A Social Cognitive Theory-Based Exploration of University Students' Knowledge, Self-Efficacy, and Outcome Expectations Related to Reducing Sedentary Behavior

by

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Abstract

Excessive sedentary behavior is associated with negative health-related outcomes. University students have been identified as a highly sedentary segment of the adult population. Understanding psychological factors that influence sedentary behavior in university students is critical for informing interventions. Social cognitive theory (SCT) offers a framework to explore cognitive and motivational factors that may influence sedentary behavior. Using SCT as a framework, this thesis explored university students' knowledge, self-efficacy, and outcome expectations related to reducing sedentary behavior and examined the effects of a self-affirmation intervention on students' processing of and social cognitive reactions to health risk information related to sedentary behavior. *Study 1* found that while some students understood the concept, some did not fully understand the concept. Most students were knowledgeable about health risks associated with sedentary behavior. Students' self-efficacy (task, context-specific) and outcome expectation beliefs related to reducing sedentary behavior were not associated with their actual sedentary behavior. Self-regulatory efficacy, however, emerged as an individual social cognitive correlate of sedentary behavior. *Study 2* employed a qualitative approach (focus groups) to explore the same topics investigated in *Study 1*, including barriers and ideas related to reducing sedentary behavior. Three themes were identified: (1) *conceptual confusion, but knowledgeable about risks*, (2) *confident, but unlikely to change,* and (3) *ideas and recommendations*. *Study 2* determined that some students found health risk information pertaining to sedentary behavior to be threatening. This finding informed *Study 3*, the aim of which was to test whether a self-affirmation intervention could improve students' processing of and reactions to health risk information on sedentary behavior and elevate self-efficacy and outcome expectations related to reducing sedentary behavior. Self-affirmation appeared to have

had no effect on measures of message acceptance, derogation, risk perceptions, negative affect, intentions, self-efficacy, or outcome expectations. Speculatively, the null effects of self-affirmation were because students may not have found health risk information related to sedentary behavior to be threatening to their self-integrity – a condition considered necessary for self-affirmation to yield benefits. Collectively, findings presented in this thesis advance knowledge of university students' perceptions of sedentary behavior and factors that influence students' decisions to be less sedentary.

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Lastly, I would like to acknowledge and thank my mother, Polly, without whom the completion of this PhD would simply not have been possible. If it were not for your unconditional support and unwavering belief in my abilities, I would not have reached the top of this mountain.

Dedication

For my mother, Polly.

Contributions of Authors

The research presented in this thesis was conceptualized by the PhD candidate (Navjot Pachu; author of the thesis) and his co-supervisors, Dr. Sandra Webber and Dr. Shaelyn Strachan. The thesis contains three manuscripts, hereafter referred to as *Studies 1*, *2*, and *3*. The following will provide details on the candidate's contributions to each study as well as the roles and contributions of co-authors on each study. Substantive contributions refer to contributions made to the design of the studies; the collection, analysis, or interpretation of data for the work; revising the work critically for intellectual content; approving manuscript submissions for publication; and agreeing to be accountable for all aspects of the work to ensure questions concerning the accuracy or integrity of any part of the work are appropriately investigated and resolved.

The conceptualization and design of *Study 1* was conceived by the PhD candidate, Dr. Webber and Dr. Strachan. The candidate was responsible for all aspects of the study, including, but not limited to, gaining Research Ethics Board (REB) approval, selecting study measures, recruiting participants, collecting and analyzing data, and producing manuscript drafts for publication. Manuscript drafts were reviewed by the candidate's supervisors (Dr. Webber and Dr. Strachan), Dr. Ed Johnson and Dr. Diana McMillan who collectively provided substantive and critical intellectual feedback on the analysis, interpretation and presentation of the work. The candidate is listed as first author on the manuscript for *Study* 1. Dr. Webber, Dr. Strachan, Dr. Johnson and Dr. McMillan are listed as co-authors.

The conceptualization and design of *Study 2* was conceived by the candidate, Dr. Webber, and Dr. Strachan. As with *Study 1*, the candidate was responsible for all aspects of the work, including gaining REB approval, recruiting participants, creating the focus group question guide

and moderating all focus groups. Dr. Webber and Dr. Strachan assisted as co-moderators for two of the four focus groups and provided substantive intellectual contributions and feedback on the analysis and interpretation of the data as well as feedback on manuscript drafts. Dr. Jacquie Ripat and Dr. McMillan were consulted for their expertise in qualitative research. Both provided substantive intellectual feedback on the analysis and interpretation of the data as well as critical feedback on manuscript drafts. The candidate is listed as first author on the manuscript for *Study 2*. Dr. Webber, Dr. Strachan, Dr. Ripat and Dr. McMillan are listed as co-authors.

The conceptualization and design of *Study 3* was developed by the candidate, Dr. Shaelyn Strachan and Dr. Sandra Webber. As with *Study 1* and *2*, the candidate was responsible for all aspects of the work, including gaining REB approval, selecting the measures, and managing the study website. Once data collection was complete, the candidate cleaned, analyzed and interpreted the data, and produced manuscript drafts. The manuscript drafts were reviewed by Dr. Webber and Dr. Strachan who provided substantive critical feedback on the analyses and interpretation of the data as well as the feedback on the presentation of the work. The candidate is listed as the first author on the manuscript for *Study 3*. Dr. Webber and Dr. Strachan are listed as co-authors.

List of Abbreviations

BMI – Body mass index

CHMS – Canadian Health Measures Survey

CSSE – Context-specific self-efficacy

HDL – High density lipoprotein lipase

LPL – Lipoprotein lipase

MET – Metabolic equivalent of task

MVPA – Moderate-to-vigorous-intensity physical activity

OE – Outcome expectations

OV – Outcome values

SBRN – Sedentary Behavior Research Network

SBQ – Sedentary behavior questionnaire

SD – Standard deviation

SOE – Salient outcome expectations

SRE – Self-regulatory efficacy

TPB – Theory of Planned Behavior

TRA – Theory of Reasoned Action

TSE – Task self-efficacy

Table of Contents

Structure and Organization of the Thesis

This thesis is structured and organized according the University of Manitoba's Faculty of Graduate Studies grouped manuscript "sandwich" style format.

Chapter I. This chapter provides an introduction and review of the relevant literature. It concludes with a summary of the aims and objectives of the research program and includes its own bibliography.

Chapter II. This chapter contains the manuscript for *Study 1*.

Chapter III. This is a linking chapter that provides logical connections between Chapter II (*Study 1*) and Chapter IV (*Study 2*).

Chapter IV. This chapter contains the manuscript for *Study 2*.

Chapter V. This is a linking chapter that provides logical connections between Chapter IV (*Study 2*) and Chapter VI (*Study 3*).

Chapter VI. This chapter contains the manuscript for *Study 3*.

Chapter VII. This chapter contains *Supplementary Analyses* pertaining to *Study 3*.

Chapter VIII. The General Discussion chapter provides an *Overview of the Context and Aims of the Thesis* and a *Summary of Key Findings* from *Studies 1*, *2* and *3*. *Contributions* and *Implications* of the work are discussed followed by *Future Research* ideas and a general *Conclusion*.

CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Defining Sedentary Behavior

Over the past two decades, there has been rapid and progressive growth in research on sedentary behavior (Dunstan, Howard, Healy, & Owen, 2012; Owen, Healy, Matthews, & Dunstan, 2010; Owen et al., 2011; Pate, O'Neill, & Lobelo, 2008; Salmon, Tremblay, Marshall, & Hume, 2011). A growing body of epidemiological evidence suggests that high levels of sedentary behavior are associated with negative health-related outcomes, independent of moderate-to-vigorous physical activity (MVPA) (Biswas et al., 2015; Katzmarzyk, Church, Craig, & Bouchard, 2009; Tremblay et al., 2010). As evidence has increased suggesting that sedentary behavior may be a distinct risk factor for morbidity and mortality independent of physical activity (de Rezende, Lopes, Rey-Lopez, Matsudo, & Odo, 2014), so too has the need for a clear, common, and accepted definition of sedentary behavior. While such standardization has been difficult to achieve, and considerable confusion has surrounded the concept of sedentary behavior, efforts have been undertaken to develop a standardized definition.

In 2017, the Sedentary Behavior Research Network (SBRN; a network consisting of sedentary behavior researchers and health professionals from around the world) conducted a comprehensive project to develop consensus definitions for sedentary behavior and related terms based on the best available evidence. The SBRN (2017) defines the term sedentary behavior as "any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents, while in a sitting, reclining or lying posture" (p. 9). A metabolic equivalent (MET) is a measure of energy expenditure where one MET is the rate of energy expenditure while sitting at rest, which for most people, is equivalent to an oxygen uptake of 3.5 ml/kg/min (Ainsworth et al., 2011). The energy expenditure of other activities is expressed in multiples of METs (Ainsworth et al., 2011). Common examples of sedentary behavior include watching television (TV), using a

computer, playing video games, reading, and sitting while in motorized transportation. The term 'sedentary behavior' is conceptually distinct from 'physical inactivity', which the SBRN defines as "an insufficient physical activity level to meet present physical activity recommendations" (Tremblay et al., 2017, p. 9).

In defining the distinct and separate concepts of sedentary behavior and physical inactivity, it is also important to define the concept of physical activity. Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p. 126). Physical activity can be classified into light-, moderate-, and vigorous-intensity. Light-intensity physical activity (1.6-2.9 METs) is considered any aerobic activity that does not cause a noticeable change in breathing rate and can be sustained for at least 60 minutes (e.g., casual walking, light domestic chores or occupational tasks) (Norton, Norton, & Sadgrove, 2010). Moderate-intensity physical activity (3.0-5.9 METs) is considered any aerobic activity that is able to be conducted whilst maintaining an uninterrupted conversation and may last 30 to 60 minutes (e.g., brisk walking, lawn mowing) (Norton et al., 2010). Vigorous-intensity activity (≥6.0 METs) is considered any activity in which conversation generally cannot be maintained uninterrupted and may last up to 30 minutes (Norton et al., 2010). Exercise is defined as "a subcategory of physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective" (Caspersen et al., 1985, p. 128).

The Modern Sedentary Lifestyle

From an evolutionary perspective, sedentary behavior among *homo sapiens* is a relatively new phenomenon. Although sitting was prevalent amongst our early ancestors, only in the past few centuries has sitting become a ubiquitous and highly pervasive behavior. Due, in part to,

rapid advancements in transportation, communication, entertainment technologies, and workplace settings, the physical and social environments in which modern day humans sit and move within the context of their daily lives has changed dramatically, resulting in reduced demands for physical activity and increased opportunities for prolonged sedentary time (Dunstan, Howard, Healy, & Owen, 2012; Tremblay, Colley, Saunders, Healy, & Owen, 2010). The prevalence of sedentary behavior among adults has been documented in large population studies showing that in contemporary societies, adults spend approximately 50-70% of their waking hours sedentary (Healy, Matthews, Dunstan, Winkler, & Owen, 2011; Stamatakis, Hamer, & Dunstan, 2011). According to objective data from the Canadian Health Measures Survey (CHMS; a cross-sectional survey on a nationally representative sample of Canadian adults aged 20-79 years), the average Canadian adult spends 9.5 hours per day sedentary, equating to approximately 69% of their waking hours (Colley et al., 2011).

Although sedentary time tends to increase with age and is typically highest among older adults (Spittaels et al., 2012), CHMS data indicate that the difference in total daily sedentary time between younger and older Canadian adults is small. Young adults aged 18-39 years were found to spend 9 hours and 36 minutes per day sedentary whereas older adults aged 60-79 years were found to spend 10 hours and 8 minutes per day sedentary (Statistics Canada, 2015). The prevalence of high sedentary time among adults is an important public health concern given the growing body of epidemiological and physiological evidence suggesting that engaging in high levels of sedentary behavior at any age may be associated with immediate and long-term health consequences (Manini et al., 2015).

Sedentary Behavior and Health Outcomes

Epidemiological evidence has accumulated suggesting that spending excessive time in sedentary behaviors may negatively impact several health outcomes, independently of moderate-to-vigorous physical activity (MVPA) (Bauman, Chau, Ding, & Bennie, 2013; Dunstan et al., 2010; Katzmarzyk et al., 2009; van Der Ploeg, Chey, Korda, Banks, & Bauman, 2012). Several systematic reviews and meta-analyses have found that, after controlling for physical activity levels, high levels of sedentary time are associated with an increased risk of cardiovascular disease (Ford & Caspersen, 2012), type 2 diabetes (Proper, Singh, van Mechelen, & Chinapaw, 2011), cancer (Shen et al., 2014), depression (Teychenne, Ball, & Salmon, 2010), anxiety (Teychenne, Costigan, & Parker, 2015) and all-cause mortality (Chau et al., 2013). While further research is needed to understand how factors such as age, sex, race/ethnicity, socioeconomic status, and weight status influence associations between sedentary behavior and different health outcomes (Katzmarzyk et al., 2019), available evidence suggests that sedentary behavior may be a distinct risk factor for multiple detrimental health outcomes in adults, independent of physical activity.

In 2014, De Rezende and colleagues conducted an overview of systematic reviews to synthesize observational evidence for the association between sedentary behavior and health outcomes and to assess the methodological quality of identified systematic reviews. The authors used the Assessing the Methodological Quality of Systematic Reviews (AMSTAR) tool (Shea et al., 2007; Shea et al., 2007) to appraise methodological qualities of identified systematic reviews. Using the AMSTAR score that each systematic review received, the authors classified the level of evidence for each health outcome as *strong*, *moderate*, *insufficient*, or as *no evidence*. They also evaluated each systematic review for improper use of causative language. De Rezende et

al.'s (2014) overview concluded that, based on the best available systematic reviews, there appears to be strong evidence for a relationship between sedentary behavior and all-cause mortality, cardiovascular disease, type 2 diabetes, and metabolic syndrome in adults. A limitation of De Rezende et al.'s (2014) overview, however, is that their findings are based only on systematic reviews of observational studies. The few systematic reviews of randomized controlled trials that were identified mainly focused on the effects of interventions to reduce sedentary behavior and/or the effects of interventions on short-term health outcomes (Leung, Agaronov, Grytsenko, & Yeh, 2012; Macmillan et al., 2014).

What De Rezende et al.'s (2014) overview of systematic reviews makes clear is that the relationship between sedentary behavior and health is complex and appears to depend on the type of sedentary behavior and age group being studied. While further randomized trials and experimental studies are required to draw stronger conclusions about causal relationship and dose-response associations between specific sedentary behaviors and specific health outcomes, the case for "reduced sitting" has become increasingly compelling given available evidence. As a generic recommendation, there appears to be sufficient evidence to support the advice that for optimal health benefits, adults should aim not only to achieve sufficient levels of physical activity, but also limit total sitting time and break up prolonged bouts of continuous sitting as often as possible.

Sedentary Behavior Physiology

Sedentary behaviors are those that involve a sitting, reclining, or lying posture and low levels of energy expenditure (≤1.5 METs) (Tremblay et al., 2017). Central to the thinking of how sedentary behavior negatively impacts health from a physiological perspective is that spending excessive time in a sedentary state results in low muscle energy turnover (Bergouignan, Rudwill,

Simon, & Blanc, 2011), or muscular unloading (Hamilton, Hamilton, & Zderic, 2007), within the large skeletal muscle groups in the legs, back, and trunk regions. Whilst in a sedentary state, the "switching off" of these large skeletal muscle groups is thought to initiate a cascade of biological and cellular events that, over time, can lead to cardiometabolic dysfunction, hyperglycemia, and hyperlipidemia (Bergouignan et al., 2011).

