39 (100.0)	0.33
Two	3 (1.9)	1 (1.5)	2 (5.3)	0 (0.0)	0 (0.0)	
Orchiectomy[b]						
Unilateral	149 (94.3)	64 (97.0)	35 (92.1)	14 (93.3)	36 (92.3)	0.41
Bilateral	6 (3.8)	1 (1.5)	3 (7.9)	0 (0.0)	2 (5.1)	
No surgery	3 (1.9)	1 (1.5)	0 (0.0)	1 (6.7)	1 (2.6)	
RPLND[b]						
Yes	23 (14.6)	15 (22.7)	4 (10.5)	0 (0.0)	4 (10.3)	0.11
No	116 (73.4)	43 (65.2)	29 (76.3)	15 (100.0)	29 (74.4)	
Unsure	19 (12.0)	8 (12.1)	5 (13.2)	0 (0.0)	6 (15.4)	
Radiation therapy[b]						
Yes	28 (17.7)	10 (15.2)	6 (15.8)	1 (6.7)	11 (28.2)	0.82
No	130 (82.3)	56 (84.8)	32 (84.2)	14 (93.3)	28 (71.8)	
Chemotherapy[b]						
Yes	46 (29.1)	19 (28.8)	11 (28.9)	3 (20.0)	13 (33.3)	0.82
No	112 (70.9)	47 (71.2)	27 (71.1)	12 (80.0)	26 (66.7)	
Metastases[b]						
Yes	57 (36.1)	21 (31.8)	13 (34.2)	5 (33.3)	18 (46.2)	0.50
No	101 (63.9)	45 (68.2)	25 (65.8)	10 (66.7)	21 (53.8)	
Recurrence[b]						
Yes	12 (7.6)	1 (1.5)	5 (13.2)	1 (6.7)	5 (12.8)	0.08
No	146 (92.4)	65 (98.5)	33 (86.8)	14 (93.3)	34 (87.2)	
Diagnosed with another cancer[b]						
Yes	14 (8.9)	4 (6.1)	7 (18.4)	2 (13.3)	1 (2.6)	0.07
No	144 (91.1)	62 (93.9)	31 (81.6)	13 (86.7)	38 (97.4)	
Body weight (kg)[a]	90.8 (15.4)	88.8 (14.7)	93.3 (16.7)	84.6 (12.6)	93.9 (15.5)	0.11
Body mass index (kg/m^2) [a]	27.7 (4.7)	27.0 (3.9)	27.8 (4.8)	25.5 (3.0)	29.6 (5.7)	**0.008**
Underweight (<18) [b]	1 (0.6)	0 (0.0)	1 (2.6)	0 (0.0)	0 (0.0)	0.14
Healthy weight (18 to <25)[b]	40 (25.3)	20 (30.3)	9 (23.7)	5 (33.3)	6 (15.4)	
Overweight (25 to <30) [b]	79 (50.0)	35 (53.0)	17 (44.7)	9 (60.0)	18 (46.2)	
Obese (≥30)[b]	38 (24.1)	11 (16.7)	11 (28.9)	1 (6.7)	15 (38.5)	
Chronic Conditions[b]						
Yes	42 (26.6)	12 (18.2)	15 (39.5)	1 (6.7)	14 (35.9)	**0.015**
No	116 (73.4)	54 (81.8)	23 (60.5)	14 (93.3)	25 (64.1)	

[a]Mean (standard deviation), [b]number (percentage)

Table 3. Demographic and behavioural profile of INTENT Study participants overall and by combined exercise guidelines.

	Overall (N=158)	Meeting Combined (N=66)	Not Meeting Combined (N=92)	*p* value
Current age[a]	46.7 (12.4)	44.5 (11.1)	48.3 (13.0)	0.053
< 50 years old[b]	103 (65.2)	46 (69.7)	57 (62.0)	0.31
≥ 50 years old[b]	55 (34.8)	20 (30.3)	35 (38.0)	
Relationship status[b]				
Single	25 (15.8)	12 (18.2)	13 (14.1)	0.56
In a relationship	132 (83.5)	54 (81.8)	78 (84.8)	
Marital status[b]				
Married	108 (68.4)	41 (62.1)	67 (72.8)	0.36
Other	48 (30.5)	24 (36.4)	24 (26.1)	
Identify as LGBTQIA2[b]				
Yes	4 (2.5)	2 (3.0)	2 (2.2)	0.73
No	149 (94.3)	63 (95.5)	86 (93.5)	
Unsure	1 (0.6)	0 (0.0)	1 (1.1)	
Gender[b]				
Male	157 (99.4)	66 (100.0)	91 (98.9)	0.40
Other	0 (0)	0 (0.0)	0 (0.0)	
Living arrangements[b]				
Alone	19 (12.0)	10 (15.2)	9 (9.8)	0.42
With others	138 (87.3)	56 (84.8)	82 (89.1)	
Locality[b]				
Urban	129 (81.6)	59 (89.4)	70 (76.1)	0.09
Rural	28 (17.7)	7 (10.6)	21 (22.8)	
Unsure	1 (0.6)	0 (0.0)	1 (1.1)	
Education[b]				
Completed university/college	102 (65.0)	43 (65.2)	59 (64.1)	0.95
Did not complete university/college	53 (33.5)	22 (33.3)	31 (33.7)	
Employment[b]				
Full time	110 (69.6)	53 (80.3)	57 (62.0)	**0.034**
Less than full time	46 (29.2)	13 (19.7)	33 (35.9)	
Income[b]				
<$100,000	62 (39.2)	16 (24.2)	33 (35.9)	0.25
≥$100,000	96 (60.8)	45 (68.2)	51 (55.4)	
Ethnicity/race[b]				
White	141 (89.2)	58 (87.9)	83 (90.2)	0.55
Other	16 (10.1)	8 (12.1)	8 (8.7)	
Cigarette smoking[b]				
Never smoked	110 (69.6)	46 (69.7)	64 (69.6)	0.99
Previous/current smoker	48 (30.4)	20 (30.3)	28 (30.4)	
Cannabis use[b]				
Never used	113 (71.5)	47 (71.2)	66 (71.7)	0.94
Currently use	45 (28.5)	19 (28.8)	26 (28.3)	
Alcohol consumption (drinks per week)[b]				
0-2	94 (59.4)	35 (53.0)	59 (64.1)	0.16
≥3	64 (40.5)	31 (47.0)	33 (35.9)	

[a]Mean (standard deviation), [b]number (percentage), note: demographic information may not add up to 100% due to missing data

Table 4. Clinical profile of INTENT Study participants overall and by combined exercise guidelines.

	Overall (N=158)	Meeting Combined (N=66)	Not Meeting Combined (N=92)	*p* value
Age at diagnosis (years)[a]	37.9 (12.4)	36.2 (12.0)	39.1 (12.6)	0.15
≤ 35 years old[b]	75 (47.5)	35 (53.0)	40 (43.5)	0.24
> 35 years old[b]	83 (52.5)	31 (47.0)	52 (56.5)	
Time since diagnosis (years)[a]	8.4 (5.7)	7.8 (5.9)	8.8 (5.5)	0.27
< 5 years[b]	51 (32.3)	26 (39.4)	25 (27.2)	0.11
≥ 5 years[b]	107 (67.7)	40 (60.6)	67 (72.8)	
Morphology[b]				
Seminoma	73 (46.2)	30 (45.5)	43 (46.7)	0.11
Non-seminoma	23 (14.6)	14 (21.2)	9 (9.8)	
Unsure	62 (39.2)	22 (33.3)	40 (43.5)	
Testicles affected[b]				
One	155 (98.1)	65 (98.5)	90 (97.8)	0.77
Two	3 (1.9)	1 (1.5)	2 (2.2)	
Orchiectomy[b]				
Unilateral	149 (94.3)	64 (97.0)	85 (92.4)	0.42
Bilateral	6 (3.8)	1 (1.5)	5 (5.4)	
No surgery	3 (1.9)	1 (1.5)	2 (2.2)	
RPLND[b]				
Yes	23 (14.6)	15 (22.7)	8 (8.7)	**0.044**
No	116 (73.4)	43 (65.2)	73 (79.3)	
Unsure	19 (12.0)	8 (12.1)	11 (12.0)	
Radiation therapy[b]				
Yes	28 (17.7)	10 (15.2)	18 (19.6)	0.47
No	130 (82.3)	56 (84.8)	74 (80.4)	
Chemotherapy[b]				
Yes	46 (29.1)	19 (28.8)	27 (29.3)	0.94
No	112 (70.9)	47 (71.2)	65 (70.7)	
Metastases[b]				
Yes	57 (36.1)	21 (31.8)	36 (39.1)	0.35
No	101 (63.9)	45 (68.2)	56 (60.9)	
Recurrence[b]				
Yes	12 (7.6)	1 (1.5)	11 (12.0)	**0.015**
No	146 (92.4)	65 (98.5)	81 (88.0)	
Diagnosed with another cancer[b]				
Yes	14 (8.9)	4 (6.1)	10 (10.9)	0.29
No	144 (91.1)	62 (93.9)	82 (89.1)	
Body weight (kg)[a]	90.8 (15.4)	88.8 (14.7)	92.2 (15.8)	0.18
Body mass index (kg/m^2) [a]	27.7 (4.7)	27.0 (3.9)	28.2 (5.1)	0.13
Underweight (<18) [b]	1 (0.6)	0 (0.0)	1 (1.1)	0.20
Healthy weight (18 to <25)[b]	40 (25.3)	20 (30.3)	20 (21.7)	
Overweight (25 to <30) [b]	79 (50.0)	35 (53.0)	44 (47.8)	
Obese (≥30)[b]	38 (24.1)	11 (16.7)	27 (29.3)	
Chronic Conditions[b]				
Yes	42 (26.6)	12 (18.2)	30 (32.6)	**0.043**
No	116 (73.4)	54 (81.8)	62 (67.4)	

[a]Mean (standard deviation), [b]number (percentage), RPLND=retroperitoneal lymph node dissection

Table 5. Exercise behavior of INTENT Study participants overall and by exercise guideline.

	Overall (N=158)	Combined (N=66)	Aerobic Only (N=38)	Resistance Only (N=15)	Neither (N=39)
Exercise behavior (mins/week)[a]					
Light aerobic exercise	90.0 (0.0-185.0)	112.5 (30.0-180.0)	60.0 (0.0-255.0)	75.0 (0.0-210.0)	90.0 (0.0-180.0)
Moderate aerobic exercise	60.0 (0.0-180.0)	120.0 (60.0-241.3)	150.0 (60.0-242.5)	60.0 (0.0-75.0)	0.0 (0.0-0.0)
Vigorous aerobic exercise	60.0 (0.0-150.0)	120.0 (80.0-255.0)	82.5 (0.0-161.3)	0.0 (0.0-10.0)	0.0 (0.0-0.0)
Resistance exercise	42.5 (0.0-142.5)	145.0 (90.0-217.5)	0.0 (0.0-11.3)	90.0 (45.0-180.0)	0.0 (0.0-0.0)
Moderate plus vigorous aerobic exercise	240.0 (87.5-480.0)	420.0 (292.5-776.3)	290.0 (217.5-543.8)	60.0 (30.0-120.0)	0.0 (0.0-80.0)

[a]Median (interquartile range)

Table 6. Theory of planned behavior constructs and perceived physical fitness of INTENT Study participants overall and by exercise guideline.