Physiological changes induced by sedentary behavior have been studied under a variety of models and contexts (e.g., animal studies, human bed rest, imposed physical inactivity, and prolonged sitting time) (Dempsey & Thyfault, 2018). Studies of human bed rest have documented positive associations between long periods of lying down and reductions in aerobic capacity, muscle strength, and muscle mass, as well as biomarkers of metabolic dysfunction such as increased total cholesterol levels, plasma triglycerides, glucose resistance, and insulin resistance (Bergouignan et al., 2011; Hamburg et al., 2007; Yanagibori et al., 1998). Insights into the biological effects of sedentary behavior on humans has also come from animal studies (Bey & Hamilton, 2003; Zderic & Hamilton, 2006) that suggest that some of the adverse effects of sedentary behavior on metabolic dysfunction appear to be partially mediated by reductions in lipoprotein lipase (LPL; an enzyme that facilitates the breakdown of triglycerides and facilitates the uptake of free fatty acids into skeletal muscle and adipose tissue) (Hamilton et al., 2007). In animal models, low levels of LPL have been found to be associated with decreases in high-density lipoprotein (HDL) cholesterol (Bey & Hamilton, 2003; Goldberg, Le, Ginsberg, Krauss, & Lindgren, 1988), increased circulating triglycerides (Bey & Hamilton, 2003; Goldberg et al., 1988), and an increased risk of metabolic syndrome and cardiovascular disease (Hamilton et al., 2007). While these experiments provide important preliminary insights into the effects of muscular inactivity, the generalizability of experimental findings is limited given that the volume

of sedentary time studied in bed-rest trials and animal models far exceed the volumes and patterns of sedentary behavior engaged in by healthy, free-living, ambulatory adults (Bergouignan et al., 2011). While further research is still required to understand the precise biological mechanisms and pathways through which sedentary behavior negatively impacts different health outcomes in humans (Schmid, Jochem, & Leitzmann, 2018), available evidence suggests that spending excessive time in sedentary behavior has distinct and direct effects on human metabolism, bone mineral content, and vascular health (Dempsey & Thyfault, 2018; Tremblay et al., 2010).

Countering Health Risks of Sedentary Behavior with Physical Activity

The extent to which the independent health consequences of sedentary behavior can be attenuated, or reversed, through physical activity is an ongoing topic of debate. Large epidemiological studies have reported significant associations between sedentary behavior and cardiometabolic risk indicators, disease, and mortality, even after controlling for MVPA (Biswas et al., 2015; Carson et al., 2014; Koster et al., 2012; Mansoubi, Pearson, Biddle, & Clemes, 2014). However, the data supporting these claims do not account for the potential of reverse causation (i.e., does sedentary behavior cause disease, or vice versa) and are based on self-report estimates of sedentary time, not objective measurements (Solomon & Thyfault, 2013). In the largest meta-analysis to date, Ekelund and colleagues (2016) examined the physical activity and sedentary behavior data of over 1 million men and women and found that high levels of physical activity (i.e., 60-75 minutes of moderate-intensity physical activity per day) appeared to eliminate the increased mortality risk associated with high volumes of sedentary behavior (i.e., sitting more than 8 hours a day). While an encouraging finding, it is unlikely that many Canadian adults achieve such levels of physical activity. Recent estimates suggests that only 20% of

Canadian adults achieve the minimum physical activity guideline of 150 min of MVPA per week (or 30 min of MVPA per day on five or more days per week), and that most adults spend approximately 9.5 hours per day sedentary (Statistics Canada, 2015).

Sitting Less and Moving More

The health benefits of MVPA are well-established (Warburton, Charlesworth, Ivey, Nettlefold, & Bredin, 2010; Warburton & Bredin, 2016). Engaging regularly in MVPA has been shown to be an effective primary and secondary preventative measure for more than 25 chronic health conditions (including cardiovascular disease) and premature mortality (Pedersen & Saltin, 2015; Warburton et al., 2010; Warburton, Nicol, & Bredin, 2006). Relative to what is known about the health benefits of MVPA, however, much less is known about the distinct health benefits that can be accrued through standing and engaging in light-intensity physical activity (Smith, Ekelund, & Hamer, 2015).

Sedentary behaviors encompass activities that involve a sitting, reclining or lying posture and low levels of energy expenditure (≤1.5 METs) (Tremblay et al., 2017). While standing quietly has been found to involve an energy expenditure level similar to that of sedentary behavior (Ainsworth et al., 2011), there is some evidence that standing may be a healthier alternative to sitting because standing upright engages the large skeletal muscle groups in the lower extremities that otherwise become inactive when seated (Hamilton et al., 2007). Preliminary evidence suggests that, relative to sitting, standing may be associated with a lower risk for metabolic dysfunction. A cross-sectional study of 7,075 adults aged 20-79 years found that standing a quarter or more of one's waking hours on most days of the week was associated with a significantly reduced odds of elevated body fat percentage in men ($p < .001$) and a reduced likelihood of obesity ($p < .009$) and abdominal obesity in women ($p = .04$) (Shuval et al.,

2015). A 12-year longitudinal study of more than 16,000 Canadian adults found a clear dose-response relationship between standing and mortality. Individuals who reported standing most of their waking hours were 33% less likely to die from all-causes relative to those who reported standing almost none of the time (Katzmarzyk, 2014). A systematic review and meta-analysis of 44 studies comprising data collected from 1,141 adults found that if an adult weighing 79 kg were to substitute six hours of daily sitting time with standing time, the individual would expend an additional 54 kcal per day – a difference in energy expenditure equivalent to losing 2.5 kg of body fat over the course of one year (Saeidifard et al., 2018). While further experimental studies are required to better understand the distinct health benefits of standing, available evidence suggests that replacing sitting with more standing may benefit cardiometabolic health (Healy, Winkler, Owen, Anuradha, & Dunstan, 2015).

Light-intensity physical activity, which is defined as any standing movement that requires an energy expenditure of 1.6-2.9 METs (Pate et al., 2008), encompasses a wide range of activities of daily living, such as casual walking, relaxed cycling, or doing light housework (Ainsworth et al., 2011). Despite the fact that approximately 40% of the average adult's waking hours is spent in light-intensity physical activity (Howard et al., 2015), and that light-intensity activity makes a substantial contribution to daily energy expenditure (Donahoo, Levine, & Melanson, 2004), the health benefits of light-intensity activity are not well understood. Evidence from observational studies is, however, accumulating showing light-intensity physical activity to be inversely associated with body mass index (BMI) (Bann et al., 2015), triglycerides (Howard et al., 2015), and 2-h plasma glucose levels (Healy et al., 2007). While further experimental, prospective, and longitudinal research is needed to better understand the distinct acute and long-term health benefits of light-intensity activity, available evidence suggests that replacing

sedentary behavior with light-intensity activity may confer significant cardiometabolic health benefits, independent of time spent in MVPA (Healy et al., 2007; Howard et al., 2015). Given the impracticality of replacing proportions of sedentary behavior with MVPA during most people's waking hours, reallocating sedentary behavior with light-intensity activity may represent a more feasible and achievable goal for many individuals.

Emerging evidence suggests that frequently interrupting (breaking up) sedentary time with brief bouts of standing and/or light-intensity activity may offer another way of deriving health benefits and countering health risks associated with uninterrupted sedentary behavior (Dunstan et al., 2012). In the first study of its kind, Healy et al. (2008) found that, independent of total sedentary time and time in MVPA, increased breaks in sedentary time were beneficially associated with waist circumference, BMI, triglycerides, and 2-h plasma glucose levels in 168 adults recruited from the 2004-2005 Australian Diabetes, Obesity, and Lifestyle Study. Several subsequent experimental investigations have found that interrupting continuous bouts of sitting (e.g., every 20-30 minutes) with brief (e.g., 1-2-minute) bouts of light activity resulted in significant reductions in systolic blood pressure (Larsen et al., 2014), postprandial insulin and glucose levels (Dunstan et al., 2012), and improved femoral artery functioning (Thosar, Bielko, Mather, Jeanne, & Wallace, 2015). According to a systematic review and meta-analysis of 10 observational studies, the theory that interrupting continuous bouts of sedentary behavior with light-intensity activity breaks may help individuals control adiposity and postprandial glycemia levels is supported by the available evidence (Chastin, Egerton, Leask, & Stamatakis, 2015).

Historically, efforts to increase physical activity at the population level have focused on trying to get individuals to engage in sufficient levels of MVPA. However, engaging in purposeful bouts of MVPA is distinct from the physical activity that is required to perform

physical tasks of daily living, which largely consist of a mix of standing, light-, and moderate-intensity physical activity (e.g., walking at a casual pace, ascending/descending stairs, performing heavier household chores) (Ainsworth et al., 2011; Kozey, Lyden, Howe, Staudenmayer, & Freedson, 2010). Given evidence that *all* movement behaviors may aid in the prevention of chronic diseases, researchers propose that approaches that focus on getting people to simply sit less and move more at any intensity may be more successful than those that focus solely on increasing MVPA (Smith et al., 2015). It is reasonable to assume that people may be more willing and able to replace sedentary behavior with standing or light-intensity activity relative to increasing MVPA because, relative to MVPA, standing and light activity: (i) require less motivation and cognitive effort to perform, (ii) elicit less palpable physiological responses, (iii) require less money, time, equipment/facilities, and (iv) can be more easily incorporated into everyday life (Smith et al., 2015). By shifting people from leading lifestyles that are predominantly sedentary towards lifestyles that involve more standing and light-intensity activity, researchers propose that subsequent MVPA interventions may be more successful because the shift in activity patterns reflects a more natural, incremental, and realistic progression along the physical activity continuum (Smith et al., 2015).

Sedentary Behavior in University Students

Research on sedentary behavior is advancing rapidly. However, most studies have focused on children, middle-aged, and older adults, with few investigations having focused specifically on young adults (McVeigh et al., 2016). Of the few large population studies that have measured sedentary behavior in young adults, available self-report (Biddle, Pearson, Ross, & Braithwaite, 2010) and objective data (Matthews et al., 2008) identify emerging adulthood as a life stage marked by small declines in MVPA and substantial increases in sedentary time. Objective data

from large population studies conducted in Australia (McVeigh et al., 2016), Belgium (Van Dyck et al., 2010), and the United States (Matthews et al., 2008) indicate that young adults (defined in these studies as individuals aged 20-25 years) spend approximately 54%-61% of their waking hours sedentary. Young Canadian adults appear to be on the higher end of this range. Objective data from the CHMS indicate that young Canadian adults spend approximately 9 hours and 36 minutes per day sedentary, equating to roughly 60% of their total waking hours (assuming 16 hours wake time) (Statistics Canada, 2015).

The transition from late adolescence to early adulthood (between 18-25 years of age) is a critical developmental period during which many young adults adopt behaviors that have a high likelihood of being ingrained and maintained into later stages of adulthood (Kwan, Cairney, Faulkner, & Pullenayegum, 2012; Scarapicchia, Sabiston, & Faulkner, 2015). For many young adults, the transition from late adolescence to early adulthood is marked by a major life event – attendance at a university/college. In Western countries including Canada, the United States, the United Kingdom, and Australia, university/college students represent large segments of the adult population. For example, in 2018, an estimated 21 million students were enrolled in universities and colleges across Canada and the United States (National Center for Education Statistics, 2018; Universities Canada, 2018).

As a population subgroup, university/college students have been receiving increased research attention due to the dramatic personal, social, and environmental changes known to take place during the university/college years (Joseph, Royse, Benitez, & Pekmezi, 2014), but also because these factors influence the health behaviors of students. Observational studies have found associations between attendance at a post-secondary institution and declines in physical activity (Kwan et al., 2012), insufficient fruit and vegetable consumption (Small, Bailey-Davis,

Morgan, & Maggs, 2013) as well as elevated rates of smoking (Kwan, Arbour-Nicitopoulos, Duku, & Faulkner, 2016) and binge drinking (Morton & Tighe, 2011). In contrast, much less is known about the sedentary behavior of university/college students. Preliminary research has, however, revealed that students can be highly sedentary and that greater time spent in sedentary behaviors among students are associated with compromised physiological health indicators. A systematic review of 23 studies comprising data collected from 6,533 university/college students across seven countries (U.S.A., Canada, Portugal, New Zealand, Republic of Korea, Turkey, Belgium) found that mean sedentary time, as measured by accelerometers and domain-specific questionnaires, to be 10.69 hours per day and 11.10 hours per day, respectively (Moulin, Truelove, Burke, & Irwin, 2019). This is particularly concerning considering evidence from a recent study of 94 college students that found that sitting ≥6 hours per day was found to be inversely associated with lean body mass and trending for positive association with fat% in female university students. Among male students, sitting above this threshold was inversely associated with 1-RM (repetition maximum) bench press (a measure of upper body strength). Female students who sat ≥7 hours per day exhibited an approximate 10-fold increased likelihood of being obese relative to females whose daily sitting time was below this threshold [OR = 9.6, 95% Confidence Interval (1.5 to 62.7), $p = .019$] (Vainshelboim, Brennan, Lorusso, Fitzgerald, & Wisniewski, 2019).

Studies that have measured sedentary behavior in university/college student populations using self-report questionnaires have provided specific insights into how students spend sedentary time (Buckworth & Nigg, 2004; Moulin & Irwin, 2017; Rouse & Biddle, 2010). Given the nature of higher education, most studies show that studying tends to account for a considerable proportion of students' overall sitting time. In a study of 84 undergraduates from

the United Kingdom (UK), Rouse and Biddle (2010) found ‘studying’ to be the highest sedentary time activity (4.66 hours per day), followed by ‘watching television (TV)’ (1.33 hours per day), ‘sitting and talking’ (1.20 hours per day), and ‘hanging out’ (1.06 hours per day). Similarly, Moulin and Irwin (2017) identified ‘studying’ (2.70 hours per day), ‘watching TV’ (2.5 hours per day) and ‘leisure-time computer use’ (2.25 hours per day) as the highest sedentary time activities in their sample of 102 Canadian undergraduates. While evidence is accumulating on the prevalence of sedentary behavior in university/college students as well as context-specific information about how students spend time being sedentary, much less research has focused on understanding factors that influence sedentary behavior in university/college students.

The Behavioral Epidemiology Framework and Ecological Model

Behavioral epidemiology is a field that is concerned with understanding and influencing health behaviors (Sallis, Owen, & Fotheringham, 2000). In 2000, Sallis, Owen and Fisher developed a behavioral epidemiology framework (Sallis et al., 2000) that specifies a general sequence for research that leads to evidence-based interventions. The behavioral epidemiology framework (Sallis et al., 2000) proposes that a necessary step prior to developing interventions to change health behaviors (e.g., sedentary behavior) is identifying correlates (i.e., variables that are associated with sedentary behavior) (Sallis et al., 2000). Of the many theories and models that can be used to guide the study of correlates, the ecological model (Sallis & Owen, 2015) has been used extensively to structure the study of factors influencing numerous health behaviors, including physical activity (Bauman et al., 2012), and to a lesser extent, sedentary behavior (O’Donoghue et al., 2016; Owen et al., 2011; Rhodes, Mark, & Temmel, 2012).

From an ecological perspective, complex health behaviors are shaped by a dynamic interrelation of multiple intrapersonal (e.g., psychological, biological, demographic), social (e.g.,

culture, community), environmental (e.g., physical environment, safety, attractiveness) and policy-related factors (e.g., health care policies and regulations) (Sallis, Owen, & Fisher, 2008). A systematic review of correlates of sedentary behavior in university/college students found that most correlates that have been studied to date have been intrapersonal factors (e.g., age, self-rated health) (Castro, Bennie, Vergeer, Bosselut, & Biddle, 2018). After excluding studies at high risk of bias, Castro and colleagues (2018) found that only three intrapersonal factors have been studied in a sufficient number of studies (defined as ≥4 studies by the authors) to determine an overall association with sedentary behavior: gender, physical activity, and obesity markers. Further explicit applications of behavioral theories and models are needed to identify psychological correlates of sedentary behavior that can be targeted and modified in interventions to reduce sedentary behavior in university students (Rhodes et al., 2012; Rollo, Gaston, & Prapavessis, 2016).

Cognitive and motivational variables represent one class of intrapersonal psychological factors that may enhance our understanding of university student sedentary behavior (Rhodes et al., 2012; Rollo et al., 2016). Various cognitive and motivational variables are included in social-cognitive models of health behavior, including the Health Belief Model (Rosenstock, 1974), the Theory of Reasoned Action (Ajzen & Fishbein, 1977), the Theory of Planned Behavior (Ajzen, 1991), and Social Cognitive Theory (Bandura, 1977). These theories outline a number of individual psychological constructs, including attitudes, self-efficacy, perceived barriers, motivation, and intentions. Systematic reviews of correlates of sedentary behavior in adults have identified several studies that have found significant relationships between cognitive and motivational factors and sedentary behavior (Rhodes et al., 2012; Rollo et al., 2016). Given that psychological factors are more amenable to change than non-modifiable factors (e.g., age,

gender, built environment), identifying cognitive and motivational correlates of sedentary behavior may be crucial for informing interventions to reduce excessive sedentary time in university students.