	Overall (N=158)	Combined (N=66)	Aerobic Only (N=38)	Resistance Only (N=15)	Neither (N=39)	*p* value
Motivational constructs[a]						
Intention	5.3 (1.7)	6.2 (0.9)	5.4 (1.8)	5.6 (1.2)	3.7 (1.9)	**<0.001**
Planning	4.7 (1.8)	5.4 (1.2)	4.4 (1.8)	5.9 (1.2)	3.2 (1.8)	**<0.001**
Self-efficacy	5.5 (1.5)	5.9 (1.2)	5.5 (1.3)	5.9 (1.3)	4.5 (1.7)	**<0.001**
Controllability	6.0 (1.1)	6.1 (1.0)	6.0 (1.3)	6.5 (0.8)	5.5 (1.2)	**0.027**
Instrumental attitude	6.2 (0.9)	6.6 (0.6)	6.2 (0.9)	6.1 (0.7)	5.6 (1.2)	**<0.001**
Affective attitude	5.4 (1.3)	6.0 (0.9)	5.4 (1.1)	5.0 (1.2)	4.5 (1.4)	**<0.001**
Descriptive norm	4.8 (1.5)	4.9 (1.4)	4.8 (1.5)	4.7 (1.7)	4.6 (1.7)	0.78
Injunctive norm	6.1 (0.8)	6.1 (0.8)	6.2 (0.7)	5.8 (0.9)	6.1 (0.8)	0.36
Exercise beliefs[a]						
Affective beliefs	4.7 (0.9)	4.9 (0.9)	5.0 (0.7)	4.4 (0.8)	4.3 (0.9)	**<0.001**
Instrumental beliefs	5.5 (0.8)	5.7 (0.7)	5.5 (0.6)	5.4 (0.7)	5.0 (0.9)	**<0.001**
Injunctive beliefs	5.9 (1.0)	5.9 (1.0)	6.1 (1.0)	6.0 (0.7)	5.7 (1.0)	0.35
Control beliefs	3.8 (1.3)	4.4 (1.2)	3.7 (1.2)	4.1 (1.2)	3.0 (1.2)	**<0.001**
Perceived physical fitness[a]	39.7 (8.8)	43.1 (7.8)	39.5 (8.9)	42.7 (5.5)	33.2 (7.9)	**<0.001**

[a]Mean (standard deviation)

Table 7. Theory of planned behavior constructs and perceived physical fitness of INTENT Study participants overall and by combined exercise guidelines.

	Overall (N=158)	Meeting Combined (N=66)	Not Meeting Combined (N=92)	*p* value
Motivational constructs[a]				
Intention	5.3 (1.7)	6.2 (0.9)	4.7 (1.9)	**<0.001**
Planning	4.7 (1.8)	5.4 (1.2)	4.1 (1.9)	**<0.001**
Self-efficacy	5.5 (1.5)	5.9 (1.2)	5.1 (1.5)	**<0.001**
Controllability	6.0 (1.1)	6.1 (1.0)	5.9 (1.2)	0.22
Instrumental attitude	6.2 (0.9)	6.6 (0.6)	5.9 (1.0)	**<0.001**
Affective attitude	5.4 (1.3)	6.0 (0.9)	4.9 (1.3)	**<0.001**
Descriptive norm	4.8 (1.5)	4.9 (1.4)	4.7 (1.6)	0.42
Injunctive norm	6.1 (0.8)	6.1 (0.8)	6.1 (0.8)	0.58
Exercise beliefs[a]				
Affective beliefs	4.7 (0.9)	4.9 (0.9)	4.6 (0.9)	**0.020**
Instrumental beliefs	5.5 (0.8)	5.7 (0.7)	5.3 (0.8)	**<0.001**
Injunctive beliefs	5.9 (1.0)	5.9 (1.0)	5.9 (1.0)	0.74
Control beliefs	3.8 (1.3)	4.4 (1.2)	3.5 (1.3)	**<0.001**
Perceived Physical Fitness[a]	39.7 (8.8)	43.1 (7.8)	37.3 (8.8)	**<0.001**

[a]Mean (standard deviation)

Table 8. Exercise beliefs of INTENT Study participants overall and by exercise guideline.

	Overall M(SD)	Combined M(SD)	Aerobic Only M(SD)	Resistance Only M(SD)	Neither M(SD)	*p* value
Affective beliefs (fun/enjoyable)[a]	4.7 (0.9)	4.9 (0.9)	5.0 (0.7)	4.4 (0.8)	4.3 (0.9)	**<0.001**
Exercise with other people	3.9 (2.1)	3.8 (2.1)	4.5 (2.0)	3.2 (2.0)	3.8 (2.1)	0.14
Do a variety of activities	5.2 (1.5)	5.5 (1.4)	5.0 (1.6)	5.3 (1.5)	4.7 (1.4)	**0.026**
Exercise outdoors for fresh air or scenery	5.3 (1.5)	5.3 (1.4)	5.8 (1.5)	4.4 (2.1)	5.1 (1.4)	**0.013**
Exercise in good weather	5.4 (1.5)	5.4 (1.4)	5.6 (1.5)	5.3 (1.6)	5.2 (1.5)	0.56
Participate in team sports	2.8 (2.0)	3.3 (2.0)	3.2 (2.3)	1.9 (1.2)	2.1 (1.4)	**0.003**
Exercise to music	4.7 (2.1)	5.2 (1.9)	4.6 (2.3)	4.6 (2.3)	3.9 (2.0)	**0.027**
Do an activity that is fun or enjoyable	5.6 (1.1)	5.9 (1.0)	5.9 (1.0)	5.0 (1.4)	5.3 (1.2)	**0.006**
Do an activity that is pain-free	4.9 (1.6)	5.1 (1.6)	5.1 (1.5)	5.2 (1.4)	4.5 (1.7)	0.22
Instrumental beliefs (benefits)[a]	5.5 (0.8)	5.7 (0.7)	5.5 (0.6)	5.4 (0.7)	5.0 (0.9)	**<0.001**
Feel better and improve your well-being	6.3 (0.8)	6.6 (0.6)	6.4 (0.6)	6.3 (0.7)	5.9 (1.2)	**0.002**
Reduce the risk of your testicular cancer returning	4.3 (1.6)	4.5 (1.7)	4.2 (1.5)	3.9 (1.8)	4.0 (1.6)	0.33
Relieve stress	5.9 (1.1)	6.3 (0.8)	6.0 (1.0)	5.7 (1.2)	5.3 (1.4)	**<0.001**
Improve your energy level	6.0 (1.0)	6.4 (0.8)	6.1 (0.7)	6.0 (0.8)	5.5 (1.3)	**<0.001**
Get your mind off cancer	4.5 (1.7)	4.6 (1.9)	4.9 (1.4)	4.5 (2.0)	4.0 (1.6)	0.12
Live longer	6.0 (1.0)	6.3 (0.9)	5.8 (1.2)	6.2 (0.7)	5.6 (1.0)	**0.005**
Reduce your risk of cardiovascular disease	6.2 (0.9)	6.4 (0.7)	6.2 (0.8)	6.2 (0.8)	5.7 (1.1)	**0.004**
Reduce the risk of your testicular cancer returning	5.3 (1.3)	5.5 (1.4)	5.4 (1.3)	4.9 (1.3)	4.9 (1.0)	0.07
Improve fertility	3.4 (1.9)	3.5 (2.0)	3.5 (1.8)	3.4 (1.9)	3.1 (1.7)	0.82
Improve your body image	5.9 (1.0)	6.3 (0.8)	5.9 (0.9)	5.9 (0.7)	5.3 (1.3)	**<0.001**
Sleep better	5.7 (1.2)	6.0 (1.1)	5.6 (1.3)	5.6 (1.2)	5.4 (1.2)	**0.043**
Feel more masculine	5.1 (1.6)	5.7 (1.2)	4.8 (1.6)	5.4 (1.0)	4.2 (1.9)	**<0.001**
Improve fitness	6.3 (0.8)	6.6 (0.7)	6.1 (0.7)	6.3 (0.7)	6.1 (0.9)	**0.002**
Injunctive beliefs (approval)[a]	5.9 (1.0)	5.9 (1.0)	6.1 (1.0)	6.0 (0.7)	5.7 (1.0)	0.35
Spouse / partner[b]	6.2 (1.2)	6.1 (1.3)	6.3 (1.2)	6.5 (0.5)	6.2 (1.2)	0.70
Children[c]	5.8 (1.4)	5.7 (1.2)	5.9 (1.6)	6.0 (0.8)	5.7 (1.5)	0.84
Parents[d]	5.7 (1.3)	5.8 (1.3)	5.9 (1.3)	5.8 (1.1)	5.1 (1.1)	0.11
Friends[e]	5.7 (1.2)	5.8 (1.1)	5.8 (1.3)	5.7 (0.8)	5.2 (1.3)	0.06
Family doctor[f]	6.3 (1.1)	6.3 (1.2)	6.6 (1.1)	6.4 (1.1)	6.2 (1.0)	0.39
Oncologist[g]	6.1 (1.4)	6.2 (1.3)	6.2 (1.3)	6.3 (1.1)	5.6 (1.5)	0.17
Coworkers[h]	5.3 (1.3)	5.4 (1.2)	5.4 (1.3)	5.4 (1.2)	4.9 (1.4)	0.30
Control beliefs (barriers)[a]	3.8 (1.3)	4.4 (1.2)	3.7 (1.2)	4.1 (1.2)	3.0 (1.2)	**<0.001**
The weather was very bad	4.9 (1.8)	5.7 (1.5)	4.4 (2.0)	5.4 (1.5)	3.8 (1.7)	**<0.001**
You felt tired or fatigued	4.2 (1.8)	4.9 (1.6)	4.2 (1.8)	4.7 (1.6)	3.0 (1.6)	**<0.001**
You had medical or health problems	3.5 (1.6)	4.1 (1.5)	3.5 (1.6)	3.6 (1.5)	2.7 (1.5)	**<0.001**
You got very busy and had limited time	3.8 (1.8)	4.3 (1.7)	4.0 (1.8)	4.1 (2.0)	2.7 (1.4)	**<0.001**
You had a recurrence of your cancer	3.6 (1.8)	4.2 (1.8)	3.2 (1.7)	3.5 (1.6)	2.9 (1.6)	**0.002**
You had pain or soreness	3.8 (1.6)	4.4 (1.6)	3.6 (1.5)	4.3 (1.6)	2.9 (1.4)	**<0.001**
You had additional family responsibilities	3.8 (1.7)	4.3 (1.5)	3.6 (1.8)	4.3 (1.5)	2.9 (1.5)	**<0.001**
The activity became boring	4.1 (1.7)	4.8 (1.4)	3.7 (1.9)	4.7 (1.6)	3.2 (1.5)	**<0.001**
You went back on cancer treatments	3.1 (1.7)	3.6 (1.7)	2.7 (1.7)	3.2 (1.1)	2.5 (1.6)	**0.003**

You had limited or no access to recreation facilities or gyms	4.2 (1.9)	4.5 (2.0)	4.3 (1.9)	4.5 (2.3)	3.4 (1.6)	**0.037**
You developed cardiovascular disease	3.8 (1.6)	4.2 (1.5)	3.6 (1.6)	4.2 (1.4)	3.3 (1.6)	**0.034**
You were diagnosed with a second type of cancer	3.3 (1.8)	3.8 (1.8)	3.1 (1.9)	3.2 (1.5)	2.7 (1.6)	**0.023**

[a]Overall (N=158), combined (N=66), aerobic only (N=38), resistance only (N=15), neither (N=39), [b]overall (N=137), combined (N=56), aerobic only (N=33), resistance only (N=13), neither (N=35), [c]overall (N=111), combined (N=43), aerobic only (N=26), resistance only (N=11), neither (N=31), [d]overall (N=112), combined (N=49), aerobic only (N=29), resistance only (N=10), neither (N=24), [e]overall (N=149), combined (N=64), aerobic only (N=36), resistance only (N=14), neither (N=35), [f]overall (N=146), combined (N=59), aerobic only (N=36), resistance only (N=14), neither (N=37), [g]overall (N=123), combined (N=49), aerobic only (N=32), resistance only (N=13), neither (N=29), [h]overall (N=121), combined (N=53), aerobic only (N=28), resistance only (N=10), neither (N=30)

Table 9. Associations between affective beliefs and affective attitude, intention, and meeting the combined exercise guidelines.

	Affective attitude	Intention	CEG
Exercise with other people	0.19*	0.17*	-0.05
Do a variety of activities	0.38***	0.38***	0.21**
Exercise outdoors for fresh air or scenery	0.27***	0.26**	0.01
Exercise in good weather	0.22**	0.33***	-0.001
Participate in team sports	0.24**	0.13	0.19*
Exercise to music	0.19*	0.21**	0.21**
Do an activity that is fun or enjoyable	0.47***	0.33***	0.16*
Do an activity that is pain-free	0.18*	0.22**	0.07

CEG=combined exercise guidelines; *p<0.05, **p<0.01, ***p<0.001

Table 10. Associations between instrumental beliefs and instrumental attitude, intention, and meeting the combined exercise guidelines.

	Instrumental attitude	Intention	CEG
Feel better and improve your well-being	0.56***	0.56***	0.23**
Reduce the risk of your testicular cancer returning	0.17*	0.23**	0.14
Relieve stress	0.56***	0.56***	0.29***
Improve your energy level	0.57***	0.58***	0.26***
Get your mind off cancer	0.26**	0.37***	0.05
Live longer	0.47***	0.36***	0.25**
Reduce your risk of cardiovascular disease	0.45***	0.41***	0.21**
Reduce your risk of developing other types of cancer	0.24**	0.26***	0.16
Improve fertility	0.23**	0.15	0.04
Improve your body image	0.46***	0.41***	0.32***
Sleep better	0.38***	0.44***	0.22**
Feel more masculine	0.37***	0.37***	0.34***
Improve fitness	0.46***	0.46***	0.29***

CEG=combined exercise guidelines; *p<0.05, **p<0.01, ***p<0.001

Table 11. Associations between control beliefs and controllability, self-efficacy, intention, and meeting the combined exercise guidelines.

	Controllability	Self-efficacy	Intention	CEG
The weather was very bad	0.28***	0.43***	0.54***	0.37***
You felt tired or fatigued	0.43***	0.59***	0.62***	0.31***
You had medical or health problems	0.36***	0.50***	0.46***	0.27***
You got very busy and had limited time	0.43***	0.59***	0.56***	0.23**
You had a recurrence of your cancer	0.29***	0.34***	0.35***	0.29***
You had pain or soreness	0.37***	0.47***	0.49***	0.29***
You had additional family responsibilities	0.48***	0.58***	0.55***	0.26***
The activity became boring	0.30***	0.46***	0.57***	0.34***
You went back on cancer treatments	0.25**	0.32***	0.35***	0.27***
You had limited or no access to recreation facilities or gyms	0.35***	0.40***	0.39***	0.13
You developed cardiovascular disease	0.27***	0.38***	0.38***	0.18*
You were diagnosed with a second type of cancer	0.35***	0.42***	0.39***	0.23**

CEG=combined exercise guidelines; *p<0.05, **p<0.01, ***p<0.001

Table 12. Social cognitive, medical and demographic correlates of meeting the combined exercise guidelines in testicular cancer survivors using hierarchical multivariable logistic regression.

	Model 1[a]		Model 2[b]		Model 3[c]		Model 4[d]	
	OR (95%CI)	*p* value	OR (95%CI)	*p* value	OR (95%CI)	*p* value	OR (95%CI)	*p* value
Block 1								
Intention[e]	1.93 (1.34-2.77)	**<0.001**	1.52 (0.98-2.34)	0.06	1.46 (0.93-2.28)	0.10	1.71 (1.04-2.81)	**0.035**
Planning[e]	1.23 (0.91-1.66)	0.18	1.17 (0.84-1.62)	0.36	1.14 (0.81-1.59)	0.45	1.17 (0.80-1.71)	0.41
Controllability[e]	0.78 (0.53-1.13)	0.19	0.70 (0.39-1.25)	0.23	0.67 (0.37-1.20)	0.18	0.72 (0.38-1.38)	0.32
Block 2								
Affective attitude[e]			1.64 (1.01-2.67)	**0.046**	1.46 (0.88-2.40)	0.14	1.29 (0.75-2.22)	0.36
Instrumental attitude[e]			1.57 (0.78-3.16)	0.21	1.77 (0.85-3.69)	0.13	1.32 (0.56-3.11)	0.52
Descriptive norm[e]			0.96 (0.73-1.25)	0.73	0.90 (0.69-1.19)	0.48	0.97 (0.71-1.32)	0.84
Injunctive norm[e]			0.85 (0.52-1.40)	0.53	0.92 (0.56-1.52)	0.74	0.89 (0.52-1.54)	0.68
Self-efficacy[e]			1.08 (0.62-1.90)	0.78	1.08 (0.61-1.91)	0.80	1.13 (0.60-2.12)	0.71
Block 3								
Perceived physical fitness[e]					1.05 (1.00-1.11)	0.07	1.05 (0.99-1.11)	0.12
Block 4								
Current age (per year)							0.99 (0.95-1.03)	0.71
Employment (full time vs less than full time)							1.99 (0.62-6.42)	0.25
RPLND (yes vs no)							5.15 (1.36-19.42)	**0.016**
Recurrence (yes vs no)							0.13 (0.01-1.54)	0.11
Chronic medical conditions (yes vs no)							0.94 (0.32-2.81)	0.92

Note: all variables were entered into the model using forced entry, OR=odds ratio, CI=95% confidence interval, RPLND=retroperitoneal lymph node dissection, [a]Nagelkerke R^2= 0.28, [b]Nagelkerke R^2=0.34, [c]Nagelkerke R^2=0.36, [d]Nagelkerke R^2=0.45, [e]change in dependent variable per one point change in independent variable

Table 13. Social cognitive, medical and demographic correlates of intention to meet the combined exercise guidelines in testicular cancer survivors using hierarchical multiple linear regression.

	Model 1		Model 2		Model 3		R^2_{change}	*p* value
	ß (95% CI)	*p* value	ß (95% CI)	*p* value	ß (95% CI)	*p* value		
Block 1							0.630	**<0.001**
Affective attitude[a]	0.19 (0.06-0.46)	**0.012**	0.16 (0.01-0.43)	**0.040**	0.18 (0.04-0.47)	**0.019**		
Instrumental attitude[a]	0.40 (0.52-1.00)	**<0.001**	0.40 (0.52-1.00)	**<0.001**	0.42 (0.54-1.05)	**<0.001**		
Descriptive norm[a]	-0.04 (-0.17-0.08)	0.47	-0.05 (-0.18-0.06)	0.34	-0.07 (-0.21-0.04)	0.18		
Injunctive norm[a]	0.08 (-0.06-0.40)	0.14	0.09 (-0.04-0.42)	0.12	0.09 (-0.03-0.43)	0.09		
Self-efficacy[a]	0.42 (0.28-0.73)	**<0.001**	0.41 (0.26-0.72)	**<0.001**	0.40 (0.25-0.71)	**<0.001**		
Controllability[a]	-0.11 (-0.43-0.08)	0.17	-0.12 (-0.43-0.07)	0.16	-0.15 (-0.49-0.02)	0.07		
Block 2							0.004	0.18
Perceived physical fitness[a]			0.08 (-0.01-0.04)	0.18	0.11 (-0.00-0.05)	0.09		
Block 3							0.018	0.19
Current age (per year)					0.05 (-0.01-0.02)	0.42		
Employment (full time vs less than full time)					-0.04 (-0.61-0.31)	0.52		
RPLND (yes vs no)					-0.06 (-0.77-0.23)	0.29		
Recurrence (yes vs no)					0.02 (-0.59-0.80)	0.77		
Chronic conditions (yes vs no)					0.08 (-0.13-0.74)	0.17		
Total Model							0.653	**<0.001**

Note: all variables were entered into the model using forced entry, ß=standardized regression coefficient, R^2= explained variance, RPLND=retroperitoneal lymph node dissection, [a]change in dependent variable per one point change in independent variable

Table 14. Associations between attitude-based beliefs and global attitude constructs using stepwise multiple linear regression.

	ß (95% CI)	*p* value	R^2_{change}	*p* value
Affective attitude				
Step 1			0.22	**<0.001**
Do an activity that is fun or enjoyable	0.47 (0.37-0.69)	**<0.001**		
Step 2			0.03	**0.011**
Do an activity that is fun or enjoyable	0.39 (0.27-0.61)	**<0.001**		
Do a variety of activities	0.20 (0.04-0.29)	**0.011**		
Step 3			0.02	**0.029**
Do an activity that is fun or enjoyable	0.36 (0.24-0.58)	**<0.001**		
Do a variety of activities	0.20 (0.04-0.29)	**0.009**		
Participate in team sports	0.16 (0.01-0.19)	**0.029**		
Total Model			0.28	**<0.001**
Instrumental attitude				
Step 1			0.32	**<0.001**
Improve your energy level	0.57 (0.41-0.65)	**<0.001**		
Step 2			0.07	**<0.001**
Improve your energy level	0.45 (0.29-0.54)	**<0.001**		
Live longer	0.29 (0.14-0.38)	**<0.001**		
Step 3			0.04	**0.002**
Improve your energy level	0.27 (0.10-0.42)	**0.002**		
Live longer	0.26 (0.11-0.35)	**<0.001**		
Relieve stress	0.27 (0.08-0.37)	**0.002**		
Step 4			0.03	**0.006**
Improve your energy level	0.16 (-0.03-0.32)	0.12		
Live longer	0.21 (0.07-0.31)	**0.002**		
Relieve stress	0.24 (0.06-0.34)	**0.005**		
Feel better and improve your well-being	0.23 (0.07-0.44)	**0.006**		
Step 5			-0.01	0.11
Live longer	0.22 (0.08-0.32)	**0.001**		
Relieve stress	0.31 (0.14-0.38)	**<0.001**		
Feel better and improve your well-being	0.29 (0.16-0.48)	**<0.001**		
Total Model			0.44	**<0.001**