Social Cognitive Theory

One theory that offers a framework to advance our understanding of psychological factors that may influence sedentary behavior is Albert Bandura's Social Cognitive Theory (SCT; Bandura, 1977; 1986; 1997; 2004). SCT specifies a core set of behavioral determinants that include *knowledge* of risks and benefits of different behaviors, *perceived self-efficacy* that one can perform specific targeted behaviors, and *outcome expectations* about the benefits and costs of behavior change. According to SCT, knowledge creates a necessary pre-condition for behavior change. Consider, for example, an undergraduate student who is unaware that spending prolonged periods of time sitting may increase chronic disease risks independently of physical activity. From a SCT perspective, it would be unlikely this student would consciously and purposefully make concerted efforts to try and be less sedentary because they lack knowledge of the potential risks of being sedentary. To date, only one study has explored university students' understanding of the concept of sedentary behavior. In a qualitative study that used focus group discussion to explore determinants of physical activity and sedentary behavior in Belgian undergraduates, Deliens et al. (2015) found that students were not fully aware of the concept of sedentary behavior and concluded that 'sedentary behavior' is still a relatively unknown concept to students.

While knowledge is theorized to create a precondition necessary for behavior change, knowledge alone is often insufficient to drive behavior change (Arlinghaus & Johnston, 2018). Most people require additional self-influences to overcome the barriers that prevent them from

leading healthier lifestyles (Bandura, 2004). According to SCT, self-efficacy, which refers to one's belief in their capability to perform specific behaviors to produce given attainments, is a primary and focal determinant of behavior (Bandura, 1997, 2004). Self-efficacy is a form of 'can do' cognition that reflects an individual's belief in their capabilities to exercise control over their own functioning and behavior, even in challenging or difficult situations (Bandura, 1977). Self-efficacy has been studied extensively in the health domain where it has been shown to be a robust and consistent predictor of numerous health behaviors, including healthy eating habits (Nastaskin & Fiocco, 2015), smoking cessation (Cupertino et al., 2012), alcohol abstinence (Maisto et al., 2015) and physical activity (Bauman et al., 2012).

Although tests of self-efficacy in the sedentary behavior domain are limited in number, preliminary findings are promising. For example, in a study of 878 adolescents aged 11-15 years, Norman et al. (2005) found that self-efficacy to plan ahead what TV shows participants would watch during the week was inversely associated with actual sedentary TV viewing time. In a study conducted with 419 Belgian adults aged 20-65 years, Dyck et al. (2011) found inverse associations between self-efficacy to reduce sedentary TV viewing and leisure time computer use and actual sedentary time spent watching TV ($p < 0.001$) and leisure time computer use ($p < 0.001$). Another study by Busschaert et al. (2016) found inverse associations between self-efficacy to reduce time spent in specific sedentary behaviors (i.e., TV viewing, computer use, electronic gaming, motorized transport) and actual sedentary time spent in these behaviors (Busschaert et al., 2016).

While preliminary evidence supports self-efficacy as a psychological correlate of sedentary behavior, the evidence base is limited to a few studies. Moreover, only one study has examined associations between self-efficacy to reduce sedentary behavior and actual sedentary behavior in

a university student population (Cotten & Prapavessis, 2016). Cotten and Prapavessis (2016) conducted a randomized controlled trial to determine whether a 6-week text-message intervention could increase frequency and length of breaks from sitting, time spent standing, and time spent in light- and moderate-intensity physical activity in a sample of 82 university students. A secondary purpose was to assess whether the intervention could increase students' self-efficacy beliefs to increase frequency and length of breaks in sitting and whether these efficacious beliefs would predict actual break behavior, time spent standing, and time spent in light- and moderate-intensity activity. At 6 weeks, students' self-efficacy levels to increase break frequency and length were significantly related to actual break frequency and length, standing time, light-, and moderate-intensity activity. The authors concluded that the intervention successfully increased students' self-efficacy to reduce sedentary behavior and that these efficacious beliefs were, in turn, associated with actual reductions in sedentary behavior (Cotten & Prapavessis, 2016).

While preliminary findings support self-efficacy as a psychological correlate of sedentary behavior, the few studies that have applied self-efficacy in the sedentary domain have employed rather narrow conceptualizations of the self-efficacy construct. For example, Cotten and Prapavessis's (2016) study assessed task self-efficacy, which is defined as one's beliefs in their capabilities to perform a single instance of a circumscribed behavior at different levels of performance (Williams & Rhodes, 2014). These researchers had participants rate how confident they were to reduce total sitting time (by 20, 30, 45…90 minutes per day), take breaks from sitting (every 30, 45, 60…240 minutes), and increase break length (by 30 sec, 1, 2, 3…15 minutes). Another self-efficacy subtypes that has been assessed in the sedentary behavior domain is context-specific self-efficacy, which refers to one's confidence in their capabilities to reduce

time spent in specific sedentary behaviors (e.g., TV viewing, computer use) (Busschaert et al., 2016; Van Dyck et al., 2011). While both task and context-specific self-efficacy subtypes capture important dimensions of the self-efficacy construct in the context of reducing sedentary behavior, decreasing sedentary behavior is conceived of as a self-regulatory challenge (Gardner, Smith, Lorencatto, Hamer, & Biddle, 2016). This idea is not unfounded considering the many self-regulatory skills that one would need to implement on a consistent basis to initiate and maintain meaningful reductions in sedentary time. Such skills might include the ability to self-monitor sedentary time (plan, track), set goals (e.g., break up sitting after every 30 minutes), problem solve (e.g., enlist social support, modify work/home infrastructure to promote less sitting and more standing/movement), and to recover after experiencing setbacks.

Bandura (2006) proposes that because many areas of functioning are governed by self-regulatory efficacy, this particular self-efficacy subtype may be most salient when examining activities of daily living (Bandura, 2004). Since most adults' waking hours are spent predominantly sedentary, standing, or in light-intensity physical activity, examining confidence to spend less time sedentary and more time standing and moving at any intensity throughout the day would appear to be highly relevant. Self-regulatory efficacy has been shown to be a self-efficacy subtype that is associated with numerous health behaviors, including physical activity (Nickel & Spink, 2010; Woodgate, Brawley, & Weston, 2005). However, no studies have examined associations between self-regulatory efficacy to reduce sedentary behavior and actual sedentary behavior. Despite evidence indicating that university students lack the ability to self-regulate their sedentary behavior (Deliens et al., 2015; Lacaille, Dauner, Krambeer, & Pedersen, 2011), no studies have examined associations between self-regulatory efficacy and actual sedentary behavior in a university student population. Examining the correlational relationship

between self-regulatory efficacy and sedentary behavior in university students may provide insights about the cognitive antecedents of the successful (or unsuccessful) self-regulation of sedentary behavior. If self-regulatory efficacy is inversely associated with sedentary behavior, such evidence may support the targeting of this social cognition in sedentary behavior reduction interventions.

Outcome Expectations

Outcome expectations are defined as the anticipated consequences (positive or negative) one expects to occur as a result of performing a behavior (Bandura, 1997, 2004). Bandura (1997, 2004) proposes that outcome expectations lie along three related, but conceptually distinct dimensions: physical, social, and self-evaluative. Physical outcome expectations refer to beliefs concerning the positive or negative physical consequences one expects to occur from the enactment of a behavior (e.g., pleasure, pain) (Bandura, 1997). Social outcome expectations refer beliefs concerning the positive or negative social reactions and evaluations one anticipates the enactment of a behavior will elicit in others (e.g., praise, disapproval) (Bandura, 1997). Self-evaluative outcome expectations refer to beliefs about the anticipated positive or negative self-reactions the enactment of a behavior is expected to evoke (e.g., a sense of self-accomplishment, disappointment) (Bandura, 1997). Additionally, SCT posits outcome value, or one's subjective evaluation of the importance (value) of anticipated behavioral outcomes (Bandura, 1978; Maddux & Rogers, 1983), as a determinant of behavior (Maddux, 1995). Outcome value is proposed to influence the effect outcome expectations have on behavior (Maddux, 1995), such that behaviors people expect will lead to valued outcomes are more likely to be performed and sustained relative to behaviors that they expect to produce outcomes of lesser value (Williams et al., 2005).

Outcome expectations have been shown to affect multiple health behaviors, including alcohol consumption (Anthenien, Lembo, & Neighbors, 2017), smoking (Nikcevic et al., 2017), and physical activity (Williams et al., 2005). In the physical activity literature, evidence of an association between outcome expectations and physical activity is mixed (Williams, Anderson, & Winett, 2005). Where some studies have found that expecting positive outcomes from physical activity is associated with greater motivation (Gellert et al., 2012), self-efficacy (Resnick et al., 2000) and physical activity behavior (Son, Kerstetter, Deborah, Mowen, & Payne, 2009; Williams, Anderson, & Winett, 2005), others have found outcome expectations to add little to no additional variance to the prediction of physical activity over and above that already accounted for by self-efficacy (Anderson, Wojcik, Winett, & Williams, 2006; Anderson et al., 2010).

To date, no studies have explicitly examined associations between outcome expectations, as conceptualized and defined by Bandura (1997, 2004), and actual sedentary behavior. Some studies, however, have examined associations between "pros" and "cons" and sedentary behavior. The "pros" and "cons" construct is derived from decisional balance theory, which focuses on understanding cognitive and motivational aspects of human decision-making (Janis, 1977; Velicer, Diclemente, Prochaska, & Brandenburg, 1985). Norman et al. (2005) found that "pros" and "cons" to reduce time in specific sedentary behaviors (watching TV, playing computer games, listening to music, talking on the phone) were correlated with actual time spent in these sedentary behaviors. Van Dyck et al. (2011) found associations between "pros" and "cons" to reducing sedentary screen-time (watching TV, leisure-time computer use) and actual screen-time, such that participants who perceived more "pros" to reducing screen-time spent less

time using screens than those who perceived more “cons” to reducing screens (Van Dyck et al., 2011).

Bandura (1997, 2004) posits three forms of outcome expectations: physical, social, and self-evaluative. It is possible that an individual, in their process of deciding whether to reduce sedentary time, might consider the potential physical, social, and self-evaluative consequences of doing so. If individuals expect positive and valued outcomes from enacting a given behavior, SCT posits that these outcome expectation beliefs may influence one’s decision to initiate and sustain the behavior. Consider, for example, an undergraduate student who discovers that prolonged sitting can increase cancer risks independently of physical activity. In learning this information, the student may decide to start monitoring sitting time and purposefully break up prolonged sitting every 20-30 minutes with light activity breaks to reduce their cancer risks. On the other hand, it is equally plausible that this same student might expect that reducing sedentary time less would lead to undesirable outcomes. For example, that interrupting important (e.g., studying) or enjoyable sedentary activities (e.g., watching TV) would be disruptive. Just as the expectation of positive and valued outcomes might influence a person’s decision to be less sedentary, expecting negative or unwanted outcomes of being less sedentary may influence a person’s decision to do nothing about changing their sedentary behavior. Despite the potentially influential role outcome expectations may play in determining sedentary behavior, no studies have explicitly examined associations between outcome expectations (physical, social, and self-evaluative) and actual sedentary behavior. Examining this relationship may reveal outcome expectations to be a psychological correlate of sedentary behavior and support the targeting of this cognition in interventions to reduce sedentary behavior in university students.

The Expectancy-Value Muddle

SCT can be viewed as belonging to a larger family of theories known as expectancy-value theories (Bolles, 1972; Carter, 1990; Feather, 1982), which include the Theory of Reasoned Action (TRA; Fishbein, 1975), and its successor, the Theory of Planned Behavior (TPB; Ajzen, 1991), and SCT (Bandura, 1986; 1997). According to expectancy-value theories, intention is the most proximal determinant of behavior. Intention can be defined as a person's conscious plan to exert effort to carry out a behavior (Fishbein & Ajzen, 1975). According to the TRA, intention is influenced by two constructs: attitude and subjective norm. Attitude refers to an evaluation of the potential outcomes that could arise if a given behavior were enacted, while subjective norm reflects perceived support from social referents (Ajzen, 1991; Fishbein & Ajzen, 1975). With respect to attitude, Fishbein and Ajzen (1975) contend that attitude arises from the simultaneous evaluation of the perceived likelihood that a particular outcome will eventuate following the enactment of a behavior (outcome expectation) and the perceived desirability of the outcome (outcome value).

According to the TRA and TPB, the expectancy-value term underpinning attitude can be expressed mathematically as:

$$A = \sum bxe$$

where *A* denotes attitude, *b* denotes outcome expectations and *e* denotes outcome value. While the expectancy-value components underpinning attitude have been examined widely (Conner & Sparks, 2005), the validity of much of this research has been called into question owing to a problem termed the 'expectancy-value muddle' (French & Hankins, 2003).

The 'expectancy-value muddle' has been identified as a problem related to the attitude construct in the TRA and TPB, but also a problem inherent to other expectancy-value models

including SCT. According to SCT, behavior can be predicted by the multiplicative combination of outcome expectations by their corresponding outcome value (Williams et al., 2005). The problem with this multiplicative method of deriving the expectancy-value term is that each component is typically assessed using Likert scales without a rational zero point (Newton, Newton, & Ewing, 2014). As a result, outcome expectations and outcome values can be assessed using combinations of unipolar (e.g., +1 to +7) and bipolar (e.g., -3 to +3) rating scales (Newton et al., 2014). The use of unipolar and bipolar rating scales interchangeably would not normally cause problems because performing linear transformations on such scales would leave important scale properties, such as rank order and standard deviation, unaffected (Schmidt, 1973). Expectancy-value models such as SCT, are different however, because they rely upon the multiplicative composite of outcome expectation by their corresponding value to derive the expectancy-value term. Consider, for example, an undergraduate student who perceives that sitting less is unlikely to lower their risk of developing cardiovascular disease (low outcome expectation), but who also perceives that lowering their cardiovascular risk is unimportant (low outcome value). If a unipolar rating scale (e.g., +1 to +7) was used to assess the outcome expectation component (e.g., student selects +1) and a bipolar rating scale (-3 to +3) was used to assess the outcome value component (e.g., student selects -3), the student would receive a mid-ranking score (1 x -3 = -3). However, if a bipolar rating scale (-3 to +3) was used to assess both outcome expectation *and* outcome value components, the participant would receive the highest possible score (-3 x -3 = 9). Expectancy-value terms generated using the multiplicative method are thus dependent upon the type of rating scales used to assess each belief-based component. Given the profound effects the ‘expectancy-value muddle’ can have on the analysis and interpretation of findings (Gagné & Godin, 2000; Hewstone & Young, 1988; Sparks, Hedderley,

& Shepherd, 1991), researchers recommend that the multiplicative method off deriving expectancy-value terms should not be used as results can be uninterpretable.

One method of resolving the 'expectancy-value muddle' advanced by French and Hankins (2003) involves modifying the way the expectancy-value term is represented. French and Hankins' (2003) approach is based on Cronen and Conville's (1975) assumption that individuals who are asked to specify salient beliefs about a particular outcome will only elicit outcomes they perceive as having a high probability of eventuating (high outcome expectations). The conceptual basis of this argument is that outcome expectations will be greater for salient outcomes as opposed to non-salient outcomes.

The Dimensional Salience Approach

French and Hankins' (2003) approach provides a simple solution to the 'expectancy-value muddle'. However, a limitation of this approach is that expectancy-value models do not account for limits in cognitive processing (Newton, Ewing, Burney, & Hay, 2012). Miller (1956) found that the amount of information individuals can process at any one time is limited. Based on this research, Fishbein and Ajzen (1975) suggest that an individual's attitude toward a behavior is determined by up to a maximum of five to nine salient outcome expectations (Newton et al., 2012). To account for limits in cognitive processing, Van der Pligt and Eiser (1984) proposed a *dimensional salience* approach, whereby participants are presented with a list of outcomes associated with a behavior and asked to select three (van der Pligt & de Vries, 1998a; van der Pligt & de Vries, 1998b) or five (Budd, 1986; Elliott, Jobber, & Sharp, 1995) outcomes they consider most important to them and to rate the desirability (value) of these three or five selected outcomes. The expectancy-value term is represented by summing participants' value ratings for the outcomes they selected as most important, which represent their salient outcome

expectations. The exact number of outcomes participants should be instructed to select as salient remains unclear. However, Newton et al. (2014) suggest that a conservative estimate is that participants should be asked to select five salient outcomes as this criterion has demonstrated success in several studies (Budd, 1986; Newton et al., 2012; van der Pligt & Eiser, 1984).