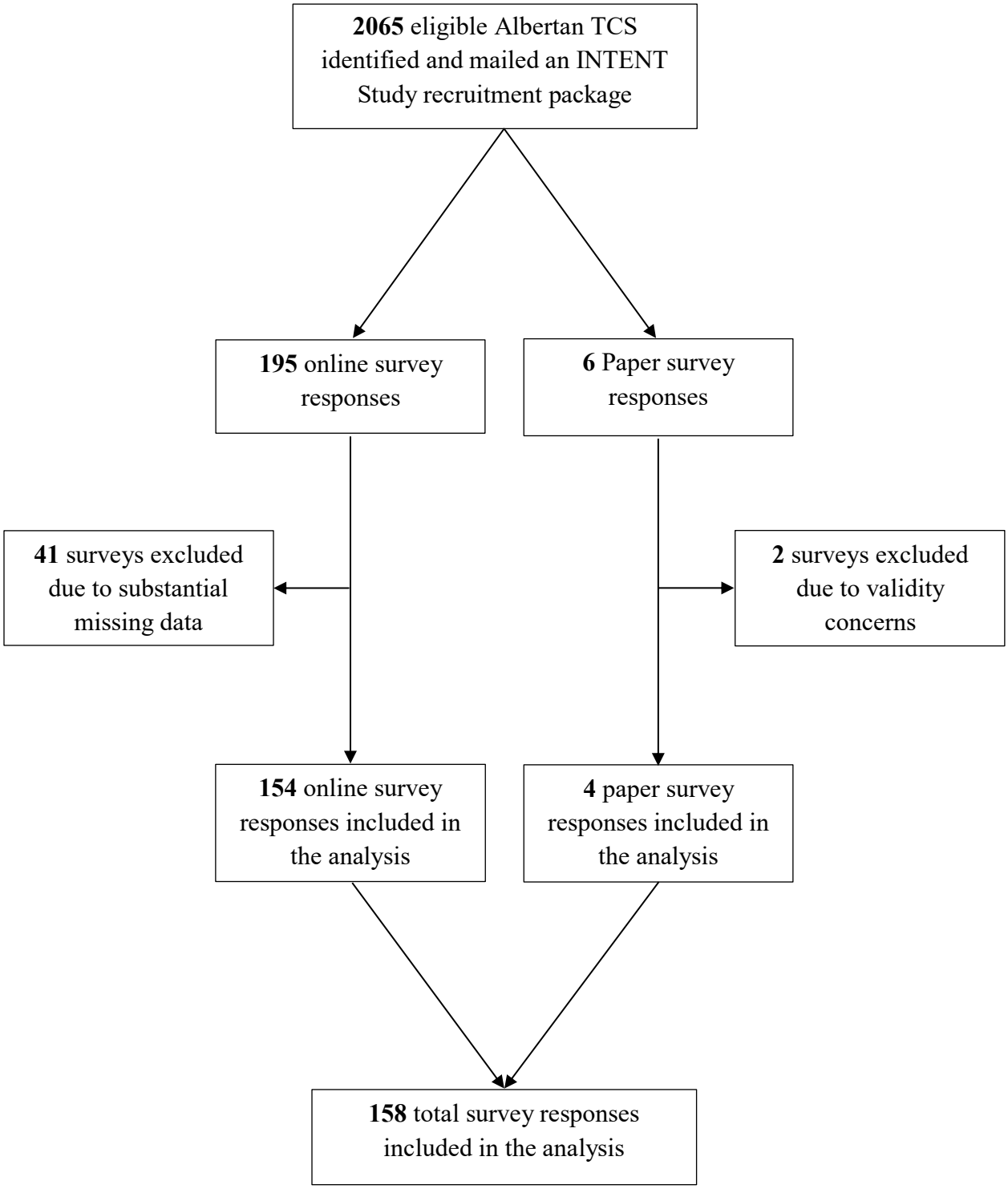
ß=standardized regression coefficient, R^2= explained variance

Table 15. Associations between control-based beliefs and global perceived behavioral control constructs using stepwise multiple linear regression.

	ß (95% CI)	*p* value	R^2_{change}	*p* value
Controllability				
Step 1			0.23	**<0.001**
You had additional family responsibilities	0.48 (0.23-0.42)	**<0.001**		
Step 2			0.02	**0.04**
You had additional family responsibilities	0.41 (0.17-0.38)	**<0.001**		
You had limited or no access to recreation facilities or gyms	0.16 (0.00-0.19)	**0.04**		
Total Model			0.25	**<0.001**
Self-efficacy				
Step 1			0.35	**<0.001**
You felt tired or fatigued	0.59 (0.37-0.58)	**<0.001**		
Step 2			0.06	**<0.001**
You felt tired or fatigued	0.35 (0.14-0.43)	**<0.001**		
You got very busy and had limited time	0.34 (0.13-0.41)	**<0.001**		
Step 3			0.02	**0.022**
You felt tired or fatigued	0.32 (0.11-0.40)	**<0.001**		
You got very busy and had limited time	0.29 (0.09-0.37)	**0.002**		
You were diagnosed with a second type of cancer	0.16 (0.02-0.24)	**0.022**		
Step 4			0.02	**0.039**
You felt tired or fatigued	0.32 (0.12-0.40)	**<0.001**		
You got very busy and had limited time	0.23 (0.12-0.41)	**<0.001**		
You were diagnosed with a second type of cancer	0.32 (0.09-0.42)	**0.002**		
You had a recurrence of your cancer	-0.22 (-0.35 to -0.01)	**0.039**		
Total Model			0.44	**<0.001**

ß=standardized regression coefficient, R^2= explained variance

Figure 1. Participant flow through the INTENT Study.



CHAPTER THREE

GENERAL DISCUSSION

General Discussion

This section of the document is dedicated to an expanded discussion of the INTENT Study results. In particular, strengths and limitations of the study and future research directions will be discussed in greater detail.

Strengths and Limitations

The INTENT Study has several notable strengths and limitations that warrant further elaboration and discussion below. Overall, the INTENT Study provides novel insights into the motivational profile of TCS regarding exercise. To the best of our knowledge, the INTENT Study is the first study to examine the correlates of exercise in TCS using a theory of behaviour. Previous studies of exercise prevalence have atheorerically examined a small number of exercise correlates in TCS. However, theories of behaviour provide a structural framework of determinants and mechanisms of action explaining how a set of concepts are related or changed [54]. Although empirical support for the superiority of theoretically developed behaviour change interventions is inconsistent, several reviews have reported positive associations between theoretical designs and changes in behaviour [78,114,115]. These mixed findings may be partially explained by poorly applied or inappropriate selection of theoretical frameworks based on the context of behaviour [54]. The TPB was selected as the model of behaviour to guide this study due to extensive empirical testing and refinement [69,70], availability and validity of measurement scales [71,72], extensive use in cancer survivor populations (Appendix A, Table 2) [116] and efficacy in the physical activity and exercise domain [67,70,74-76]. Exercise is defined as planned, structured and repetitive bodily movements performed to increase physical fitness [27]. As a social-cognitive model, the TPB may be aptly positioned to explain exercise motivation given the inherently

volitional nature of the behaviour. Following standard practices outlined by Ajzen [72,73], the INTENT Study aimed to identify the key correlates of meeting the combined exercise guidelines. This formative research provides greater precision in the selection of key constructs to target in future intervention research. Findings from the INTENT Study provide preliminary evidence of the usefulness of the TPB to explain exercise among TCS.

In addition, the INTENT Study was the first study to examine the correlates of the dichotomized combined exercise guidelines in any cancer survivor group using the TPB. The exercise guidelines for cancer survivors include an aerobic and resistance exercise component [46]. Distinctions between resistance and aerobic exercise mechanisms and mechanics are well established and form opposite ends of the training modality continuum [117]. Depending where particular exercise modalities exist on this spectrum, a variety of distinct and overlapping physiological adaptations may occur [117]. Research in cancer populations suggests aerobic, resistance and a combination of these exercise modalities may result in differential benefits depending on the specified health outcome. For example, the ACSM recommends moderate intensity aerobic training or combined aerobic plus resistance training to reduce anxiety in cancer survivors [28]. However, resistance training alone does not appear to reduce anxiety. In contrast, evidence suggests fatigue may be improved by specific prescriptions of aerobic, resistance or combined exercise [28]. Exercise guidelines incorporate both components in order to maximize the benefits of each modality. Therefore, this study used the combined exercise guidelines as a behavioural endpoint in line with recommendations for cancer survivors [46]. Previous studies have reported differential correlates between participants meeting the combined, aerobic-only, resistance-only and neither guideline [66,118-120]. Although determining the differential correlates

between cancer survivors meeting each guideline category provides additional information, this process may present methodological challenges.

The principle of compatibility proposes that measuring intention and behaviour at the same level of generality or specificity will produce the greatest predictive validity [58,71]. In particular, the measures of intention and behaviour should consist of the same action, target, context and time components. In this context, meeting the combined exercise guidelines and meeting the aerobic-only exercise guidelines are distinct exercise behaviours that may be associated with different motivational factors. To maintain intention-behaviour compatibility when comparing the correlates of the FEGs, therefore, intentions towards meeting the combined, aerobic-only and resistance-only guidelines should be measured individually. However, with the INTENT Study survey already consisting of 135 items, concerns arose around the feasibility of measuring the TPB variables for each independent behavioural criterion (combined, aerobic-only, resistance-only). Overall, adherence to the principle of compatibility was another consideration when selecting the dichotomized combined exercise guidelines as the behavioural criterion in the TPB and highlights another strength of the INTENT Study.

Despite the strengths mentioned above, several limitations of the INTENT Study must be acknowledged and discussed. The INTENT Study was conducted as a population-based cross-sectional survey of exercise prevalence and correlates in TCS. The nature of cross-sectional studies does not permit causal inferences between study variables, in part due to a lack of temporal context and experimental conditions [121,122]. The INTENT Study provided preliminary data on key motivational variables that should be targeted in future behaviour change interventions. Corroboration of these findings is required in future studies to confirm the key correlates of meeting the combined exercise guidelines in TCS. Further, these findings may be

extended through prospective and adequately controlled experimental studies to confirm the key determinants of exercise in TCS.

The findings from the INTENT study were further limited by a low response rate, which raises concerns of external validity. Considering less than 10% of invited TCS responded to the INTENT Study survey, the findings from this study may not be representative of the entire TCS population within Alberta. Unfortunately, it was not possible to compare the INTENT Study sample to the general population of TCS in Alberta. Demographic and clinical information provided by the ACR was limited and categorized differently than variables collected in the INTENT Study, which precluded comparison. The recruitment materials also transparently disclosed the exercise nature of the survey. Although this was an ethically appropriate practice, it may have introduced response bias as respondents to the survey may be more active and have more favourable exercise beliefs than non-respondents [123-125]. Concerns of external validity may be mitigated in future studies by adapting methods to increase recruitment rates. Previous studies of survey methods in TCS found online surveys to be returned faster, with 50% of the required reminders as mailed paper surveys [126]. Although approximately 57% of TCS preferred a paper format, participant non-response bias was significantly lower among participants who chose the online survey. In addition, Smith et al. [126] reported equal or better data quality from online surveys compared to mailed paper versions in TCS. However, online survey responses were biased towards participants with higher education and those working in a professional occupation. With this in mind, the INTENT Study was designed with multiple survey response modes to maximize recruitment. Although the survey was primarily designed for online completion, participants were able to request a mailed paper copy. However, less than five percent of participants requested a paper copy of the survey. The INTENT Study was restricted

to contacting TCS by mail due to the ACR only collecting and maintaining the mailing addresses of eligible cancer survivors in Alberta.

The study was also limited due to a modest sample size, which may limit the internal validity of the findings. This also further precluded subgroup analyses of clinical and demographic moderators of TPB variables in TCS. Previous studies of exercise correlates in cancer survivors have found the TPB correlates of exercise intentions to vary by age and BMI, while the TPB correlates of exercise varied by age and adjuvant therapy [65,105]. Understanding how to differentially target exercise intention among clinical and demographic subgroups of TCS may provide greater precision in enhancing exercise guideline behaviour. Future studies may benefit by recruiting from a larger population of TCS. For example, future studies conducted in Canada may benefit by drawing participants from multiple provincial cancer registries.

The subjective, retrospective measures of behavioural and clinical variables may have introduced additional response bias to the results of the INTENT Study. In particular, self-reports of behavioural variables, such as exercise prevalence and alcohol consumption may be influenced by social-desirability bias. Social desirability bias occurs when respondents wish to present a socially favourable image resulting in overreporting of socially desirable behaviors (i.e., exercise) and an underreporting of adverse behaviours, (i.e., smoking behaviour) [127]. However, previous studies indicate social desirability bias in self-reports of exercise may be minimal [128]. Assessments of physical activity through objective accelerometry may address response bias inherent in self-report measures [129]. However, the associated expense, mailout logistics, focus on planned and structured exercise including the strength exercise guidelines and concerns of accrual made objective measures impractical for the INTENT Study.

The retrospective reports of exercise and clinical variables may be vulnerable to recall bias. This is less likely for measures of exercise, as participants were only required to recall exercise levels throughout the previous month. However, some clinical variables detailing TC morphology or date of diagnosis may have occurred decades prior and may be at greater risk of recall bias. For example, nearly 40% of participants responded "unsure" to the measure of TC morphology. Future studies may benefit from collecting prospective measures of exercise in TCS and collecting object clinical data from cancer registries or medical records to enhance the validity of behavioural and clinical variables.