The dimensional salience approach has been applied successfully to resolve the 'expectancy-value muddle' in several investigations. For example, Newton et al. (2012) measured UK adults' direct and indirect attitudes toward posthumous organ donation and intentions to consent to organ donation. From a list of eighteen outcomes related to organ donation, participants selected five they considered *most* important to them. Newton et al. (2012) found that their use of the dimensional salience approach satisfied the Cronen and Conville (1975), in that participants perceived they selected as important (salient) as more likely to eventuate than outcomes they did not select as salient outcomes and that salient outcomes were positively associated with attitude (r = .50) and intention (r = .48). The study by Newton et al. (2012) demonstrated that salient outcome expectations can be used to represent the expectancy-value term in expectancy-value models and that the dimensional salience approach offers a solution for resolving the 'expectancy-value muddle'. Newton et al.'s (2012) findings have been supported by Newby, Brown, French, and Wallace (2013) who replicated the method used by Newton et al. (2012) in a study assessing attitudes towards condom use.

To recap, no studies have explicitly examined associations between outcome expectations and values, as conceptualized and defined by Bandura (1997, 2004), and actual sedentary behavior. Examining the influence university students' outcome expectations and values related to reducing sedentary behavior have on their actual sedentary behavior may reveal these particular social cognitions as psychological correlates of sedentary behavior that can be targeted

in interventions. Further, using the dimensional salience approach may provide insights into outcomes of reducing sedentary behavior that students perceive as salient and the relationship between salient outcome expectations and students' actual sedentary behavior. Such information could be important to inform, for example, health campaigns that aim to motivate university students to be less sedentary. Campaigns that feature beneficial outcomes of being less sedentary that students perceive as highly salient may enhance the impact such campaigns may have on motivating students to be less sedentary and eliciting behavior change.

Communicating Sedentary Behavior Health Risk Information

One way to familiarize students with concept and health risks of sedentary behavior is through health campaigns. A systematic review of behavior change strategies used in interventions to reduce sedentary behavior in adults found that interventions that incorporate education (i.e., 'increasing knowledge and understanding') and persuasion (i.e., 'using communication to induce positive or negative feelings or stimulate action') are particularly promising in reducing sedentary behavior (Gardner et al., 2016). University campuses represent ideal settings in which to convey health information pertaining to sedentary behavior to students and encourage sedentary behavior change. First, because of their size, large numbers of students can be reached and exposed to health-related information and behavior change interventions (Plotnikoff et al., 2015). Second, university campuses are equipped with facilities, resources, and qualified health professionals who are uniquely situated to address and influence the health behaviors of students (Plotnikoff et al., 2015). Third, because university campuses are defined and self-contained communities, they are ideal settings in which to create and establish norms and policies that support and encourage healthful behaviors (Kwan, Arbour-Nicitopoulos, Lowe, Taman, & Faulkner, 2010). Perhaps most importantly, university students as a population

subgroup represent a captive audience who have been shown to be particularly receptive to information and programs that can improve health and wellbeing (Kwan et al., 2010).

Many health campaigns feature risk messages that are designed to alert people to behaviors that can increase their health risks and to encourage behavior change (Good & Abraham, 2011; Snyder et al., 2004). Ironically, health risk messages are often least persuasive to individuals at higher level of risk (Sherman, Nelson, & Steele, 2000). One reason for this is that individuals whose behavior puts them at risk tend to process and react to health risk information defensively because such information implies to them that they have not acted adaptively or wisely (Jemmott, Ditto, & Croyle, 1986). When individuals perceive health risk information as a threat to their sense of self-integrity and personal adequacy, they tend to process and react to such information in a defensive, biased, and self-serving manner to maintain or restore a view of the self as healthy, adaptive, adequate, and able to control important outcomes. Consider, for example, a highly sedentary undergraduate student confronted with information suggesting to them that excessive screen time can increase risk for type 2 diabetes. This particular student consistently spends several hours playing video games before bed each night. If the students were to perceive the message as threatening, they may react defensively, by, for example, dismissing or downplaying the seriousness of the risks, questioning the accuracy of information, rationalizing their behavior, or avoiding the information (Sherman & Cohen, 2006). While such reactions may temporarily relieve the student from having to worry about their video-gaming behavior and considering behavior change, the consequences of defensively rejecting the information and failing to act upon it can potentially come at great cost to the their health and well-being.

Self-Affirmation

One method of reliably changing how people appraise and respond to threatening health risk information is through self-affirmation (Cohen & Sherman, 2014). Self-affirmation is the act of affirming one's moral and adaptive adequacy (Steele, 1988). According to Self-Affirmation Theory (1988), people are highly motivated to maintain a positive, global self-image; a view of themselves as "adaptively and morally adequate" (Steele, 1988, p. 262). People whose behavior may be increasing their health risks tend to react defensively to health risk information because the information threatens their sense of personal adequacy (Jemmott et al., 1986). The standard self-affirmation intervention involves presenting individuals with an opportunity to write briefly about an important personal value in a domain unrelated to the domain under threat, such as relationships or past acts of kindness and compassion (Cohen & Sherman, 2014). Although brief, affirming the self can have profound effects, bolstering their sense of self-worth and rendering health risk messages as less threatening. By giving people an opportunity to remind themselves of "who they are" in a global sense prior to exposing them to health risk information they perceive as threatening has been shown to improve the way individuals process and react to such information and can increase the likelihood of subsequent behavior change (Armitage, Harris, Hepton, & Napper, 2008; Harris & Napper, 2005; Sherman, Nelson, & Steele, 2000; Sherman & Cohen, 2006; Steele, 1988).

A 'self-affirmation' can be any act that allows an individual to demonstrate their sense of personal adequacy (Steele, 1988). On any given day, many events can occur that may be personally meaningful and bring about a positive view of the self and its resources (e.g., spending quality time with friends and family, volunteering) (Cohen & Sherman, 2014). Because people can draw from a myriad of past experiences, personal characteristics, or attributes to

bolster their self-concept, self-affirmation can include a wide range of activities. Various methods have been used to experimentally induce self-affirmation. The most common procedure involves presenting individuals with a list of values or positive attributes or characteristics and then asking them to write an essay, use imagery techniques, or think about positive qualities they possess (Mcqueen & Klein, 2006). While there is no consensus as to the "best" method of experimentally inducing self-affirmation, a review of experimental techniques indicates that it may be sufficient to have all participants affirm their kindness or honesty (Mcqueen & Klein, 2006).

The Effects of Self-Affirmation on Message Processing

Research suggests that self-affirmation can increase acceptance of threatening health risk information, reduce the degree to which messages are derogated, and can increase personal risk perceptions (Harris & Epton, 2009; Harris & Napper, 2005; Koningsbruggen & Das, 2009; Mcqueen & Klein, 2006; Reed & Aspinwall, 1998; Sherman et al., 2000). For example, adult smokers who self-affirmed by reflecting on past acts of kindness or compassionate behavior prior to reading an antismoking leaflet were more accepting of the information than smokers who did not self-affirm (Armitage et al., 2008). In another study, young female coffee drinkers who self-affirmed prior to reading an article linking caffeine consumption to breast cancer were more accepting of the article's conclusion relative to their non-affirmed counterparts (Sherman et al., 2000). Self-affirmation has also been shown to reduce the degree to which individuals derogate (i.e., disparage, denigrate, belittle, downplay) threatening health risk information. For example, Koningsbruggen and Das (2009) found that individuals at risk of type 2 diabetes who were given an opportunity to self-affirm prior to viewing information on risk factors associated with type 2 diabetes perceived the information as less exaggerated, manipulative, and overblown than their

non-affirmed counterparts (Koningsbruggen & Das, 2009). Self-affirmation has also been shown to enhance personal risk perceptions. For example, Sherman et al. (2000) found that sexually active participants who self-affirmed prior to watching an AIDS educational video saw themselves at greater risk for HIV and purchased condoms more often than did non-affirmed participants. Another example can be seen in a study by Harris and Napper (2005), who found that female drinkers who self-affirmed prior to reading a leaflet highlighting links between alcohol consumption and breast cancer reported higher ratings of perceived risk for breast cancer from alcohol consumption relative to their non-affirmed participants.

The Effects of Self-Affirmation on Self-Efficacy and Outcome Expectations

Theory and research suggest that self-affirmation can also enhance cognitive predictors of intentions, such as self-efficacy and response-efficacy (conceptually similar to outcome expectations) (Epton & Harris, 2008; Harris, Mayle, Mabbott, & Napper, 2007; Jessop, Simmonds, & Sparks, 2009; Reed & Aspinwall, 1998; Zhao & Nan, 2010). For example, Epton and Harris (2008) found that undergraduates who self-affirmed prior to reading a message about the benefits of meeting the "five portions of fruit and vegetables per day" guideline were more confident they could meet the guideline (elevated self-efficacy) and to indicate that meeting the guideline would lower their heart disease and cancer risk (enhanced positive outcome expectations) (Epton & Harris, 2008). In another study, Jessop et al. (2009) found that self-affirmed sunbathers who read a leaflet describing the link between overexposure to ultraviolet light and cancer reported higher levels of self-efficacy to use sunscreen and more positive outcome expectations related to sunscreen use than did non-affirmed sunbathers (Jessop et al., 2009).

The mechanisms through which self-affirmation is thought to enhance self-efficacy and outcome expectation beliefs are not well understood. Some researchers contend that because self-affirming promotes a more open-minded stance, it makes individuals more receptive and willing "to accept that behavior change is achievable and effective" (Epton & Harris, 2008, 747). Others suggest that the effects of self-affirmation on self-efficacy are mediated by self-esteem, positive affect, and physiological stress (Arpan, Lee, & Wang, 2017). Equivocally, it could also be that because self-affirming increases thoughts about personal success and engenders positive emotions (Bandura, 1997; Ekblom-Bak, Ekblom, Vikström, de Faire, & Hellénius, 2014), self-affirming can enhance people's confidence in their ability to enact recommended behaviors and that doing so will lead to beneficial outcomes (Bandura, 1997).

Tests of Self-Affirmation in the Sedentary Behavior Domain

To my knowledge, only two studies (Falk et al., 2015; Kang et al., 2018) have examined the effects of self-affirmation in the sedentary behavior domain. The aim of both of these studies was to understand the neural mechanisms induced by self-affirmation during exposure to sedentary behavior risk messages. Falk et al.'s (2015) study was conducted in a community sample of sedentary adults (n=67; mean age=33.42 years) while Kang et al.'s (2018) study was conducted among sedentary and obese/overweight adults (n=220, mean age=33.75). Both studies found that participants who self-affirmed exhibited greater activity in the ventromedial prefrontal cortex (VMPC; a brain region associated with self-related processing and positive valuation) during message exposure relative to controls. Further, increased VMPC activity was also found to be predictive of subsequent reductions in sedentary behavior (Falk et al., 2015; Kang et al., 2018). While Falk et al.'s (2015) and Kang et al.'s (2018) provide novel insight into the neurological mechanisms induced by self-affirmation, no studies have examined the effects of

self-affirmation on message-processing variables that are commonly reported in the literature (e.g., message acceptance, message derogation, risk perceptions, self-efficacy, outcome expectations). Understanding the impact self-affirmation may have on university students' processing of and social cognitive reactions to health risk information related to sedentary behavior may provide evidence support the use of self-affirmation as an intervention technique to decrease sedentary behavior in this population.

Summary

University students represent a large segment of the adult population for whom excessive sedentary behavior is prevalent (Moulin et al., 2019) and potentially problematic. Students who spend greater volumes of time sitting have been shown to be at increased risk of obesity and exhibiting markers of compromised cardiometabolic health (Vainshelboim et al., 2019). Encouraging and supporting university students to be less sedentary is important given evidence that sedentary patterns students established during the university-years have a high likelihood of being ingrained and maintained into later stages of adulthood (Biddle et al., 2010). While evidence is accumulating on the prevalence and physiological effects of sedentary behavior in university students, much less research has focused on understanding psychological factors that may influence the sedentary behavior of university students.

SCT (Bandura, 2004) offers a framework to explore what university students know and understand about the concept and health risks of sedentary behavior, their confidence to be less sedentary, and the outcomes students expect may occur if they reduced sedentary time. To date, no studies have explicitly used SCT as a framework to explore university students' perceptions of sedentary behavior, nor have any studies sought to understand how students process and react to health risk information related to sedentary behavior.

The overall objective of this thesis was to use SCT (Bandura, 2004) to explore university students' social cognitive perceptions related to sedentary behavior and sedentary behavior change. The thesis had three specific objectives. The first objective was to evaluate university students' knowledge and perceptions of self-efficacy and outcome expectations related to reducing sedentary behavior and determine whether these perceptions were related to students' actual sedentary behavior (*Study 1*). The second objective was to explore the same topics studied in *Study 1* in greater depth using a qualitative approach (*Study* 2) and determine whether students perceive health risk information related to sedentary behavior as threatening. The third objective was to test the effects of a self-affirmation manipulation and determine if self-affirming could improve students' processing of and reactions to health risk information related to sedentary behavior (*Study 3*).

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CHAPTER II: STUDY 1

Study 1

University Students' Knowledge of Sedentary Behavior and Associations Between Self-Efficacy, Outcome Expectations, and Self-Reported Sedentary Time

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Abstract

Objective: University students are at high-risk for excessive sedentary behavior, which is associated with detrimental health outcomes. Little is known about social cognitive correlates of sedentary behavior in university students. The purpose of this study was to use Social Cognitive Theory as a framework to explore university students' conceptual and health risk knowledge of sedentary behavior and to examine associations between different self-efficacy sub-types for reducing sedentary behavior (self-regulatory, context-specific, task), outcome expectations/values, and self-reported sedentary time. **Method:** Ninety-six students from a Canadian university (women = 49; men = 47; M_{age} = 20.1) completed a web-based survey assessing knowledge, self-efficacy, outcome expectations/values related to reducing sedentary behavior and a modified Sedentary Behavior Questionnaire. **Results**: Fifty-seven percent of participants provided accurate definitions of sedentary behavior, 16% provided inaccurate/ambiguous definitions, and 27% provided no response. Most participants (90%) associated sedentary behavior with detrimental health outcomes. On average, participants self-reported 10.83 hours (SD=3.62) of sedentary time per day. The overall model predicting sedentary behavior (including all predictor variables) was not statistically significant, $F(4, 91) = 1.679$, $p = .162$, accounting for only 6.9% of the variance. Self-regulatory efficacy was as the only social cognitive variable significantly associated with sedentary time ($\beta = -.243$, $p < .05$). **Conclusion:** Findings suggest that interventions to reduce sedentary behavior in university students should include education to familiarize students with the distinct concept of sedentary behavior and there may be value in enhancing students' self-regulatory efficacy to manage reductions in sedentary time.

Introduction

Evidence suggests that high levels of sedentary behavior – defined as any waking behavior with an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture (Tremblay et al., 2017) – poses health risks that are independent of those attributable to a lack of physical activity (Biswas et al., 2015; Thyfault et al., 2015). Due to advancements in communication, media and entertainment technologies, altered school and workplace settings, and passive modes of transportation (Owen et al., 2010), sedentary behavior is pervasive in modern societies. National surveillance data indicate that most adults spend 9-10 hours per day sedentary (Clark & Sugiyama, 2015; Colley et al., 2011). University students are a high-risk population for excessive sedentary behavior due to the amount of time students spend sitting in class and studying (Peterson et al. 2018). Several studies have shown that undergraduates spend an average of 10-12 hours per day sedentary (Moulin & Irwin, 2017; Prapavessis et al., 2015). As evidence suggests that sedentary patterns established during the university years (18-25 years of age) track into later stages of adulthood (Biddle et al., 2010), intervening to reduce sedentary behavior during this critical life stage may be an important public health goal for chronic disease prevention and health promotion.