Additionally, previous reviews of the TPB found theoretical constructs were less capable of explaining objective measures of behaviour [70,101]. Armitage and Conner [101] suggest this discrepancy may be due to self-reports maximizing measurement compatibility rather than reflecting discrepancies between subjective and objective measures. For example, in a study comparing the utility of three different social cognitive models for predicting objective and self-reports of physical activity in adults with type 2 diabetes, approximately 6% more variance was explained in the self-report measures compared to objective measures [130]. Plotnikoff et al. [130] suggest this discordance between associations may result from common method bias or poor adherence to the principle of compatibility. In particular, common source effects refer to inflated covariance between variables due to the same respondent providing responses for both measures in succession when self-reporting physical activity [131]. Common source effects may result from participants desiring to maintain a consistent representation of cognitions and attitudes (consistency effect) or a tendency to present a socially desirable image (social-desirability bias). In contrast, Plotnikoff et al. [130] suggest that discrepancies in framing the motivational and behavioural variables may result in poor adherence to the principle of compatibility. While the

social cognitive variables were framed as achieving the aerobic physical activity guidelines over the next six months, the self-report and objective measures of physical activity were framed as weekly minutes of metabolic-equivalent weighted physical activity and total steps respectively. The self-report measure more closely resembles the measured intention criterion. Regardless of the reasons for the observed discrepancy between objective and subjective measures, appropriately designed objective measures of exercise would provide further support for the TPB in explaining exercise motivation in TCS.

While the dichotomized combined exercise guidelines were selected as the behavioural criterion for the INTENT Study due to the benefits of combined exercise and adherence to the principle of compatibility, the results from the INTENT Study do not suggest how to differentially motivate TCS depending on whether they are already meeting the aerobic-only, resistance-only or neither guideline. As the social cognitive correlates of meeting each guideline category have varied in previous studies of cancer survivors, this warrants investigation in TCS as well. Tailored behaviour change interventions may benefit from targeting differential correlates based on whether TCS are meeting a single guideline or neither guideline. As well, the results from the INTENT Study may not be generalizable to other exercise behaviours in TCS. Further studies are required to explore the unique correlates of various exercise behaviours in TCS based on the emerging benefits of exercise.

Finally, the INTENT Study was solely guided by a single social cognitive theory of behaviour. Although the TPB has received considerable attention and support as a useful model for explaining behaviour, several criticisms have emerged since the theory's introduction. Like other social-cognitive models, the TPB relies on deliberative cognitive processing of available information [55]. The TPB contains a parsimonious set of explanatory constructs that exclude non-

conscious processes such as habit formation and automatic motivation and fails to account for broad environmental determinants of behaviour [55,132]. The sufficiency hypothesis of the TPB asserts that additional explanatory variables external to the model will be mediated by internal constructs [71]. However, empirical results support the consideration of additional variables external to the TPB [78,133]. Further, a considerable proportion of variance in behaviour is unaccounted for by the TPB, which raises concerns of sufficiency of the model [132]. In particular, the intention-behaviour gap, characterized by individuals who form an intention but fail to perform a behaviour, threatens a fundamental proposition of the TPB and suggests intentions alone may be insufficient to explain and predict behaviour [132]. In addition, authors have criticized the TPB due to inconsistent support from experimental studies [55,70,132]. A systematic review of behaviour change interventions using the TPB concluded that approximately one-half and two-thirds of the interventions were effective at changing intentions and behaviour respectively, with small to medium effect sizes [134]. However, the authors acknowledged that the studies were often of poor design. Further, the majority of studies used the TPB to evaluate the effects of the intervention, but the intervention components were not guided by the TPB [134,135]. As Ajzen suggests, only four of 24 studies reviewed aligned with theoretical requirements of the TPB [135]. A more recent meta-analysis of behaviour-change studies based on the TPB found interventions to successfully result in moderate changes in behaviour across a range of behavioral categories [67]. Physical activity interventions in particular exhibited a moderate effect size on behaviour (weighted average effect size=0.54). Therefore, the TPB has received mixed empirical support and care must be taken to design and implement effective behaviour change interventions that conform to the theoretical tenants of the TPB.

Future Directions

Building on the strengths and limitations of the INTENT Study, several key recommendations for future research in TCS are provided below. The INTENT Study provides a preliminary examination of exercise correlates in TCS using a theory of behaviour. Overall, the TPB performed well in explaining the motivational correlates of the combined exercise guidelines and intentions to meet the combined exercise guidelines in TCS. If future studies can corroborate the role of intention as an independent correlate of meeting the combined exercise guidelines, it will support the role of reflective reasoning processes in the exercise behaviours of TCS.

The INTENT Study identified the key social-cognitive correlates of meeting the combined exercise guidelines in TCS. Future studies may translate these findings into targeted behaviour change interventions focused on developing strong intentions to meet the combined exercise guidelines in TCS. In turn, strong intentions to meet the combined exercise guidelines should be addressed by focusing on the benefits and enjoyment of exercise along with developing strong perceptions of self-efficacy. Interventions informed by the TPB can effect changes in the theoretical determinants of behaviour by targeting key accessible beliefs [72,73]. Although the INTENT Study failed to conduct an elicitation survey of salient exercise beliefs in TCS, several key behavioral and control beliefs were identified. In particular, interventions can strengthen beliefs about how exercise can be enjoyable, relieve stress, improve one's well-being and improve longevity. Additionally, targeting beliefs about one's capability to exercise in the face of fatigue and limited time may be important in improving self-efficacy.

Further illumination of accessible exercise beliefs in TCS will improve the specification of intervention targets for future behaviour change studies. An elicitation survey of accessible

behavioural, normative and control beliefs following standard procedures should accompany further correlational research in TCS [71,72]. Behaviour change interventions using the TPB can change behavior by targeting the strength of currently held accessible beliefs or by introducing new, currently absent beliefs. Ajzen [73] suggests the formation of new beliefs may be easier to accomplish than the augmentation of previously held beliefs.

A meta-analysis of TPB interventions identified a range of behaviour change strategies used to target accessible beliefs in previous TPB studies [67]. Using a taxonomy defined by Abraham and Michie [136], Steinmetz et al. [67] identified 13 behavior change techniques used individually or in combination across a range of behaviours in TPB interventions. In particular, among studies reporting individual behaviour change techniques, motivational appeals, persuasive strategies and increasing skills were successful in changing the strength of TPB variables. Increasing skills had the largest effect on changing attitudes while persuasive strategies had the largest effect on PBC. Motivational appeals alone elicited changes in intention and behaviour. Planning, meanwhile, only had minimal effects on intention, and no effect on behaviour. Steinmetz et al. [67] also found interventions in a group format and performed in public were more successful than interventions performed individually and in private. Interestingly, increasing the number of behaviour change strategies used in an intervention was not associated with larger effects in any TPB variable other than intention [67]. In contrast, a systematic review and meta-analysis of internet-based behaviour change interventions found increasing the number of behaviour change techniques resulted in larger effects on behaviour outcomes [137]. Taken together with results from the INTENT Study, future intervention studies should focus on behaviour change techniques prioritizing motivational processes over implementation processes in TCS [67]. The design of future behaviour change interventions may additionally benefit by

incorporating physical activity preferences of TCS, such as individual and team sport opportunities, age-specific programming and embedded psychoeducation [50].

Future survey studies in TCS may benefit from strategies to enhance recruitment to online surveys. Although it was not possible in the INTENT Study, strategies to enhance recruitment, such as sequential mixed survey modes (online followed by paper) and mixed methods of contact (email and mail) may improve response rates to online surveys [138]. Recruiting a larger sample of TCS will permit the analysis of demographic and clinical moderators of the social-cognitive associations. This will be particularly important in enabling greater precision of specified correlates in subgroups of TCS in future behaviour change interventions. In particular, it may be useful to examine how social cognitive correlates differ between TCS with and without a history of RPLND.

The INTENT Study presents the most comprehensive estimate of self-report exercise in TCS to date. Results from the INTENT Study corroborate previous estimates of exercise prevalence among TCS. In line with previous reports, TCS appear to be more active than other cancer survivor populations [113]. However, no previous studies have reported objective measures of physical activity or exercise in TCS. Assessing objective exercise levels will confirm the validity of self-report measure in TCS.

Future correlational studies may broaden our understanding of exercise in TCS by examining the correlates of additional exercise endpoints. For example, understanding how the social-cognitive correlates differ between participants meeting the combined, aerobic only, resistance only or neither guideline, will assist in developing interventions with greater specificity. As can be seen in Table 6, a substantial drop-off in TPB scores can be seen for TCS

meeting neither guideline. This potentially indicates substantial capacity for change in TPB constructs with properly designed interventions.

Finally, future studies may benefit from the inclusion of additional explanatory variables or alternative behavioural models to explain and predict exercise in TCS. As previously discussed, although the TPB has demonstrated utility in predicting and changing behaviour, additional theoretical constructs have shown promise in affecting positive health behaviour change. Among other social cognitive models, Social Cognitive Theory (SCT) has shown promise in changing health behaviours among cancer survivors. A systematic review and meta-analysis of SCT-based behaviour change interventions in cancer survivors identified intervention effects on physical activity [139]. The Health Action Process Approach (HAPA) has shown limited but potentially promising results in cancer survivors. HAPA explained 38% of intentions to meet the aerobic exercise guidelines and 23% of accelerometry-measured moderate-to-vigorous physical activity in colorectal and gynecological cancer survivors [140]. Only a single behaviour change trial based solely on the HAPA model has been conducted in cancer survivors [62]. Increases in physical activity were observed in the intervention group compared to controls following a four-week intervention, but these differences disappeared after 10 weeks of follow-up [141]. As reviewed above, the TPB does not contain broad environmental determinants of behaviour. Social-ecological models account for multiple levels of environmental influences on behaviour and have shown utility in explaining physical activity in kidney cancer survivors [142]. Applying these models to explain and address behaviour change in TCS will broaden the understanding of environmental determinants of exercise. Finally, dual process models incorporate reflective and automatic processes and may explain additional variance in exercise beyond social cognitive models [55]. A systematic review of physical activity theories found

automatic processes to partially regulate physical activity [133]. Regardless of the theory selected to guide future correlational or behaviour change interventions in TCS, rigorous application must be upheld for effective changes in behaviour. Frameworks such as the Theory Coding Scheme (Michie & Prestwich, 2010)[143] can guide the application and communication of theory in behaviour change interventions.

Conclusion

With a growing population of TCS vulnerable to a host of late effects from the diagnosis and treatment of TC, strategies to increase positive health behaviours are required to mitigate adverse health outcomes. A substantial portion of TCS are insufficiently active, with over 50% failing to meet the combined exercise guidelines. The INTENT Study provides the first evaluation of exercise correlates in TCS using a theory of behaviour. Overall, results from the INTENT Study suggest the TPB is a useful model for explaining the correlates of exercise in TCS. In particular, intentions to meet the combined exercise guidelines and a history of RPLND were associated with meeting the combined exercise guidelines in TCS. Sixty-three percent of the variance in intentions to meet the combined exercise guidelines was explained by instrumental attitude, self-efficacy and affective attitude. Therefore, future intervention studies aiming to increase adherence to the combined exercise guidelines in TCS should focus on developing strong intentions by targeting instrumental attitudes, self-efficacy and affective attitudes. Corroboration and extension of these findings through future prospective and experimental studies will advance strategies to increase exercise guideline adherence in TCS.

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APPENDICES

Appendix A. Supplementary Review Tables

Supplementary Table 1. The prevalence and demographic, clinical and motivational correlates of exercise in testicular cancer survivors.