The strategic and conceptual basis for sedentary behavior research is guided by the Behavioral Epidemiology Framework (Sallis et al., 2000), which proposes that identifying correlates and determinants (i.e., variables associated with a target health behavior) is key to informing interventions aimed at behavior change (Sallis et al., 2000). Of the many models that can be used to structure the study of behavioral correlates and determinants, the Ecological Model (Owen et al., 2011; Sallis et al., 2008) has been used extensively to understand factors that influence physical activity (Bauman et al., 2012), and more recently, sedentary behavior

(O'Donoghue et al., 2016). An ecological approach to understanding factors that influence behavior assumes that complex health behaviors are shaped by a dynamic interrelation of intrapersonal (e.g., ethnicity, attitudes), interpersonal (e.g., social support), environmental (e.g., building design) and policy-related factors (Hadgraft et al., 2018). In a recent systematic review of correlates of sedentary behavior in university students, Castro et al. (2018) concluded that only three intrapersonal variables (physical activity, obesity markers, gender) have been sufficiently examined (≥4 studies) to determine an overall association with sedentary behavior. To address the issue of reducing sedentary behavior in university students, more systematic applications and evaluations of behavioral theories are needed to identify modifiable psychosocial correlates and determinants of sedentary behavior that can be targeted in interventions (Castro et al., 2018).

One behavioral theory that may advance knowledge of psychological correlates of sedentary behavior is Social Cognitive Theory (SCT; Bandura, 2004). SCT outlines a multifaceted causal structure of constructs that are theorized to act as psychological determinants of behavior. These determinants include *knowledge* of the risks and benefits of given health behaviors, *perceived self-efficacy* that one can exercise control over their own behavior and functioning, *outcome expectations* concerning the anticipated consequences of one's actions (Bandura, 2004) and the *value* (importance) one attaches to anticipated outcomes (Bandura, 2004; Maddux, 1995). Knowledge, according to SCT, creates a necessary pre-condition for behavior change (Bandura, 2004). The premise of this proposition is that if individuals lack knowledge of sedentary behavior and its potential negative health impacts, they would have little reason to reduce their sedentary behavior. While knowledge of sedentary behavior has been studied among office workers (Mcguckin et al., 2017) and older adults (Webber et al., 2018), we

identified only one study that focused on university students. In a qualitative study that employed focus group discussions, Deliens et al. (2015) explored determinants of physical activity and sedentary behavior among Belgian undergraduates and found that students were relatively unfamiliar with the concept of sedentary behavior.

Beyond knowledge, most people require additional self-influences to overcome barriers that prevent them from leading healthier lifestyles (Bandura, 2004; Kelly & Barker, 2016). According to SCT, *self-efficacy*, that is, one's belief in their capability to perform target behaviors, plays a critical role in behavior change (Bandura, 2004). A large body of evidence identifies self-efficacy as a robust and consistent predictor of numerous health behaviors, including healthy eating (Nastaskin & Fiocco, 2015) and physical activity (Bauman et al., 2012). While applications of the self-efficacy construct in the sedentary behavior domain are limited in number (Biddle, 2018), preliminary evidence from studies of adolescents (Norman et al., 2005), community-dwelling adults (Busschaert et al., 2016), and university students (Eysenbach et al., 2016) identify self-efficacy as a social cognitive correlate of sedentary behavior and sedentary behavior change.

Since Bandura's original conceptualization of the self-efficacy construct, researchers have distinguished between several self-efficacy subtypes (Williams & Rhodes, 2014), two which appear to have been examined in the sedentary behavior domain: task and context-specific self-efficacy. Task self-efficacy refers to belief in one's capability to perform a single instance of a circumscribed behavior at different levels of performance (Williams & Rhodes, 2014). For example, Cotten and Prapavessis (2016) assessed university students' task self-efficacy to reduce total sitting time (by 20, 30, 40…90 minutes/day), break up sitting (every 30, 45, 60…240 minutes), and increase break duration (by 1, 2, 3…15 minutes). Context-specific self-efficacy

refers to beliefs in one's capability to reduce time in specific sedentary behaviors. For example, Busschaert et al. (2016) assessed Belgian adolescents' self-efficacy to reduce television (TV) viewing and leisure-time computer use. In a sedentary behavior context, task and context-specific self-efficacy measures capture important dimensions of the self-efficacy construct. However, Bandura (2004) proposes that changing complex health behaviors may also be dependent upon self-regulatory self-efficacy, that is, people's ability to use self-regulatory skills (e.g., goal-setting, self-monitoring, problem solving) to manage the performance of complex behaviors on a consistent basis (Bandura, 1986; De Ridder & De Wit, 2006). Despite evidence from previous studies indicating that students struggle to self-regulate their sedentary behavior (Deliens et al., 2015; Lacaille et al., 2011), no studies have examined the relationship between self-regulatory efficacy to reduce sedentary behavior and actual sedentary behavior.

SCT posits outcome expectations and outcome values as determinants of behavior (Bandura, 1997). In the physical activity domain, evidence supporting outcome expectations as a cognitive predictor of physical activity is mixed (Williams et al., 2005). Where some studies have found positive associations between outcomes expectations and physical activity motivation (Gellert et al., 2012), self-efficacy (Resnick, 2000), and behavior (Williams et al., 2005), other studies have found outcome expectations to add little to no additional variance to the prediction of physical activity over and above that already accounted for by self-efficacy (Anderson et al., 2006; Anderson et al., 2010). To our knowledge, no studies have examined associations between outcome expectations/values related to reducing sedentary behavior and actual sedentary behavior.

The purpose of this study was to explore university students' conceptual and health risk knowledge of sedentary behavior and assess associations between self-efficacy (task, context-

specific, self-regulatory) and outcome expectation beliefs related to reducing sedentary behavior and actual sedentary time. Our hypothesis was that self-efficacy and outcome expectations would explain a significant proportion of variance in students' actual sedentary time. No hypotheses were advanced concerning students' knowledge of sedentary behavior as this research objective was exploratory in nature.

Methods

Participants

Students from the University of Manitoba (a large Canadian university) were recruited through advertisements. The study advertisements outlined the study as one that sought to understand university students' thoughts and opinions related to sedentary behavior. To participate, students had to be 18 years of age or older and registered full time. Because we intended to enter four independent variables into a regression equation and assuming a medium effect size, we estimated that 82 participants ($N>50 + 8(4) = 82$) would be required to meet power demands (Tabachnick & Fidell, 2007, p. 123). The study protocol was approved by the University of Manitoba's Education and Nursing Research Ethics Board (Protocol #E2017:073 [HS21029]).

Procedure and Measures

Participants were emailed a link to a confidential website where they completed eligibility, consent, demographics, and the study questionnaires.

Knowledge of Sedentary Behavior. Knowledge of sedentary behavior was assessed using two open-ended questions: "What is sedentary behavior?" and "In what ways does sedentary behavior impact health?"

Self-Regulatory Efficacy. Participants rated their confidence to: (1) self-monitor; (2) set goals; (3) problem solve; and (4) restart their efforts to reduce sedentary time after experiencing setbacks. A composite mean score was computed using all four items, which demonstrated good internal consistency, $\alpha = .86$ (Tabachnick & Fidell, 2007).

Context-Specific Self-Efficacy. Participants rated their confidence to reduce time spent in four sedentary behaviors: (1) studying; (2) watching TV; (3) using a computer (or other screen-based device) during leisure-time; and (4) socializing with friends/family. The item assessing participants' self-efficacy to reduce sedentary time in the context of socializing with friends/family was removed to increase the internal consistency of the measure. A composite mean score was computed using the three remaining items, which demonstrated acceptable internal consistency, $\alpha = .69$ (Tabachnick & Fidell, 2007).

Task Self-Efficacy. Task self-efficacy was assessed using a measure used previously by Cotten and Prapavessis (2016). Participants were asked *"How confident are you that you can reduce the amount of time you spend sitting, reclining, or lying down per day by 20, 30, 45, 60, 75 and 90 minutes?"* A composite mean score was computed using all six items, which demonstrated good internal consistency, $\alpha = .91$ (Tabachnick & Fidell, 2007).

All self-efficacy measures (self-regulatory, context-specific, task) asked participants to rate their confidence using a 100-point scale ranging in 10-unit intervals from 0 ("Cannot do at all"), to intermediate degrees of assurance 50 ("Moderately certain can do"), to complete assurance 100 ("Highly certain can do"), as recommended by Bandura (2006).

Outcome Expectations and Values. Outcome expectations/values were assessed using a fifteen-item measure. For each item, participants rated how strongly they felt that *"Minimizing prolonged sitting time and breaking up long periods of sitting as often as possible would…"*

result in a physical (e.g., *improve my cardiovascular health*), social (e.g., *create opportunities to socialize*), or self-evaluative outcome (e.g., *give me a sense of personal accomplishment*) (*1=Strongly disagree, 5=Strongly agree*) as well as the importance (value) of each outcome (e.g., *"How important is it for you to improve your cardiovascular health?"*) (*1=Not at all important, 5=Extremely important*). The outcomes in the measure, which were based on information from Australia's Physical Activity and Sedentary Behavior Guidelines for Adults (2014), demonstrated good internal consistency, $\alpha = .80$, $\alpha = .89$, respectively (Tabachnick & Fidell, 2007).

Salient Outcome Expectations. SCT belongs to a larger family of psychological theories known as expectancy-value theories (Maddux et al., 1986), which propose that behavior can be predicted by a multiplicative combination of outcome expectations and outcome values (Williams et al., 2005). Researchers have however deemed the multiplicative method of deriving the expectancy-value term problematic due to the types of rating scales used to assess each belief-based component in the expectancy-value term (see Newton et al., 2014). One solution to this 'expectancy-value muddle' is the dimensional salience approach (van der Pligt & Eiser, 1984), which involves presenting participants a list of behavioral outcomes and asking them to nominate five (Newton et al., 2014) they consider *most* important to them. The rationale for this approach is based on the Cronen and Conville (1975) assumption that people perceive salient outcomes as more likely to eventuate than non-salient outcomes. The five outcomes participants nominate as salient are used to signify the 'expectancy' component in the 'expectancy-value' term. The 'expectancy-value' term is represented by summing participants' value ratings for the five salient outcomes nominated. Several studies have used the dimensional salience approach to successfully resolve the 'expectancy-value muddle' (Newby et al., 2013; Newton et al., 2012). In

this study, participants were presented with the same list of 15 outcomes used in the outcome expectations/values measure and asked to select five outcomes that were *most* important.

Sedentary Behavior. Sedentary behavior was measured using a 10-item modified Sedentary Behavior Questionnaire (SBQ; Rosenberg et al., 2010). Participants selected the amount of time they spend sitting, reclining, or lying down in different contexts (e.g., watching TV, playing video games) on a typical weekday and weekend day separately. We modified the SBQ to include contemporary sedentary activities that were relevant to university students (e.g., watching NETFLIX, playing mobile phone games). We also added one item assessing time spent sitting for meals. Total daily sitting time was calculated as: (weekday sitting hours × 5 + weekend sitting hours × 2)/7. The SBQ has demonstrated good internal consistency (α ranges from 0.48 to 0.93) and excellent test-retest reliability for weekday (r = 0.64 to 0.90) and weekend day (r = 0.51 to 0.93) sedentary time in adults (Rosenberg et al., 2010).

Data Analysis

To assess participants' understanding of the concept of sedentary behavior, we used a directed content analysis methodology (Hsieh & Shannon, 2005). Participants' definitions of sedentary behavior were compared with the consensus definition (Tremblay et al., 2017) and classified as 'consistent', 'inconsistent', or 'ambiguous', as has been done previously (Kinnett-Hopkins et al., 2019). To assess participants' knowledge of health risks associated with a sedentary lifestyle, we compared their responses to the question "In what ways does sedentary behavior impact health?" with published risk factors known to be associated with sedentary behavior (e.g., cardiovascular disease, diabetes, cancer). A multiple regression was performed to examine the relationship between three self-efficacy subtypes (task, context-specific, self-regulatory), salient outcome expectations, and sedentary time. Given Bandura's (1991, 2006)

proposition that self-efficacy beliefs are highly particular to situational contexts, we also performed a one-way repeated measures analysis of variance (ANOVA) to examine differences within participants in their ratings of each context of their context-specific self-efficacy scores. Pearson correlations were conducted to examine relationships between context-specific self-efficacy scores to reduce sedentary time in four contexts (studying, watching television (TV), using a computer during leisure-time, socializing) and actual time spent in these sedentary behaviors (as measured by the SBQ) (e.g., association between self-efficacy to reduce TV time and actual time spent watching TV). All quantitative data were cleaned and analyzed using SPSS (version 24.0.0.0 64-bit edition).

Results

Data were collected from 121 participants. However, preliminary analyses revealed that 25 participants provided implausible sedentary time data (i.e., average daily SBQ scores in excess of 18 hours per day) and were thus excluded, as has been done previously (Bueno-Antequera et al., 2017). A series of one-way between-groups ANOVAs (Kao & Green, 2008) comparing the excluded (n=25) and remaining (n=96) participants revealed no differences between groups in terms of age, BMI, hours in class/week or any of the main study variables.

Participants

The final sample consisted of 96 students (women=49; men=47; M_{age}=20.1, *SD*=2.85), Most (97.9%) were undergraduates in their first year (72.1%). The sample consisted of students from a diverse range of ethnic backgrounds (45.8% were South Asian/East Indian,17.7% were Chinese, 16.7% were White, 7.3% were Black, and 8.5% listed other racial/ethnic groups). The majority lived off-campus (90.6%) and were either unemployed (60.4%) or employed part-time

(36.5%). On average, students reported spending 12.96 (SD=5.71) hours in class per week. The average BMI was 24.16 (SD=6.02).

Knowledge

The directed content analysis revealed that 56 students (57%) provided definitions and/or examples of sedentary behavior that were 'consistent' with the SBRN definition (e.g., *"Behavior that requires very little energy, particular to sitting and lying positions"* ID 56). Nine students (10%) provided 'inconsistent' definitions and/or examples (e.g., *"If your daily routine consists of less than 20 minutes of medium intensity activity, you are considered to live a sedentary lifestyle"* ID 40). Four students (6%) provided 'ambiguous' definitions and/or examples (e.g., "*Spending time with friends and family"* ID 87). Twenty-six students (27%) provided no response. Eighty-seven students (90%) associated sedentary behavior with adverse health outcomes (e.g., heart disease, diabetes, back pain, depression).

Descriptive Data

Composite mean scores and standard deviations for all social cognitive variables were as follows: self-regulatory efficacy (M = 66.86, SD = 18.32), context-specific self-efficacy (M = 58.25, SD = 17.66), task self-efficacy (M = 68.23, SD = 20.89), outcome expectations (M = 3.64, SD = .53), outcome values (M = 4.24, SD = .56), salient outcome expectations (M = 4.54, SD = .50).

Self-Reported Sedentary Time

Students reported an average of 10.83 hours (SD=3.62) of sedentary time per day (Table 1). The most common sedentary behaviors on weekdays and weekend days were screen-based activities (using a computer, watching TV) followed by reading and socializing.

Associations Between Self-Efficacy, Salient Outcome Expectations, and Sedentary Time

Overall, the regression model (including all predictor variables) was not significant, $F(4, 91) = 1.679$, $p = .162$, accounting for only 6.9% of the variance in sedentary time (Table 2). Self-regulatory efficacy emerged as an individual social cognitive variable significantly associated with sedentary time ($\beta = -.243$, $p < .05$). Table 3 displays intercorrelations, means, and standard deviations for total daily sedentary time, self-regulatory efficacy, context-specific self-efficacy, task self-efficacy, and salient outcome expectations.

A one-way repeated measures ANOVA revealed significant differences between students' self-efficacy ratings to reduce sedentary behavior in different contexts, $F(2.558, 243.001) = 11.297$, $p < .001$, partial eta squared = .106. Based on guidelines proposed by Cohen (1988, pp. 284-287), this indicates a large effect size. Post hoc paired-samples t-tests revealed that students were significantly less confident to reduce sedentary behavior while studying ($M = 49.34$, $SD = 27.61$) relative to reducing sedentary behavior while using a computer during leisure-time ($M = 55.24$, $SD = 24.27$); $t(95) = -2.16$, $p = .033$), watching TV ($M = 61.50$, $SD = 26.80$; $t(95) = -3.59$, $p = .001$), and socializing ($M = 66.91$, $SD = 25.58$); $t(95) = -4.56$, $p < .001$. Students were also significantly less confident to reduce leisure-time computer use ($M = 55.24$, $SD = 24.27$) relative to reducing TV time ($M = 61.50$, $SD = 26.80$; $t(95) = 2.61$, $p = .011$) and socializing ($M = 66.91$, $SD = 25.58$); $t(95) = -3.59$, $p = .001$). All other comparisons were non-significant.