Author	Sample Size	Comparison	Exercise Measure	PA/Exercise prevalence	Correlates of PA/Exercise[a]
Agrawal et al., 2020 [51]	479	No PA/exercise comparison	Unspecified	94.5% of TCS engage in some moderate intensity exercise 65.8% of TCS engage in some vigorous intensity exercise	No association between exercise and treatment regimens (surgery vs BEPx3 vs BEPx4 vs other chemotherapy)
Haugnes et al., 2010 [144]	990	No PA/exercise comparison	Single item, author-developed questionnaire	8% of TCS accumulated no PA 38% of TCS accumulated moderate PA 54% of TCS accumulated vigorous PA	No demographic, clinical or motivational correlates reported
Petrella et al., 2021 [38]	135	No PA/exercise comparison	Godin Leisure Time Exercise Questionnaire	66% of TCS accumulate ≥ 150min per week of moderate to vigorous aerobic exercise	No association between exercise and age, cancer stage and time since cancer diagnosis Exercise mediated the association between psychological needs satisfaction and physical health but not mental health
Reilley et al., 2014 [37]	189	No PA/exercise comparison	Rapid Assessment of Physical Activity	50.3% of TCS report adequate aerobic exercise, while 28.0% of TCS report adequate strength and flexibility exercise	No association between exercise and age, race, marital status, education or job status
Shinn et al., 2007 [145] Shinn et al., 2010 [43]	162	74 age and sex-matched relatives 7,826 CDC age, education and income-matched controls	Structured interview items pulled from the 1999 CDC BRFSS	54% TCS engage in regular aerobic exercise 3x per week or more 15% TCS engage in regular vigorous aerobic exercise 3x per week or more TCS are more likely to engage in regular	No demographic, clinical or motivational correlates reported

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				aerobic exercise than age and sex-matched relatives (OR=1.98) TCS no more likely to engage in regular aerobic exercise than age, education, and income-matched CDC controls (OR=1.00)	
Thorsen et al., 2003 [44] Thorsen et al., 2005 [36]	1276	20,391 sex-matched Norwegian general population controls	Single item, author-developed questionnaire	43% of TCS are highly active vs 37% of the general population 44% of TCS are minimally active vs 45% of the general population 14% of TCS are inactive vs 18% of the general population Statistically significant differences in PA levels between groups ($p<0.0001$)	Positive association between PA and education Inverse association between PA and the presence of comorbidities or smoking No association between PA and BMI, age or "living as a couple" or treatment history (surgery vs chemotherapy vs radiotherapy)
Thorsen et al., 2023 [39]	1392 (T1)[b] 1011 (T2)[c]	No PA/exercise comparison	Nord-Trondelag Health Study Physical Activity Questionnaire	At T1[b]: 31% of TCS were classified as "overall inactives"[d] while 69% were "overall actives"[e] 6% were classified as inactives[f], 25% were low-actives[g], 33% were actives[h] and 36% were high-actives[i] At T2[c]: 20% of TCS were classified as "overall inactives"[d], while 80% were "overall actives"[e] 62% of TCS were persistent actives[j], 17% were improvers[k], 9% were decliners[l], 12% were persistent inactives[m]	High-actives[i] were younger than other activity groups More inactives[f] had low education, were unemployed and were daily smokers than other activity groups No association between any other demographic or clinical variables and activity groups
The Platinum Study Cohort[n]					
Feldman et al., 2018 [35]	787	No PA/exercise comparison	Minnesota Leisure Time Physical Activity Questionnaire	70.4% of TCS engage in at least one vigorous activity per week (≥ 6METs)	No demographic, clinical or motivational correlates reported

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Fung et al., 2017 [34]	952	No PA/exercise comparison	Minnesota Leisure Time Physical Activity Questionnaire	95.8% of TCS engage in at least one moderate intensity activity per week (3 to < 6METS) 69.0% of TCS engage in at least one vigorous intensity activity per week (≥6METS)	No association between PA and treatment type (BEPx3 vs EPx4)
Kerns et al., 2018 [33]	1214	No PA/exercise comparison	Minnesota Leisure Time Physical Activity Questionnaire	68.8% of TCS engage in at least one vigorous intensity activity per week (>6METS)	No demographic, clinical or motivational correlates reported
Zaid et al., 2018 [45]	486	486 age, race and education-matched NHANES controls	Minnesota Leisure Time Physical Activity Questionnaire	93.8% of TCS engage in at least one moderate intensity activity per week vs 42.4% of controls 66.7% of TCS engage in at least one vigorous intensity activity per week vs 33.5% of controls	No demographic, clinical or motivational correlates reported
Zaid et al., 2019 [32]	491	No PA/exercise comparison	Minnesota Leisure Time Physical Activity Questionnaire	93.7% of TCS engage in at least one moderate intensity activity per week 66.2% of TCS engage in at least one vigorous intensity activity per week	No demographic, clinical or motivational correlates reported

[a]Demographic, clinical or motivational correlates, [b]survey at time point one (mean=12 years post-orchiectomy), [c]survey at time point two (mean=20 years post-orchiectomy), [d]≤6 metabolic equivalent task hours per week, [e]≥10 metabolic equivalent task hours per week, [f]0 metabolic equivalent task hours per week, [g]2-6 metabolic equivalent task hours per week, [h]10-18 metabolic task-hours per week, [i]≥20 metabolic task-hours per week, [j]overall actives at T1 and T2, [k]overall inactives at T1 but actives at T2, [l]overall actives at T1 but overall inactive at T2, [m]overall inactives at T1 and T2, [n]The Platinum Study consists of a cohort of North American and UK testicular cancer survivors treated with cisplatin chemotherapy; TCS=testicular cancer survivors, PA=physical activity, NHANES=National Health and Nutrition Examination Survey, CDC=Centers for Disease Control, BRFSS=Behavioural Risk Factor Surveillance Survey, OR=odds ratio, METS=metabolic equivalent task hours, BEP=bleomycin, etoposide, cisplatin, EP=etoposide, cisplatin, BMI=body mass index

Appendix A. Supplementary Review Tables

Supplementary Table 2. Studies examining the correlates of intention, planning and physical activity/exercise in cancer survivors using the TPB.

Author	Cancer Population	Mean age (years)	Sample Size	Intention Criterion	Behavioural Criterion	Correlates of Intention	Correlates of Planning	Correlates of Behaviour
Bao et al., 2020 [146]	CRCS	63.3	174	PA≥3x/week for ≥20 minutes	Total weekly Leisure Score Index	SE Attitude SN PBC	NA	Intention Planning Past physical activity
Belanger et al., 2012 [103]	Young adult	38.2	588	Exercise over the next 12 weeks	4 exercise guideline categories[a]	PBC AA IA	Intention	Planning Intention AA General health Education
Blanchard et al., 2002 [147]	BCS PCS	61.8 BCS 68.3 PCS	83 BCS 46 PCS	Exercise	Total weekly Leisure Score Index	BCS: Attitude SN PBC PCS: PBC	NA	BCS: Intention PCS: Intention
Buffart et al., 2018 [148]	Head and neck	66.6	284	Exercise regularly over the next month	Z scores (continuous PA)	Attitude SN PBC Exercise history	NA	Intention PBC Age Unintentional weight loss Comorbidities
Courneya & Friedenreich, 1997 [149]	CRCS	60.9	110	Exercise during cancer treatment	Total weekly Leisure Score Index	Attitude	NA	Intention PBC Exercise pre-diagnosis
Courneya & Friedenreich, 1999 [150]	BCS	53.0	164	Exercise during cancer treatment	Total weekly Leisure Score Index	Attitude SN	NA	Intention PBC
Courneya et al., 1999 [151]	CRCS	60.8	66	Exercise regularly	Total weekly Leisure Score Index	Attitude	NA	Intention Exercise pre-diagnosis

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Courneya et al. 2000 [100]	Mixed cancers	47.8	28 non-thrombocytopenic patients	Exercise during hospitalization for BMT	Cycling duration	Attitude PBC	NA	Past exercise behaviour
Courneya et al. 2005 [152]	Non-Hodgkin's Lymphoma	61.0	399	Vigorous physical activity ≥3x/week for ≥20 minutes, or moderate physical activity ≥3x/week for ≥30 minutes	Total weekly MVPA[b]	PBC AA SN	NA	Pre-diagnosis exercise[a]: AA Exercise during treatment[a]: Intention IA Off-treatment exercise[a]: Intention PBC IA AA SN
Forbes et al., 2014 [68]	BCS PCS CRCS	65.6	248 BCS 253 PCS 240 CRCS	75 minutes per week of vigorous PA or 150 minutes per week of moderate PA	Total weekly MVPA[b]	BCS: IA AA PBC PCS: IA DN PBC CRCS: IA AA DN PBC	BCS: Intention DN PCS: Intentions CRCS: Intention	BCS: Planning PCS: Planning PBC CRCS: Intention
Forbes et al., 2015 [92]	BCS PCS CRCS	65.6	248 BCS 253 PCS 240 CRCS	75 minutes per week of vigorous PA or 150 minutes per week of moderate PA or a combination	Resistance exercise ≥2x/week	NA	NA	Intention Education Age BMI

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Hunt-Shanks et al., 2006 [153]	BCS PCS	58.7 BCS 66.3 PCS	126 BCS 82 PCS	30 minutes of moderate intensity exercise at least 3 days per week over the next month	Total weekly Leisure Score Index	BCS: IA SN PBC Past exercise PCS: AA SN PBC Past exercise	NA	NA
Jones et al., 2006 [154]	Multiple myeloma	63.8	70	Moderate intensity exercise ≥3x/week for ≥30 minutes	Total minutes moderate-vigorous exercise per week	IA PBC	NA	Pre-diagnosis exercise[c]: No significant TPB correlates Exercise during treatment[c]: PBC IA Off-treatment exercise[c]: Intention PBC AA
Jones et al., 2007 [155]	Brain	44.7	100	Exercise ≥3x/week for ≥20 minutes	Total minutes of exercise per week	AA PBC	NA	Pre-diagnosis exercise[c]: Intention AA Exercise during treatment[c]: Intention PBC Off-treatment exercise[c]: Intention
Karvinen et al., 2007 [105]	Endometrial	64.5	70	Vigorous PA for 20 minutes ≥3x/week or moderate PA for 30	3 exercise guideline categories[d]	Self-efficacy AA	NA	Intention Self-efficacy Income

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				minutes ≥5x/week				
Karvinen et al., 2009 [65]	Bladder	70.2	397	Vigorous PA for 20 minutes ≥3x/week or moderate PA for 30 minutes ≥5x/week	3 exercise guideline categories[d]	IA AA DN PBC	NA	Intention PBC Planning
Keats et al., 2007 [102]	Adolescent	17.4	59	Physically active on a regular basis	Total weekly Leisure Score Index	AA IA	NA	Intention Self-efficacy
Lowe et al., 2012 [156]	Palliative	61.5	50	Regular physical activity over the next month	Total physical activity minutes per week	IA[c] PBC SE	NA	Intention[c] AA SE
Min et al., 2022 [157]	BCS	52.3	286	Regular PA/exercise over the next month	Total weekly MVPA[b]	IA SN PBC	Intention PBC	Planning PBC
Packel et al., 2015 [158]	CRCS	65.6	96	Intention to be active in the next 3 months	Total weekly MVPA[b]	PBC SN	NA	PBC Age
Speed-Andrews et al., 2012 [159]	CRCS	67.3	600	75 minutes per week of vigorous PA or 150 minutes per week of moderate PA	4 exercise guideline categories	PBC AA IA	Intention PBC	Intention Planning
Stevinson et al., 2009 [160]	Ovarian	60.2	359	Vigorous and moderate intensity physical activity intended over the next month	4 exercise guideline categories	IA AA PBC	NA	Intention Education BMI
Tabaczynski et al., 2020 [66]	Kidney	64.4	651	Exercise "regularly"	AEG REG CEG NEG	NA	NA	AEG vs NEG: Intention Planning REG vs NEG: Age BMI