Discussion

To our knowledge, this study is the first to explore university students' conceptual and health risk knowledge of sedentary behavior as well as the first to examine relationships between different self-efficacy subtypes (task, context-specific, self-regulatory) and outcome expectation beliefs related to reducing sedentary behavior and self-reported sedentary time. Our findings

revealed that while approximately half of the students in our sample provided appropriate definitions of sedentary behavior, suggesting they understood the concept, some students did not fully understand the concept or were completely unfamiliar it. Despite signs that some students were confused about or unfamiliar with the concept of sedentary behavior, most perceived the term "sedentary behavior" to have negative connotations and associated a sedentary lifestyle with negative health outcomes. When examined together, SCT variables did not significantly explain variance in university students' self-reported sedentary time.

The directed content analysis revealed that while most students provided 'consistent' definitions of sedentary behavior, a small but meaningful proportion provided 'inconsistent' (10%) or 'ambiguous' definitions (6%). Of those who provided 'inconsistent' definitions, the most common misconception was that sedentary behavior and physical inactivity (i.e., insufficient physical activity to meet guidelines) are synonymous (Tremblay et al., 2017). This finding, which is consistent with Deliens et al. (2015), highlights how some students lack knowledge of the distinct concept of sedentary behavior as well as other important concepts related to the physical activity continuum. Given the conceptual knowledge deficits observed in this study, we support Deliens et al.'s (2015) recommendation that policy-makers, researchers, and health educators need to work to familiarize students with the distinct concept of sedentary behavior. Evidence suggests that interventions that incorporate education (i.e., 'increasing knowledge or understanding') are particularly promising in reducing sedentary behavior (Gardner, Smith, Lorencatto, Hamer, & Biddle, 2016). Future studies to identify effective ways of educating students about sedentary behavior and to examine the effects of increased knowledge on cognitions related to sedentary behavior and actual sedentary behavior change are warranted. However, it is important to recognize that while increasing students' understanding of

the concept of sedentary behavior may assist in creating the knowledge precondition Bandura (2004) posits as necessary for behavior change, knowledge is often insufficient on its own to drive behavior change (Arlinghaus & Johnston, 2018).

Previous tests of self-efficacy in the sedentary behavior domain are limited in number (Biddle, 2018) and have focused on two self-efficacy subtypes: task and context-specific self-efficacy. While both self-efficacy subtypes have been shown to be inversely associated with sedentary behavior (e.g., Busschaert et al., 2016; Eysenbach et al., 2016), this was not the case in the present study. In this study, only self-regulatory efficacy was inversely associated with sedentary time. Students with greater confidence to self-regulate their sedentary behavior (e.g., set goals, self-monitor, problem solve) reported engaging in less sedentary behavior. This finding suggests that self-regulatory efficacy may be an important cognitive antecedent of the self-regulation of sedentary behavior and supports Bandura's (1995) proposition that people's self-regulatory efficacy beliefs to perform the various skills required to manage complex health behaviors is essential. That self-regulatory efficacy was inversely associated with sedentary behavior is consistent with previous studies that have found positive relationships between self-regulatory efficacy and exercise behavior (Rodgers et al., 2002; Woodgate et al., 2005).

Several reasons may explain why task and context-specific self-efficacy to reduce sedentary behavior were not associated with actual sedentary behavior. Task self-efficacy measures, commonly used in the exercise domain (Maddux, 1995), are used to capture an individual's confidence in their ability to perform elemental aspects of exercise-related tasks (e.g., confidence to run 30 minutes at increasing levels of intensity) (Rodgers et al., 2002). While task self-efficacy is considered highly relevant to exercise (Rodgers et al., 2002), our findings suggest this particular self-efficacy subtype may be less relevant to reducing sedentary behavior.

Unlike engaging in moderate-to-vigorous intensity exercise, reducing sedentary behavior can simply involve breaking up continuous bouts of sitting with brief periods of standing or light-intensity activity (e.g., casual paced walking) – physical tasks that are well within the capability of most healthy able-bodied university students. Although students' mean task self-efficacy level to reduce sedentary time by between 30 to 90 minutes per day was moderately high (M = 68.23, SD = 20.89), task self-efficacy was not associated with their actual sedentary time. This finding suggests that for young adult university students, reducing sedentary behavior may have less to do with their confidence and ability to perform the physical tasks required to be less sedentary (e.g., increase standing and light activity), and more to do with their capability to self-regulate their sedentary behavior on a consistent basis. Such an explanation would support Maddux's (1995) claim, based on Bandura's (1995) proposition, that "in most daily life, in fact, [self-regulatory] self-efficacy is more crucial than task self-efficacy" (p. 382). Evidence suggests that interventions that incorporate self-regulatory training (e.g., self-monitoring, problem-solving) are particularly promising in reducing sedentary behavior (Gardner et al., 2016). Therefore, interventions that aim to enhance students' confidence and capabilities to self-regulate sedentary time in contexts and situations in which they have some degree of control over their sedentary time (e.g., studying, leisure-time screen-based activities) may be particularly effective.

Context-specific self-efficacy, that is, students' confidence to reduce time spent in specific sedentary behaviors (e.g., studying, watching TV, socializing) was moderately high (M = 58.25, SD = 17.66), but not associated with actual time spent sedentary in these behaviors (as measured by the SBQ). This finding is inconsistent with previous studies that have found inverse associations between self-efficacy beliefs related to reducing time spent in specific sedentary behaviors (TV time, computer/Internet use) and actual time spent in these behaviors (Busschaert

et al., 2016; Van Dyck et al., 2011). Although context-specific self-efficacy was not associated with actual sedentary time, post-hoc analyses revealed significant differences between self-efficacy scores to reduce sedentary time in specific contexts that may have important implications for future research and interventions. Students were significantly less confident to reduce sedentary behavior while studying relative to watching TV, using a computer during leisure time, and socializing. That students were least confident to reduce sedentary behavior while studying is consistent with findings from a study of Canadian undergraduates where students identified studying as a major barrier to reducing sedentary behavior (Moulin & Irwin, 2017). A recent study by Felez-Nobrega et al. (2018) found that, independent of physical activity, interruptions in prolonged time every 10-20 minutes via short light-intensity physical activity breaks was positively related to academic achievement (Felez-Nobrega, Hillman, Dowd, Cirera, & Puig-Ribera, 2018). Thus, interventions that include education to increase students' awareness of the potential academic benefits of breaking up prolonged sitting time via short activity breaks may be a particularly effective .

Context-specific self-efficacy beliefs to reduce sedentary behavior while TV viewing and leisure-time computer use were not associated with actual time spent in these behaviors. One reason for this may be due to the function these sedentary behaviors serve (e.g., enjoyment, relaxation), which may act as barriers to being less sedentary. To our knowledge, no studies have explicitly explored barriers to reducing non-academic-related sedentary behaviors among university students (Moulin & Irwin, 2017). Given that students spend a considerable proportion of time being sedentary whilst engaging with screens (e.g., watching TV, using cell phones) (Barkley & Lepp, 2016), further research exploring barriers to reducing leisure-time sedentary behaviors is needed. Qualitative research may be particularly suited for this endeavor.

Salient outcome expectations were not associated with sedentary behavior in the present study. A possible reason for this may have been due to the influence of outcome proximity. Behavioral economics and intertemporal choice research (Ainslie, 1975) suggest that outcome proximity influences how outcomes are processed, such that as outcomes become more distal, they decrease in value. We endeavored to create a measure of outcome expectations that included a variety of proximal and distal physical, social, and self-evaluative outcomes related to reducing sedentary behavior. However, the measure contained a disproportionately greater number of chronic disease outcomes (e.g., heart disease, type 2 diabetes) due to the more established evidence-base supporting positive associations between sedentary behavior and chronic disease risk and incidence. Students may have perceived that being less sedentary might, for example, reduce their risk for heart disease, but because they perceived the proximity of acquiring heart disease as distal, this outcome may not have been salient enough to influence their current sedentary behavior. Future studies should identify outcomes of being less sedentary that students perceive as more salient than the outcomes included in our measure. For example, it is possible that students may perceive the potential academic benefits of reducing sedentary behavior (e.g., improved grade point average) (Felez-Nobrega et al., 2018) as more salient than outcomes of being less sedentary that they perceive as distal, such as reductions in chronic disease risk. Future research exploring university students' beliefs about the proximity of outcomes of being less sedentary and examining whether outcome proximity mediates the relationship between outcome expectations and actual sedentary behavior may provide insights that can be used to inform future interventions.

Students self-reported an average of 10.83 hours of sedentary time per day. This finding is in line with evidence from a systematic review of 23 studies that assessed sedentary time among

undergraduate students across the world and found mean sedentary time, as measured using domain-specific questionnaires and accelerometers, to be 11.10 hours per day and 10.69 hours per day, respectively (Moulin, Truelove, Burke, & Irwin, 2019). Taken together, these findings underscore the importance of focusing on reducing excessive sedentary time among university students.

Our findings highlight the need for further research to identify modifiable correlates of sedentary behavior in university students that cover the full ecological breadth (Castro et al., 2018; Sallis et al., 2008). To date, most reported correlates have been non-modifiable intrapersonal factors (e.g., age, self-rated health), of which only three (physical activity, obesity markers, gender) have been sufficiently examined (≥4 studies) to determine an overall association with sedentary behavior (Castro et al., 2018). It is likely that university students' sedentary behavior is influenced by not only intrapersonal factors (e.g., habits, intentions) (Conroy et al., 2013), but also by interpersonal (e.g., modelling, social support), environmental (e.g., campus/home infrastructure), and policy-related factors (e.g. class schedules) (Castro et al., 2018). Further studies employing an ecological approach are needed to identify influential intrapersonal, interpersonal, social, and environmental correlates of sedentary behavior that can be targeted and modified in interventions to reduce excessive sedentary time in university students.

Limitations

This study had several limitations. Sedentary behavior was assessed using a self-report questionnaire. While self-report questionnaires offer several advantages (e.g., cost-effective, low participant burden, can identify the context in which sedentary behavior occurs), they are also prone to recall and social desirability biases (Atkin et al., 2012). One limitation of the SBQ is

that it assesses sitting time on a “typical” day. Sedentary patterns among university students are likely to fluctuate considerably over the course of an academic year. Future studies should employ self-report and objective measures to provide more comprehensive and accurate assessments of sedentary behavior in university students. Another limitation is that we did not assess whether students had set a goal to reduce their sedentary behavior. According to SCT (Bandura, 2004), goals represent a core determinant of behavior. By not assessing whether participants had an established a goal to reduce their sedentary behavior, the influence goals (or lack of one) had on the findings could not be determined. If students did not have a clearly defined goal to be less sedentary, this may explain why self-efficacy and outcome expectation beliefs were not associated with students’ actual sedentary time. Another limitation of the study concerns the cross-sectional design, which prevents us from making causal inferences. Lastly, the fact that almost half of our sample self-identified as South Asian/East Indian (42.1%) limits the generalizability of our findings. Future studies should include more representative samples given the increasingly diverse makeup of students attending universities and colleges.

Conclusion

Findings from this study confirm university students as a high-risk population for excessive sedentary behavior. Given the knowledge deficits we detected in this study, we recommend that future interventions should include educational components to familiarize university students with the distinct concept of sedentary behavior. The findings also suggest that there may be value in incorporating self-regulatory training components into interventions to enhance students’ confidence and capability to self-regulate time spent in sedentary and physical activity behaviors. Further research to identify modifiable correlates that cover the full ecological breadth, exploring proximal and salient benefits of being less sedentary, and identifying barriers

to being less sedentary may provide important insights that can be used to inform effective evidence-based interventions to decrease sedentary behavior in university students.

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Table 1

Average Daily Domain-Specific Sitting Time in Hours Per Day

Domain	*M* (*SD*)
TV	1.60 (1.71)
Videogames	0.60 (0.88)
Music	1.00 (1.14)
Socializing	1.48 (1.24)
Computer	2.12 (1.48)
Reading	1.30 (1.15)
Instrument	0.15 (0.34)
Arts/Crafts	0.36 (0.73)
Travel	1.08 (0.89)
Meals	1.14 (0.80)
Daily	10.83 (3.62)

Table 2

Multiple Regression Results of Analyses Assessing Associations Between Self-Efficacy (Self-Regulatory, Context-Specific, Task), Salient Outcome Expectations, and Self-Reported Sedentary Time

Variable	*B*	*Std. Error*	*β*	95% CI
Constant	10.190	3.542		[3.33, 17.05]
SRE	-.048	.024	-.243*	[-.10, -.00]
CSSE	-.015	.020	-.086	[-.06, .03]
TSE	.004	.003	.143	[-.85, 2.17]
SOE	.660	.759	.091	[-.01, .06
R^2	.069			
F	1.679			

Note. N = 96. CI = confidence interval; SRE = self-regulatory efficacy; CSSE = context-specific self-efficacy; TSE = task self-efficacy; SOEs = salient outcome expectations.
*$p < .05$

Table 3

Summary of Intercorrelations, Means, and Standard Deviations of Average Daily Sitting Time, Self-Efficacy (Self-Regulatory, Context-Specific, Task), and Salient Outcome Expectations

Variable	1	2	3	4	5
1. ST	—	-.20*	-.13	.03	.05
2. SRE	-.20*	—	.46*	.42*	.22*
3. CSSE	-.13	.46*	—	.35*	.17
4. TSE	.03	.42*	.35*	—	.16
5. SOEs	.05	.22*	.17	.16	—
M	10.82	66.86	55.36	68.23	4.54
SD	3.62	18.32	20.66	20.89	.50

Note. $N = 96$. ST = sedentary time (h/day); SRE = self-regulatory self-efficacy; CSSE = context-specific self-efficacy; TSE = task self-efficacy; SOEs = salient outcome expectations.
*$p < .05$

CHAPTER III: LINKING CHAPTER

The purpose of *Study 1* was to explore university students' knowledge of sedentary behavior and examine associations between self-efficacy, outcome expectations, and self-reported sedentary time. Findings revealed that 56% of participants provided definitions of sedentary behavior that were 'consistent' with the consensus definition (Tremblay et al., 2017), suggesting they understood the concept. Some participants, however, provided 'inconsistent' (10%), or 'ambiguous' (6%) definitions, suggesting they did not fully understand or were completely unfamiliar with the concept. The level of understanding of the concept of sedentary behavior in the 27% of students who did not respond to the conceptual knowledge question remains uncertain. Most students (90%) perceived the term "sedentary behavior" to have negative connotations and linked sedentary behavior with negative health outcomes (e.g., heart disease, type 2 diabetes, back pain, obesity, depression), suggesting they were relatively aware of health risks associated with sedentary behavior.

The overall model (including all four predictor variables: task/context-specific/self-regulatory self-efficacy, salient outcome expectations) was not statistically significant, $F(4, 91) = 1.679$, $p = .162$, and accounted for just 6.9% of the variance in students' actual self-reported sedentary time. Self-regulatory efficacy emerged the only individual social cognitive variable associated with sedentary time ($\beta = -.243$, $p < .05$). As students' confidence to self-regulate (e.g., set goals, self-monitor, problem solve) their sedentary behavior increased, the amount of time they reported spending being sedentary decreased. While this finding has potentially important implications for future research and interventions, the fact that the overall model (including all social cognitive predictor variables) was not statistically significant, and that no other individual variable was associated with sedentary behavior, prompted further investigation.

Qualitative approaches are often best suited to address *why* and *how* type questions for which an in-depth understanding of a phenomenon is required (Sullivan & Sargeant, 2011). To understand the null findings from *Study 1*, we felt that a qualitative approach might be particularly suited given that qualitative approaches can provide a deeper understanding of survey responses (McCusker & Gunaydin, 2015). Qualitative approaches are also useful for exploring uncertain or "immature" concepts, socially dependent phenomena, and for describing complex intentions, motivations, and behaviors (Maudsley, 2011). To date, one qualitative study has explored university students' perceptions of sedentary behavior (Deliens, Deforche, De Bourdeaudhuij, & Clarys, 2015), highlighting the lack of qualitative research in the area. To better understand the relatively null findings from *Study 1*, *Study 2* employed a qualitative approach to explore university students' conceptual and health risk knowledge of sedentary behavior and their perceptions of self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior.

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CHAPTER IV: STUDY 2

Study 2

University Students' Knowledge, Self-Efficacy, Outcome Expectations, and Barriers Related to Reducing Sedentary Behavior: A Qualitative Study

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Abstract

Objective: To explore university students' conceptual and health risk knowledge of sedentary behavior and their perceptions of self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior. **Participants:** Nineteen students from a Canadian university participated. **Methods:** Four focus groups were conducted. Discussions were recorded, transcribed, and coded to identify categories and themes. **Results:** Some students were confused by the concept, but most were relatively aware of health risks associated with sedentary behavior. Most students were also confident they could be less sedentary if they wanted to, but unlikely to actually do so because they believed: (a) it is not a priority, (b) the health risks are distal, (c) simply increasing standing and light activity would not confer health benefits, and (d) class norms and infrastructure encourage sitting and are not under their control to change. **Conclusion:** Findings may inform interventions aimed at decreasing excessive sedentary behavior in university students.

Introduction

Evidence suggests that sedentary behavior – defined as any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs) while in a sitting, reclining, or lying posture (Tremblay et al., 2017) – may have detrimental impacts on several health outcomes, independent of a lack of moderate-to-vigorous physical activity (Thorp, Owen, Neuhaus, & Dunstan, 2011). Sedentary behavior has emerged as an important public health concern due to its high prevalence in modern societies. Most adults spend 9-10 hours per day sedentary (Colley et al., 2011; Matthews et al., 2008). University students have been identified as a highly sedentary segment of the adult population (Arias-Palencia et al., 2015; Clemente, Nikolaidis, Martins, & Mendes, 2016). Self-report data indicate that university students spend upwards of 10-12 hours per day sedentary (Moulin & Irwin, 2017; Prapavessis, Gaston, & DeJesus, 2015). The prevalence of sedentary behavior in university students raises concern given evidence suggesting that high levels of sedentary behavior are associated with an increased risk of cardiovascular disease (Ford & Caspersen, 2012), type 2 diabetes (Biswas et al., 2015), cancer (Shen et al., 2014), depression (Teychenne et al., 2010), and anxiety (Teychenne et al., 2015). Breaking up prolonged sedentary behavior with standing and light-intensity activity may mitigate some of the cardiometabolic consequences of prolonged continuous bouts of uninterrupted sitting (Dunstan et al., 2012; Healy, Winkler, Owen, Anuradha, & Dunstan, 2015).

The behavioral epidemiology framework (Sallis et al., 2000) proposes that a necessary step prior to developing interventions to change behavior (e.g., sedentary behavior) is identifying variables that influence a target behavior (i.e., correlates and determinants) (Sallis et al., 2000). The ecological model (Owen et al., 2011; Sallis et al., 2008) has been used extensively to structure the study of variables that influence numerous health behaviors, including physical

activity (Bauman et al., 2012) and sedentary behavior (O'Donoghue et al., 2016). An ecological approach to understanding factors that influence behavior assumes that complex health behaviors are shaped by a dynamic interrelation of multiple individual, social, organizational/community, environmental, and policy-related variables (Sallis et al., 2008). Outlining a framework for mapping the multiple domains and influences of sedentary behavior, the ecological model has been instrumental in providing a comprehensive approach for examining the multiple factors that influence sedentary behavior (Owen et al., 2011). Castro et al. (2018) systematically reviewed correlates of sedentary behavior in university students and found that only three intrapersonal correlates (physical activity, obesity markers, gender) have been sufficiently examined (>4 studies) to determine an association with sedentary behavior. To advance knowledge of intrapersonal correlates, explicit applications of behavioral theories and models are needed to identify psychological correlates of university student sedentary behavior that can be targeted and modified in interventions (Glanz, Rimer, & Viswanath, 2015; Linke, Robinson, & Pekmezi, 2014; Rhodes, Mark, & Temmel, 2012; Rollo, Gaston, & Prapavessis, 2016).

One theory that offers a framework to explore psychological factors that may influence sedentary behavior is Social Cognitive Theory (SCT; Bandura, 1986; Bandura, 1997). Key constructs in SCT include: (1) knowledge of risks and benefits of different health practices; (2) self-efficacy, or one's beliefs in their capabilities to perform target behaviors; (3) outcome expectations, or one's beliefs about the expected costs and benefits of behavior change; and (4) barriers to change (Bandura, 2004). According to SCT, knowledge of risks and benefits of behavior creates a precondition for behavior change (Bandura, 2004). If students lack knowledge of what sedentary behavior is and its potential health consequences, they would have little reason to put effort into trying to be less sedentary (Bandura, 2004). While studies have explored office

workers' (Gilson, Burton, Uffelen, & Brown, 2011; Mcguckin, Sealey, & Barnett, 2017) and older adults' knowledge of sedentary behavior (Biswas, Faulkner, Oh, & Alter, 2018; Webber et al., 2018), only one study has focused on university students (Deliens, Deforche, De Bourdeaudhuij, & Clarys, 2015). In a qualitative study of Belgian undergraduates, Deliens et al. (2015) found that students were not fully aware of the concept of sedentary behavior. Further, despite providing students with a definition and examples of sedentary behavior, Deliens et al. (2015) found that students perceived sedentary behavior and physical inactivity (i.e., insufficient physical activity to meet recommended guidelines) (Tremblay et al., 2017) as synonymous concepts. Deliens et al. (2015) concluded that "sedentary behavior" is a relatively unknown concept among university students. To our knowledge, no qualitative studies have explored Canadian university students' concept and health risk knowledge of sedentary behavior.

While SCT posits that knowledge creates a precondition necessary for behavior change, most people require additional self-influences to overcome the barriers that prevent the enactment and maintenance of health-promoting behaviors. SCT outlines self-efficacy, or one's confidence in their ability to perform target behaviors, as a focal determinant of task-oriented behavior (Bandura, 2004). Within SCT, self-efficacy is theorized to influence the goals people set for themselves, the outcomes they envision their actions will produce, and behavioral engagement (Bandura, 2004). Self-efficacy has been shown to be a consistent and robust predictor of numerous health behaviors, including smoking cessation (Cupertino et al., 2012) and increased physical activity (Trost, Owen, Bauman, Sallis, & Brown, 2002; Young, Plotnikoff, Collins, Callister, & Morgan, 2014). While applications of the self-efficacy construct in the sedentary behavior domain are limited in number (Biddle, 2018), available evidence from studies in adolescents (Norman, Schmid, Sallis, Calfas, & Patrick, 2005), community-dwelling adults

(Busschaert et al., 2016; Van Dyck et al., 2011), and university students (Cotten & Prapavessis, 2016) have found self-efficacy to be an important social cognitive predictor of sedentary behavior and sedentary behavior change.

In addition to knowledge and self-efficacy, SCT specifies outcome expectations as a key determinant of behavior (Bandura, 1997, 2004). Outcome expectations, which are defined as one's beliefs concerning the anticipated consequences of one's actions (Williams et al., 2005) – lie along three related, but conceptually independent dimensions: physical, social, and self-evaluative (Bandura, 1997; 2004). Outcome expectations have been examined as a cognitive predictor of numerous health behaviors, including physical activity (Williams et al., 2005). However, to our knowledge, no studies have explored outcome expectations related to reducing sedentary behavior. Understanding the outcomes university students expect to occur if they were to reduce excessive sedentary time may reveal insights that could be used to inform the development of persuasive health campaigns emphasizing the potential beneficial outcomes of being less sedentary that students perceive as salient and motivating.

To inform effective interventions, identifying the specific barriers students perceive as affecting their ability to be less sedentary is important (Bandura, 1998; 2004). Currently there is a lack of research on barriers to reducing sedentary behavior in adults (Biddle, 2018) and only one study was found that explored and reported on barriers to reducing sedentary behavior in a university student population (Moulin & Irwin, 2017). Moulin et al. (2017) investigated barriers to reducing sedentary behavior (at school, home, work, transportation) in a sample of 145 Canadian undergraduates. The authors identified two themes: sitting during lectures and studying outside of class. Barriers to sitting less during lectures included norms (e.g., lack of breaks) and infrastructure (e.g., lack of standing desks) while barriers to sitting less outside of class included

heavy workloads and beliefs that studying necessitates sitting for comfort and concentration purposes. Other than barriers identified by Moulin et al. (2017), little else is known about barriers to reducing sedentary behavior among university students.

To inform the development of effective sedentary behavior interventions for university students, further research is needed to understand the role that social cognitive factors play in influencing students' perceptions of sedentary behavior and behavior change. To that end, the purpose of this study was to qualitatively explore knowledge, self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior in a sample of Canadian university students. A qualitative methodology was deemed appropriate given that our objective was to gain an in-depth understanding of students' perceptions of sedentary behavior – perceptions that may not be captured as well using a quantitative approach (Bourgeault, Dingwall, & De Vries, 2010).

Methods

Participants

Four focus groups were conducted with a total of 19 students (females=13; males=6; undergraduate=17; graduate=2) recruited from a large Canadian university using posters and leaflets. To be eligible, participants had to be ≥18 years of age and registered full-time. Participants' mean age in years was 24.6 ± 7.10. Fifty-seven percent of the sample self-identified as Caucasian. At the time of the study, 89% of students were living off-campus, 53% were working part-time, and 37% were unemployed. Mean body mass index (based on self-reported height and weight) was 24.1 ± 3.5 kg/m^2.

Procedure

The study was approved by the university's research ethics review board. At the start of each focus group, participants completed consent form and demographic questionnaire (e.g., age, gender, year/program of study). Focus groups were moderated by a male PhD student (NP) and co-moderated by either of two female professors: (SW; Physical Therapy or SS; Kinesiology and Recreation Management). A semi-structured question guide was developed using prescribed focus group methodology (Krueger & Casey, 2009) (see Table 1). Preliminary focus group questions explored participants' understanding of the concept and health impacts of sedentary behavior (knowledge). Next, the moderator defined and distinguished the terms 'sedentary behavior' and 'physical inactivity' (Tremblay et al., 2017) to establish a common understanding for subsequent discussion, as has been done previously (Deliens et al., 2015). Subsequent discussion was facilitated to explore participants' perceptions of self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior. Participants were not provided an honorarium or incentive to encourage them to take part in this study.

Data Analysis

All focus group discussions were audio recorded, transcribed verbatim by the first author (NP), and imported into NVIVO (QSR, version 10.0) for coding and analyses. Guided by the methodological and analytic principles of thematic analysis (Braun, Clarke, & Weate, 2016), two team members (NP, SW) independently and read each transcript carefully several times to identify natural language statements conveying thoughts and ideas of potential relevance to the research objectives. The identified natural language statements were then "tagged" with a code (i.e., labelled with a short phrase) that captured their content and analytic relevance. Following each round of independent coding, NP and SW met to compare, contrast, and refine identified codes. This process was repeated after each round of independent coding until a mutually

agreed-upon set of codes that richly and thoroughly captured the analytically relevant aspects of the dataset was developed. Any instances of disagreement were discussed until consensus was achieved. The process of theme development involved clustering and organizing identified codes into higher level themes, reviewing and revising themes with the larger research team, and conducting a rich analysis of the data represented by the finalized themes (Braun et al., 2016). Field notes describing observations, thoughts, and ideas were taken during and immediately after each focus group and reviewed during the data analysis process.

Results

Three recurring themes were identified: (1) conceptual confusion, yet knowledgeable about risks; (2) confident, but unlikely to change; and (3) ideas to reduce sedentary behavior. Participant quotes are included as examples of themes that emerged from the data.

Conceptual confusion, yet knowledgeable about risks

The consensus definition of sedentary behavior (Tremblay et al., 2017) was used to guide our analysis and interpretation of students' understanding of the concept of sedentary behavior. Some provided appropriate definitions and/or examples of sedentary behavior suggesting they understood the concept (e.g., "Sitting down for a prolonged period of time" [FG2; P2]). Others, however, provided definitions and/or examples suggesting they did not fully understand the concept. Common misconceptions were that: (i) sedentary behavior is the same as physical inactivity: "*Not following the Canadian guidelines I guess, the 90 minutes three times a week or something?*" (FG1; P5); (ii) sedentary behavior includes standing, and (iii) that the term "sedentary behavior" pertains to lazy unproductive sitting activities (e.g., "*Being a couch potato*" [FG4; P1], "Not doing anything important" [FG2; P6]), but is not a term that pertains to seated activities that require mental effort and concentration (e.g., studying).

Despite indications that some were confused about the concept, most participants perceived the term "sedentary behavior" to have negative connotations and associated it with adverse health outcomes. While some focused on more immediate negative effects of specific sedentary behaviors (e.g., eye-strain/back pain caused by excessive computer use), most participants associated sedentary behavior with cardiometabolic and musculoskeletal diseases and conditions: "*Sedentary behavior can lead to poor health outcomes perhaps later in life, it can lead to cardiovascular disease, type 2 diabetes…all down the line*" (FG1; P3). Several participants also linked sedentary behavior with mental health issues, including depression, anxiety, and loneliness: "*It greatly impacts mental health, like I know if I'm doing something sedentary, I feel like I haven't accomplished anything and I get sad and like anxiety and depression*" (FG2; P5). Tiredness and fatigue emerged as one of the more consistent adverse effects of sedentary behavior, as described by the following participant:

> "*When you're sitting down looking at the same thing over and over again…like you go to class, you sit down, you use your phone, you use your computer…it's exhausting"* (FG1; P1).

While most students focused on the detrimental health effects of sedentary behavior, some students expressed how, in low doses and in particular situations, sedentary behavior is necessary and provides important physical (recuperative) and social benefits: "*There comes a time when you need to be sedentary, especially if you know you've had a long day and you need to unwind and just relax*" (FG1; P3).

Confident, but unlikely to change

Overall, most students were relatively confident that they could reduce their sedentary behavior if they wanted to and, that doing so would be easier than increasing exercise time or meeting physical activity guidelines: "*For me, the one-minute break is ok, it's just being*

physically active that's kind of impossible" (FG1; P5); "*It's more easily achievable than meeting physical activity guidelines*" (FG1; P6). While some students felt that being less sedentary might provide some health benefits: "*I'd feel less tired*" (FG1; P2), "*I'd feel more energy and less back pain*" (FG2; P2), most felt that simply sitting less, standing more, and doing more light-intensity activity would not provide meaningful health benefits: "*It feels like it's nothing*" (FG4; P3); "*I definitely stand up and do stuff, but I feel like it doesn't help me*" (FG1; P2). The idea that being less sedentary would not provide benefits that students perceive as important to them was aptly described by one participant:

> "*We want to look good, we want to feel good, especially women with the focus on body image and appearance, or even men, they want to be big, so why would they waste their time standing up for like 2 minutes?*" (FG4; P3).

Common non-academic barriers to being less sedentary included breaking the habit of sitting and foregoing the enjoyment of sedentary activities: "*Getting out of that habit is like trying to climb out of a hole because you're so used to it*" (FG2; P5); "*It feels good to be lazy*" (FG1; P1). Most students also did not perceive reducing sedentary behavior to be an important priority: "*There's just more important things*" (FG1; P6). This was most often the case in the context of studying, which students described as their main priority, an activity that contributes significantly to overall seated time, and is a task that requires sitting and concentrating for long periods without interruption. Students also did not perceive sitting less to be a priority because their perceived the health risks as distal: "*We know that we're not going to get cardiac disease till we hit like 40, 50, so it is not our priority right now…we just don't see it as a problem yet*" (FG1; P2). University-specific barriers included the arrangement of class schedules, insufficient movement break opportunities during lectures, and restrictive classroom environments (i.e., lack

of standing desks): "*I think a barrier for me at school at least is that it's a norm, so like today for example, I have three classes with just 10-minute breaks, that's like 5 hours of sitting down*" (FG2; P2).

Ideas to Reduce Sedentary Behavior

Most of the ideas and recommendations students provided for how universities could motivate and support them to be less sedentary centered on education. Several students highlighted the importance of increasing students' knowledge, understanding, and awareness of the concept, health risks, and benefits of reducing sedentary behavior: "*I think a lot of people don't know about sedentary behavior, so you need to advertise it*" (FG1; P4); "*Educate students and let them know that there are other things that can be done as opposed to sitting down*" (FG1; P2). Signage (e.g., posters) on campus information about sedentary behavior to students was proposed as a potentially effective means of achieving this: "*If there were posters that mentioned the facts you've presented to us here, saying that 'sedentary behavior can lead to health problems…that would be helpful*" (FG1; P3). However, some argued that alone, signage would likely be insufficient to motivate students to change their sedentary behavior unless signage was coupled with more personalized approaches, such as group education/support sessions led by health professionals on campus:

> "*I'm not sure if people would think that sitting is such a dangerous thing, so I'm not sure if posters would work…I feel you'd have to couple it with some kind of group educational thing*" (FG3; P4).