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								PBC Intention Planning CEG vs NEG: Education Disease stage General health IA Intention Planning AEG vs REG: Age BMI AA PBC CEG vs AEG: General health IA CEG vs REG: General health IA PBC
Trinh et al., 2012 [99]	Kidney	65	703	Moderate intensity physical activity performed for at least 150 minutes per week or vigorous intensity physical activity performed at least 75 minutes per week	4 exercise guideline categories	PBC IA DN	Intention	Intention Planning PBC
Ungar et al., 2015 [161]	Mixed cancers	62.2	64	Exercise regularly for 150 minutes a week over the next 4 weeks	Minutes per week	Active patients[d]: SN	NA	NA

Appendix A. Supplementary Review Tables

						Insufficiently active[e] patients: Positive attitude Negative attitude		
Vallance et al., 2012 [104]	BCS	62.4	524	Moderate intensity PA for 30 minutes per day on at least 5 days per week	Total moderate to vigorous minutes per week	AA IA IN DN SE	NA	Intention

[a](a) completely sedentary (no moderate or vigorous PA), (b) insufficiently active (some PA but less than 150 minutes per week), within guidelines (150 to 300 PA minutes per week), (d) above guidelines (≥300 minutes of PA per week), [b](a) meeting public health guidelines (≥60 minutes of vigorous or ≥150 minutes of moderate plus vigorous exercise per week), (b) not meeting public health exercise guidelines but accumulating some moderate to vigorous exercise minutes, (c) not reporting any moderate to vigorous exercise, [c]univariable analysis; [d]≥150 minutes per week of at least moderate intensity, [e]<150 minutes per week of moderate intensity, BCS=breast cancer survivors, PCS=prostate cancer survivors, MVPA=moderate + doubled vigorous minutes per week CRCS=colorectal cancer survivors, SE=self-efficacy, SN=subjective norm, PBC=perceived behavioural control, NA=not available/not reported, AA=affective attitude, IA=instrumental attitude, DN=descriptive norm, IN=injunctive norm, AEG=meeting the aerobic-only exercise guideline; REG=resistance-only exercise guideline, CEG=combined exercise guidelines, NEG=neither exercise guideline, BMT=bone marrow transplantation, PA=physical activity

Appendix B. Exclusion of Morphology Codes

Supplementary Table 3. Exclusion of morphology codes for research studies from the Alberta Cancer Registry.

Description of Morphology Codes	ICD-O Morphology Code(s)
Carcinoid Tumor, NOS	8240/3
Enterochromaffin Cell Carcinoid	8241/3
Enterochromaffin-like Cell Carcinoid tumor, malignant	8242/3
Goblet Cell Carcinoid	8243/3
Composite Carcinoid	8244/3
Adenocarcinoid Tumor	8245/3
Atypical Carcinoid Tumor	8249/3
Pheochromocytoma, malignant	8700/3
Gastrointestinal Stromal Tumors	8936/3
Malignant mastocytosis	9741/3
Langerhans cell histiocytosis, NOS	9751/3
Immunoproliferative Disease, NOS	9760/3
Heavy Chain Disease	9762/3
Polycythemia Rubra Vera	9950/3
Chronic Myeloproliferative Disease, NOS	9960/3
	9975/3
Myelosclerosis with Myeloid Metaplasia	9961/3
Essential Thrombocythemia	9962/3
Post-Transplant Lymphoproliferative Disorder (PTLD)	9971/3
Refractory Anemia	9980/3
Refractory Anemia with Sideroblasts	9982/3
Refractory Anemia with Excess Blasts	9983/3
Refractory Anemia with Excess Blasts in Transformation	9984/3
Refractory Cytopenia with Multilineage Dysplasia	9985/3
Myelodysplastic Syndrome with 5q Deletion Syndrome	9986/3
Therapy-related Myelodysplastic Syndrome	9987/3
Myelodysplastic Syndrome, NOS	9989/3
Refractory Neutropenia	9991/3
Refractory Thrombocytopenia	9992/3

Appendix C. Alberta Health Services Introduction Letter

March 23, 2023
Dear Sir,

Seeking volunteers to participate in "The INTENT Study"

The Alberta Cancer Registry (ACR) is seeking volunteers on behalf of researchers for "**The INTENT Study**". You are among those who **may** be eligible to participate in approved research studies.

The Alberta Cancer Registry is overseen by Alberta Health Services (AHS), the province's healthcare system. You are being contacted about this research study because AHS is facilitating research as an authorized use of section 27(1)(d) of the Alberta's Health Information Act. Your privacy is very important to AHS. This letter has been mailed out **confidentially** by the Alberta Cancer Registry. Only the Alberta Cancer Registry knows your identity and personal information (name, address, health data, etc.). This means that the research team **will not and does not** see or have access to your personal or health information unless you **agree** to participate. Alberta Health Services value research studies very much as the information assists Cancer Care Alberta in improving its knowledge about issues that are important to patients.

Enclosed is some information from the researchers describing the study to help you make an informed choice about whether or not you would like to participate. **If you are interested**, please contact the study coordinator directly. By way of responding (completely voluntary), you control your information and disclose only what you wish directly to the researchers. **If you are not interested, please disregard and confidentially destroy this package.** Please know this study has been approved by the Health Research Ethics Board of Alberta.

If you would like to participate or have questions about the research or eligibility, please contact the study team directly by telephone at **780-492-8246** or e-mail: **info@intentstudy.ca**.

For more information about the **Alberta Cancer Registry**, please read the enclosed card. If you have questions about the Alberta Cancer Registry, please contact Lorraine.Shack@albertahealthservices.ca or call 587-774-3743.

We sincerely thank you for your time and interest,

Lorraine Shack
Director, Advanced Analytics
Cancer Care Alberta
Alberta Health Services

Alberta Cancer Registry
#2133, 11560 University Ave, Edmonton, AB T6G 1Z2 Tel: 403-521-3755
Email: AlbertaCancerRegistry.AdminSupport@albertahealthservices.ca

Appendix D. INTENT Study Recruitment Letter

UNIVERSITY OF ALBERTA

Behavioral Medicine Laboratory
Faculty of Kinesiology, Sport, and Recreation
College of Health Sciences

1-113 University Hall
Edmonton, Alberta, Canada T6G 2H9

Tel: 780.492.1031
kerry.courneya@ualberta.ca

ExercIse iN TEsticular CaNcer Survivors: A MoTivation Study (The INTENT Study)

Dear Sir,

My name is Kerry Courneya, and I am a Professor and Canada Research Chair at the University of Alberta and a Scientific Staff member of the Cross Cancer Institute in Edmonton. As part of my responsibilities, I conduct research on the health of cancer survivors. The Alberta Cancer Registry is contacting you on my behalf to see if you might be interested in participating in a survey questionnaire study which requires the voluntary participation of people who were diagnosed with testicular cancer. This study has been approved by the Health Research Ethics Board of Alberta Cancer Committee (HREBA.CC-22-0334) and has met rigorous requirements for ethical approval. For questions about the ethics review process, please contact the Health Research Ethics Board of Alberta at 1-877-423-5727 or cancer@hreba.ca.

My graduate student, Spencer Allen, is conducting a research study in men diagnosed with testicular cancer in Alberta. As a testicular cancer survivor (TCS) himself, Spencer is interested in studying why some survivors exercise after completing treatments and why some do not. Although research shows that regular aerobic and strength exercise is good for TCS, many do not exercise enough to improve their health. One important question that remains unanswered relates to the key factors that influence exercise behavior in TCS. By gaining a better understanding of exercise motives and barriers in TCS, we may be able to help these survivors exercise regularly and improve their health.

If you are interested in participating in this study, all you need to do is complete one online survey that will ask you questions about your exercise beliefs (e.g., exercise barriers, benefits) and behaviors (e.g., if you exercise or not). You are eligible to participate in this study whether you currently exercise or not. We are interested in the exercise beliefs and behaviors of everyone, including those who do not exercise at all or only occasionally. It is only by understanding the beliefs of both exercisers and non-exercisers that we can gain a full understanding of exercise behavior in TCS.

The questionnaire should take approximately 15-25 minutes to complete. If you agree to participate, please access the online survey through **one of three** options below:

Option 1: Access the study by visiting The INTENT Study website using the link below:

www.intentstudy.ca **(**Please enter the following access code when prompted: **2023)**

Option 2: Access the study by scanning the QR code below with the camera on your smart phone or tablet:

Option 3: Contact the study lead, Spencer Allen, at **(780) 492-8246** or **info@intentstudy.ca** to receive a paper copy of the survey by mail. A business reply envelope will be provided. No postage is necessary.

Your participation in this study is completely voluntary. Any information that you provide will be held in strict confidence. If you have questions about the study, please contact the study lead, Spencer Allen at (780) 492-8246, e-mail info@intentstudy.ca or visit our study website at: www.intentstudy.ca.

Thank you for considering our study. It is only through voluntary participation in research projects that we can increase our knowledge about issues that are important to TCS.

Sincerely,

Kerry Courneya

Kerry S. Courneya, PhD
Professor and Canada Research Chair in Physical Activity and Cancer
Director, Behavioral Medicine Laboratory and Fitness Center, University of Alberta

Appendix E. INTENT Study Questionnaire

ExercIse iN TEsticular CaNcer Survivors: A MoTivation Study (The INTENT Study)

Questionnaire

Investigators: Spencer J. Allen, BSc[1]; John C. Spence, PhD[1]; Kerry S. Courneya, PhD[1].

[1] – University of Alberta

Instructions

Thank you for agreeing to participate in this study. Your participation is extremely valuable and will help us to understand why some people exercise and why others do not. In this questionnaire, we are going to ask you a series of questions about yourself and your exercise beliefs. Some of the questions ask you about your physical health, and some may be viewed as personal. It is important to answer as many of these questions as possible. If you feel uncomfortable answering any questions, please leave them blank. All responses are completely anonymous. Your name will not be collected or attached to your responses. All collected information will be analyzed and presented as group data only, and no information will trace back to you. Many of the questions may seem similar, but it is important to treat each question separately and to provide an answer for each. There are no right or wrong answers, and all we ask is that you provide responses that are as honest and accurate as possible.

The questionnaire contains approximately 120 questions and should take about 15-25 minutes of your time to complete. If you have any questions about completing the questionnaire, please contact our project lead and research coordinator, Spencer Allen, at (780) 492-8246 or info@intentstudy.ca.

Appendix E. INTENT Study Questionnaire

Today's date (dd/mm/yyyy) ____/____/_____

IMPORTANT: The next set of questions focus on leisure-time exercise. Leisure time means activity done during your free time and does **not** include your work/job or household chores. Exercise means any activity that is planned and structured with the goal of maintaining or improving physical fitness. Exercise will include activities that result in a noticeable increase in heart rate and breathing rate. Examples of exercise include brisk walking, jogging, cycling, swimming and dancing.

For this next question, we would like you to recall the amount of exercise you have done IN THE PAST MONTH.

When answering these questions please:

- Only count exercise sessions that lasted 10 minutes or longer in duration
- Only count exercise that was done during free time (i.e., not occupation or housework).
- Note that the main difference between the first three categories is the intensity of the endurance (aerobic) exercise and the fourth category is for strength (resistance) exercise.
- Please write the average frequency on the first line and the average duration on the second.
- If you did not do any exercise in one of the categories, please write in "0".

Considering a typical week (7 days) how many times on the average did you do the following kinds of exercise IN THE PAST MONTH?

	Times Per Week	Average Duration
Vigorous or Strenuous Aerobic Exercise (Heart Beats Rapidly, Sweating) (e.g., running, aerobics classes, cross country skiing, vigorous swimming, vigorous bicycling)	_____	_____
Moderate Aerobic Exercise (Not Exhausting, Light Perspiration) (e.g., fast walking, tennis, easy bicycling, easy swimming, popular and folk dancing)	_____	_____
Light or Mild Aerobic Exercise (Minimal Effort, No Perspiration) (e.g., easy walking, yoga, bowling, lawn bowling, driving range golfing, mini golf)	_____	_____
Resistance or Strength Exercise (e.g., lifting weights, push-ups, sit-ups, TheraBands)	_____	_____

Appendix E. INTENT Study Questionnaire

For this next set of questions, we will ask you about regular exercise. We define regular exercise as either: 1) moderate intensity exercise (e.g., brisk walking) done for at least 150 minutes per week (2.5 hours) plus strength exercises (e.g., lifting weights) done at least two days per week, OR 2) vigorous intensity exercise (e.g., jogging) done for at least 75 minutes per week (1.25 hours) plus strength exercises done at least two days per week.

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

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

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

Appendix E. INTENT Study Questionnaire

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

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

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

These next two questions ask you to rate how much exercise you think other people in your life are likely to do themselves over the next month.

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

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

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

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

Appendix E. INTENT Study Questionnaire

These next questions ask you to rate how likely it is that you would be able to participate in regular exercise over the next month if you were really motivated. Pay careful attention to the words in each scale. Select the number that best represents how you feel.

If you were really motivated…

1. How much control would you have over doing regular exercise over the next month?

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

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

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

3. How much do you feel that engaging in regular exercise over the next month is beyond your control?

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

4. Participating in regular exercise over the next month would be...

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

5. If I wanted to, I could easily engage in regular exercise over the next month.

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

6. How confident are you that you could do regular exercise over the next month?

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

Appendix E. INTENT Study Questionnaire

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

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

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

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

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

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

1	2	3	4	5	6	7
no plans			some plans			detailed plans

Appendix E. INTENT Study Questionnaire

Please use the scale below to guide your responses to the next set of 8 questions.

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

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

1. exercise with other people	1	2	3	4	5	6	7
2. do a variety of activities	1	2	3	4	5	6	7
3. exercise outdoors for fresh air or scenery	1	2	3	4	5	6	7
4. exercise in good weather	1	2	3	4	5	6	7
5. participate in team sports	1	2	3	4	5	6	7
6. exercise to music	1	2	3	4	5	6	7
7. do an activity that is fun or enjoyable	1	2	3	4	5	6	7
8. do an activity that is pain-free	1	2	3	4	5	6	7

Appendix E. INTENT Study Questionnaire

Please use the scale below to guide your responses to the next set of 13 questions.

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

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

1. feel better and improve your well-being	1	2	3	4	5	6	7
2. reduce the risk of your testicular cancer returning	1	2	3	4	5	6	7
3. relieve stress	1	2	3	4	5	6	7
4. improve your energy level	1	2	3	4	5	6	7
5. get your mind off cancer	1	2	3	4	5	6	7
6. live longer	1	2	3	4	5	6	7
7. reduce your risk of cardiovascular disease	1	2	3	4	5	6	7
8. reduce your risk of developing other types of cancer	1	2	3	4	5	6	7
9. improve fertility	1	2	3	4	5	6	7
10. improve your body image	1	2	3	4	5	6	7
11. sleep better	1	2	3	4	5	6	7
12. feel more masculine	1	2	3	4	5	6	7
13. improve fitness	1	2	3	4	5	6	7

Appendix E. INTENT Study Questionnaire

Please use the scale below to guide your responses to the next set of 7 questions.

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

How supportive do you think each of the following people would be if you tried to do regular exercise over the next month? If one category does not apply to you, please select "NA".

1. spouse / partner (if applicable)	1	2	3	4	5	6	7	NA
2. children (if applicable)	1	2	3	4	5	6	7	NA
3. parents (if applicable)	1	2	3	4	5	6	7	NA
4. friends	1	2	3	4	5	6	7	NA
5. family doctor	1	2	3	4	5	6	7	NA
6. oncologist	1	2	3	4	5	6	7	NA
7. coworkers (if applicable)	1	2	3	4	5	6	7	NA

Appendix E. INTENT Study Questionnaire

Please use the scale below to guide your responses to the next set of 12 questions.

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

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

1. the weather was very bad	1	2	3	4	5	6	7
2. you felt tired or fatigued	1	2	3	4	5	6	7
3. you had medical or health problems	1	2	3	4	5	6	7
4. you got very busy and had limited time	1	2	3	4	5	6	7
5. you had a recurrence of your cancer	1	2	3	4	5	6	7
6. you had pain or soreness	1	2	3	4	5	6	7
7. you had additional family responsibilities	1	2	3	4	5	6	7
8. the activity became boring	1	2	3	4	5	6	7
9. you went back on cancer treatments	1	2	3	4	5	6	7
10. you had limited or no access to recreation facilities or gyms	1	2	3	4	5	6	7
11. you developed cardiovascular disease	1	2	3	4	5	6	7
12. you were diagnosed with a second type of cancer	1	2	3	4	5	6	7

Appendix E. INTENT Study Questionnaire

The following statements are designed to assess your perception of your physical fitness. Please read each statement carefully, and then select one of the five alternatives.

	Item Content	Scoring				
1.	I am in good physical condition	1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly Agree
2.	I need to alter (lose or gain) my weight in order to improve my physical health	5 Strongly Disagree	4 Disagree	3 Undecided	2 Agree	1 Strongly Agree
3.	I am better able to walk briskly for twenty minutes than most individuals my age	1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly Agree
4.	I am as physically strong as I need to be	1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly Agree
5.	An object that I can lift once with slight difficulty soon becomes strenuous when I attempt to lift it repeatedly	5 Strongly Disagree	4 Disagree	3 Undecided	2 Agree	1 Strongly Agree
6.	I possess greater muscular flexibility than most individuals my age	1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly Agree
7.	I am more overweight than most individuals my age	5 Strongly Disagree	4 Disagree	3 Undecided	2 Agree	1 Strongly Agree
8.	When I exercise, I tire easily	5 Strongly Disagree	4 Disagree	3 Undecided	2 Agree	1 Strongly Agree

Appendix E. INTENT Study Questionnaire

9.	I am more physically fit than most individuals my age	1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly Agree
10.	I am a very limber (flexible) individual	1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly Agree
11.	I possess less muscular strength than most individuals my age	5 Strongly Disagree	4 Disagree	3 Undecided	2 Agree	1 Strongly Agree
12.	I need to improve my present overall physical condition	5 Strongly Disagree	4 Disagree	3 Undecided	2 Agree	1 Strongly Agree

Appendix E. INTENT Study Questionnaire

This next part of the questionnaire is needed to help understand the medical profile for those participating in the study. For this reason, it is very important information. All information is held in strict confidence. Please answer the questions to the best of your knowledge.

1. Approximately which date were you diagnosed with testicular cancer? (dd/mm/yyyy)
   _____/_____/_____

2. What type of testicular cancer were you diagnosed with?
   ___ seminoma ___ nonseminoma ___unsure

3. Was your cancer found in one or two testicles?
   ___ one ___ two

4a. Did your cancer spread (metastasize) from your testicle?
   ___ yes ___ no

4b. If yes, in which part(s) of your body did the cancer spread to? Please check all that apply.
   ___ lymph nodes ___ lung ___ brain
   ___ liver ___ bone ___ unsure
   ___ other (please specify): _____

5. Have you ever had a recurrence of your testicular cancer?
   ___ yes ___ no ___ unsure

6a. Did your treatment for testicular cancer include the surgical removal of a testicle (orchiectomy)?
   ___ yes ___ no

6b. If yes, was it one or two testicles?
   ___ one ___ two

7. Did your treatment for testicular cancer include a retroperitoneal lymph node dissection (RPLND)? This is a surgery to remove lymph nodes from your abdomen.
   ___ yes ___ no ___ unsure

Appendix E. INTENT Study Questionnaire

8. Did your treatment for testicular cancer include radiation therapy?
___ yes ___ no

9a. Did your treatment for testicular cancer include chemotherapy?

___ yes ___ no

9b. If your treatments included chemotherapy, which kind(s) of chemotherapy did you receive? Please select all that apply.

___ bleomycin ___ carboplatin ___ cisplatin

___ etoposide ___ ifosfamide ___ paclitaxel

___ vinblastine ___ unsure

___ other (please specify): _____

10. Have you ever been diagnosed with another cancer besides your testicular cancer?

___ yes ___ no

11a. Have you ever been diagnosed with any other chronic medical conditions other than cancer?

___ yes ___ no

11b. If yes, have you ever been diagnosed with any of the following conditions? Please select all that apply.

___ high blood pressure ___ diabetes ___ chronic bronchitis

___ heart attack ___ angina (chest pain) ___ high cholesterol

___ arthritis ___ emphysema ___ stroke

___ any other chronic medical conditions: _____

Appendix E. INTENT Study Questionnaire

This next section of the questionnaire is very important for understanding the characteristics of the people participating in this study. The information collected below will be held in strict confidence and will only be presented as group data. Please answer as many questions as possible. If you do not feel comfortable answering any questions, you may leave them blank.

1. What is your date of birth? (dd/mm/yyyy) ____/____/_____

2. What is your current relationship status?

___ in a relationship ___ single

3. What is your current marital status?

___ married ___ never married ___ common law

___ separated but still married ___ widowed ___ divorced

4. Do you identify as lesbian, gay, bisexual, trans, queer, intersex, asexual or two-spirit (LGBTQIA2)?

___ yes ___ no ___ unsure

___ prefer not to answer

5. What is your gender? This refers to current gender which may be different from sex assigned at birth and may be different from what is indicated on legal documents.

___ male ___ female ___ other

___ prefer not to answer

6. What are your current living arrangements?

___ living alone ___ living with others

7. Do you consider your primary residence to be located in a rural or urban neighborhood area?

___ rural ___ urban

8. What is the highest level of education you have attained?

___ some high school ___ completed high school ___ some university/college

___ completed university/college ___ some graduate school ___ completed graduate school

Appendix E. INTENT Study Questionnaire

9. What is your primary ethnic origin or race?

___ Black	___ East/Southeast Asian (e.g., Chinese, Korean, Japanese)	___ Indigenous (First Nations, Métis, Inuk/Inuit)
___ Latino	___ Middle Eastern (e.g., Arab, Persian, West Asian descent)	___ South Asian (e.g., East Indian, Pakistani)
___ White	___ Other _____	

10. What is your current employment status?

___ Full time	___ Part time	___ Disability
___ Retired	___ Sick leave	___ Temporarily unemployed
___ Student		

11. What is your annual family income?

___ Less than $20,000	___ $20,000 - $39,999	___ $40,000 - $59,999
___ $60,000 - $79,999	___ $80,000 - $99,999	___ >$100,000

12. What is your current height (feet, inches)? _____,_____

13. What is your current weight in pounds? _____lbs.

14. Which of the following best describes your cigarette smoking status?

___ Never smoked	___ Ex-smoker	___ Current smoker

15. When considering the <u>last six months</u>, how often did you use cannabis (smoked or ingested)?

___ Never	___ Monthly or less	___ 2 - 4 times per month
___ 2 - 3 times per week	___ 4 or more times per week	

16. When considering the last three months, how many standard alcoholic drinks did you usually have <u>each week</u>?

One standard drink is equivalent to one 341ml (12 oz) bottle of 5% beer, one shot (1.5 oz) of 40% hard liquor or one 142 ml (5 oz) glass of 12% wine.

___ 0	___ 1-2	___ 3-6
___ 7-13	___ 14-20	___ 21+

You have now completed the survey! Thank you very much for your participation! Your contribution to this study will support the health of testicular cancer survivors in the future.

If you would like to be contacted by email about the results from this study or any future publications, please enter your email address below.

Email: _____

Thank you, and have a wonderful day!