Several participants indicated how sitting in class contributes significantly to their overall seated time and recommended that professors ought to provide sufficient movement breaks during long lectures: "*I think if professors implemented breaks, like even just between*

presentations in classes that are over an hour, that would be helpful" (FG3; P3). Several students were also in favor of equipping classrooms with standing desks: "*Stand up during class and have stand-up desks*" (FG4; P3).

Discussion

This study is the first to have used a qualitative approach (focus groups) to explore Canadian university students' knowledge, self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior. Three themes were identified: (1) *conceptual confusion, yet knowledgeable about risks,* (2) *confident, but unlikely to change,* and (3) *ideas for reducing sedentary behavior.*

The first theme, *conceptual confusion, yet knowledgeable about risks,* offered insights into students' knowledge of the concept and health impacts of sedentary behavior. While some students appeared to understand the concept of sedentary behavior, some did not fully understand the concept. Consistent with Deliens et al. (2015), the most common misconception students had about the concept of sedentary behavior was that it is the same as the concept of physical inactivity (i.e., achieving insufficient physical activity to meet guidelines) (Tremblay et al., 2017). Additionally, students were confused about postural aspects of sedentary behavior and mistakenly believed the term "sedentary behavior" applies to lazy unproductive seated activities (e.g., TV viewing) only, and not to productive seated activities (e.g., studying). Despite evidence of conceptual misunderstandings, most students perceived the term "sedentary behavior" to have negative connotations and associated it with detrimental health outcomes. Similar to office workers (Mcguckin et al., 2017), students linked high levels of sedentary behavior with fatigue, back and neck pain, weight gain and obesity, and an increased risk of chronic disease (e.g., cardiovascular disease, type 2 diabetes, osteoporosis). Given our knowledge findings, we echo

Deliens et al.'s (2015) recommendation that policy-makers, researchers, and teachers should increase efforts to educate students about the distinct concept and independent health risks of sedentary behavior. Such efforts may be especially important in creating the knowledge precondition Bandura (2004) posits as essential for behavior change. However, as research on the effects of education and knowledge enhancement on health behavior change has shown, knowledge alone is often insufficient to drive behavior change (Kelly & Barker, 2016).

Researchers propose that interventions that focus on reducing sedentary behavior may be more successful than those that focus on increasing exercise because, relative to exercise, reducing sedentary behavior poses fewer barriers (Smith et al., 2015). Our findings support this notion in that students were confident that replacing sedentary activities with standing and light activities would be easier than increasing exercise participation or meeting physical activity guidelines. However, the second theme, *confident but unlikely to change*, revealed that despite students' greater confidence to be less sedentary relative to increasing exercise, most expressed they would be unlikely to try and be less sedentary. Across focus groups, common reasons for this were that students believed that: (i) sitting less is not a priority, (ii) health risks of sedentary behavior are distal, (c) simply breaking up and replacing sedentary activities with standing or light activities would not provide meaningful health benefits, and (d) class norms and infrastructure promote sitting and are not under their control to change.

Consistent with previous research (Moulin & Irwin, 2017), students expressed how studying is a high priority activity, accounts for a significant proportion of their daily sitting time, and is a task that requires them to sit and concentrate for prolonged periods without interruption. While some students expected that active study breaks might provide some cognitive and physical benefits, most felt that activity study breaks would be disruptive and their

decrease productivity – perspectives similarly found among office workers (Niven & Hu, 2018). SCT (Bandura, 2004) proposes that the tendency for individuals to perform a specified behavior (e.g., take active study breaks) is the product of their expectation that the behavior will produce an outcome (positive outcome expectation) and the perceived value (importance) of the outcome. Our findings are in line with the theoretical propositions of SCT; one reason students may be unlikely to reduce excessive sedentary behavior is not necessarily because they lack self-efficacy, but because they expect that being less sedentary might lead to undesirable or unwanted outcomes (e.g., interfere with studying, decrease productivity, provide meaningless health benefits).

Students perceived many of the health consequences of being too sedentary as distal. Behavioral economics and intertemporal choice research (Ainslie, 1975) suggest that the proximity of future outcomes fundamentally alters how outcomes are processed, such that as outcomes are pushed farther into the future, they decrease in value. A fitting example that demonstrates the effect that outcome proximity can have on behavior can be seen in the context of physical activity behavior, where the association between outcome expectations and physical activity has been shown to have a tendency to be weaker among younger adults compared to older adults. Williams et al. (2005) suggest this weakening of the association between outcome expectations and physical activity may be due to the moderating influence of outcome proximity. In line with this theorizing, our finding suggest that outcome proximity may also have play an important moderating role in the relationship between outcome expectations and sedentary behavior. Future research is warranted to explore the potential moderating influence of outcome expectation proximity and actual sedentary behavior.

Several students lacked motivation to be less sedentary because they believed that breaking up and replacing sedentary behavior with standing and light-intensity physical activity would not provide meaningful health benefits. Felez-Nobrega et al. (2018) found that interrupting prolonged sitting time every 10-20 minutes via short light-intensity activity breaks was associated with improved cognitive operations associated with academic performance (grade point average) (Felez-Nobrega et al., 2018). Given that many students are highly motivated to succeed academically, students may perceive the potential academic benefits of being less sedentary as more salient to them than distal benefits, such as reductions in chronic disease risk. Conveying academic-related benefits of being less sedentary may form the basis of persuasive health communication and awareness campaigns seeking to motivate students to be less sedentary via gain-framed messages (Rothman & Salovey, 1997). As Bandura (2004) suggests, "*motivation is enhanced by helping people see how behavior change is in their self-interest and the broader goals they value highly*" (p. 144). While long-term distal goals set the course of behavior change, often there are too many competing factors at hand for distal goals to control current behavior. Short-term goals, however, help people succeed by motivating them and guiding action in the here and now. Our preliminary findings suggest that conveying information to students about the potential academic benefits of reducing sedentary may be more effective in eliciting sedentary behavior change than focusing too heavily benefits students perceive as distal, and thus less temporally salient (e.g., lowering heart disease risk).

Consistent with previous studies that have explored barriers to reducing sedentary behavior in university students (Deliens et al., 2015; Moulin & Irwin, 2017), students in our study highlighted several university-specific barriers to being less sedentary, including the arrangement of their class schedules, insufficient movement breaks during long lectures, and restrictive

classroom infrastructure (i.e., lack of standing desks). Additionally, students highlighted several non-academic barriers to being less sedentary such as ‘breaking the habit of sitting’, ‘challenges related to self-regulating/self-monitoring sitting and activity breaks’, ‘enjoyment of sedentary activities’, ‘social norms/pressure to sit’, and ‘lack of social support to sit less’. Similar barriers have been identified in studies of office workers (Nooijen et al., 2018) and older adults (Chastin, Fitzpatrick, Andrews, & Dicroce, 2014; Greenwood-Hickman, Renz, & Rosenberg, 2016; Webber et al., 2018), highlighting how many barriers to reducing sedentary behavior are universally shared by individuals across seemingly different populations.

In terms of ways universities can assist students to be less sedentary, students emphasized the importance of education and making them more knowledgeable and aware of the concept, health risks, and benefits of reducing sedentary behavior. Signage (e.g., posters on campus) was highlighted as a potentially effective means of achieving this. Signage interventions have been successfully used to increase physical activity (Bungum, Meacham, & Truax, 2007; Soler et al., 2010) and reduce sedentary behavior (Southard, Rhoades, Whitehead, & Walch, 2018). Southard et al. (2018) found that a one-week signage intervention (i.e., table tents/signs) promoting active study breaks in a college library significantly increased active breaks compared to pre- and post-intervention weeks. However, because the intervention was only one week long, the authors speculated that signage would likely be insufficient to sustain active study breaks over the long-term. Our findings support Southard et al.’s (2018) speculation; several students in the present study felt that alone, signage would likely be insufficient to motivate students to be less sedentary unless coupled with more personalized approaches, such as group-based education and support sessions led by health professionals on campus.

Students expressed how sitting in lectures contributes significantly to their overall daily sitting time. To counter this, several students indicated that professors ought to provide sufficient movement breaks during long lectures. Consistent with previous research (Benzo, Gremaud, Jerome, & Carr, 2016), students also indicated they would prefer the option of standing in class and were in support of equipping classrooms with standing desks. A study by Jerome et al. (2017) found that college students who were given access to sit-stand desks in a classroom stood significantly more (7.2 minutes/hour/student; 9.3% of class time spent standing) relative to when they were provided with access to sitting desks only (0.7 min/hour/student; 1.6% of class time spent standing). Further, students who used sit-stand desks reported significant improvements in engagement and affective outcomes. Together, providing activity breaks during long lectures and modifying classroom infrastructure represent two potentially effective means of assisting students to spend less time sitting. Such initiatives may, in turn, influence students' perceptions of sedentary behavior and enhance their motivation to be less sedentary in contexts and situations outside of the classroom.

Strengths and Limitations

This study is not without limitations. Focus groups were conducted with a relatively small number of students from one university. The majority were also female (68%) and enrolled in undergraduate programs (90%). Because of this, the transferability of our findings to all university students is limited. However, we were able to achieve some diversity in terms of students' ethnicities and educational backgrounds. We also identified similar themes across focus groups and did not identify any new themes after the third focus group. This is consistent with findings by Guest et al. (2017) who concluded that 80-90% of all themes related to health-related behaviors in qualitative research are discoverable within 2-3 focus groups. Another limitation

was that we did not complete member-checking, which may have been useful in validating the findings and enhancing the trustworthiness of the results (Shenton, 2004). A strength of this study was the use of focus groups, which provided students with a powerful way of communicating and sharing their perspectives related to sedentary behavior.

Conclusion

This study adds to a limited body of qualitative research on sedentary behavior in university students. Our findings offer insights into students' understanding of the concept and health risks associated with sedentary behavior (knowledge) as well as their perceptions of self-efficacy, outcome expectations, barriers, and ideas to reduce sedentary behavior. Our findings also illuminate the complexity of sedentary behavior and illustrate how effectively intervening to reduce sedentary behavior in university students requires multi-dimensional approaches that include education, changing norms, and modifying classroom infrastructure. We hope our findings inspire further research aimed at identifying effective means of educating, motivating, and supporting university students to 'sit less and move' to promote optimal health and wellbeing outcomes in this population.

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Table 1

Focus Group Question Guide

Topic	Questions
Knowledge of sedentary behavior (concept/health impacts)	What is sedentary behavior?
	Moderator defined and differentiated the terms 'sedentary behavior' and 'physical inactivity'
	In what ways does sedentary behavior impact health?
Outcome expectations	If you reduced the amount of time you spend being sedentary, what do you think would happen as a result?
Barriers	What barriers (if any) would make it hard for you to reduce the amount of time you spend being sedentary?
Ideas to reduce sedentary behavior	How confident would you say you are to reduce the amount of time you spend being sedentary?
Self-efficacy	Do you have any ideas or suggestions that might help us reduce sedentary behavior among university students?
Conclusion	Does anyone wish to add anything we have not already discussed?

CHAPTER V: LINKING CHAPTER

The purpose of *Study 2* was to use a qualitative approach (focus groups) to explore university students' knowledge, self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior. Introductory questions in each focus group facilitated our exploration of participants' understanding of the concept and health impacts of sedentary behavior. The moderator (Navjot Pachu; male PhD candidate and author of the thesis) then defined and differentiated the terms 'sedentary behavior' and 'physical inactivity' using consensus definitions and examples (Tremblay et al., 2017). Discussion was then facilitated to explore participants' self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior.

During each focus group, participants viewed a slide presentation entitled "Health risks associated with sedentary behavior: Why sitting too much is bad for your health." The purpose of the presentation was to explore students' reactions to health risk information related to sedentary behavior. The presentation highlighted research evidence indicating that university students are highly sedentary, spending 10-13 hours per day sedentary, on average (Arias-Palencia et al., 2015; Clemente, Nikolaidis, Martins, & Mendes, 2016; Sui & Prapavessis, 2018). The presentation also outlined research evidence linking sedentary behavior to cardiovascular disease (Biswas et al., 2015), weight gain (Smith, Thomas, Bell, & Hamer, 2014), depression/anxiety (Rebar, Vandelanotte, van Uffelen, Short, & Duncan, 2014), type 2 diabetes (de Rezende, Lopes, Rey-Lopez, Matsudo, & Odo, 2014), cancer (Schmid & Leitzmann, 2014), and mortality (Wilmot et al., 2012). Following the presentation, the moderator asked participants "*What are your thoughts on what you just heard about sedentary behavior?*" This question was asked to explore participants' immediate reactions to the information. As the following quotes indicate, some participants reacted in ways suggesting they were threatened by the information:

"It's scary, it really is…and that's the lifestyle it is for being a student especially. It's not healthy at all. That's how it's been for me for the past four years. It's a scary thing." (P1; FG1)

"It's a lot worse than I thought…the effects." (P6; FG2)

"Those are high numbers. I would say a lot of risks. I thought it was just something that doesn't really affect us…for myself, I live in back pain but I didn't know it had other risks." (P2; FG3)

"…and these aren't like little things either, it's not like the common cold, like you can get cancer and die…I mean like, they're fixable, but not all of them…like you can't fix osteoporosis and stuff like that." (P5; FG3)

"I was surprised. It makes me want to throw out my TV, I was really surprised, especially the one about cardiovascular disease…it kind of freaks me out a bit." (P3; FG3)

This set of findings from *Study 2* provided a rationale and logical link for *Study 3*, the purpose of which was to test whether a self-affirmation manipulation could improve students' processing of and reactions to health risk information related to sedentary behavior. If some students perceive health risk information related to sedentary behavior as threatening, this warrants efforts to explore and identify intervention techniques that may improve the way students process, react to, and act upon health risk information related to sedentary behavior. Health communication and awareness campaigns are widely used to influence the health behavior of large populations. Many campaigns feature risk messages designed to alert people to behaviors that increase health risks (e.g., smoking, drinking and driving) and to motivate behavior change (Wakefield, Loken, & Hornik, 2010), often by increasing perceptions of

personal risk (Sherman et al., 2000). Knox et al.'s (2015) content analysis of risk messages related to sedentary behavior used in mass media campaigns in the United Kingdom, United States, Canada, and Australia revealed that most campaigns featuring information related to sedentary behavior pose it as extremely hazardous to health (Knox, Biddle, Esliger, Piggin, & Sherar, 2015). Threat also seems to feature prominently in messages disseminated to the population through mass media channels (e.g., TV, News, Radio, Internet), as evidenced by the following newspaper headlines: "*Sitting for long periods increases risk of death, disease: study*" (Leung, 2015); "*Sitting can increase your risk of cancer by up to 66%"* (Park, 2014). Findings from *Study 2* showed that some students were threatened by health risk information related to sedentary behavior. Research suggests that when threatened, people tend react to health risk information defensively because the information threatens their sense of personal adequacy by implying that they have volitionally engaged in health-compromising behavior, and thus that they have not acted adaptively or wisely (Liberman & Chaiken, 1992).

One type of intervention that reliably promotes adaptive responses to threatening health risk information is self-affirmation (Cohen & Sherman, 2014; Steele, 1988); a technique that involves getting individuals to write about core values, attributes, or past actions unrelated to threat (Steele, 1988). Self-Affirmation Theory (Steele, 1988) proposes that getting people to self-affirm gives them an opportunity to remind themselves of "who they are" in a global sense. This act, although brief, can have profound effects and can bolster an individual's sense of personal adequacy and self-integrity. With one's sense of self-integrity on trial, self-affirmation theory proposes that people should be less defensive and more open and receptive to health risk information that they would otherwise perceive as threatening. Research has shown that brief self-affirmations can make it more likely that individuals who find health risk information

threatening will accept such information and act upon it by subsequently changing their behavior (Armitage et al., 2008; Harris & Napper, 2005; Sherman et al., 2000; Sherman & Cohen, 2006; Steele, 1988).

Self-affirmation theory has been tested and supported in many health-related contexts (Cohen & Sherman, 2014). For example, self-affirmation interventions have been shown to promote adaptive responses (e.g., greater acceptance, less derogation, higher risk perceptions, stronger intentions to perform recommended behaviors) to threatening health risk messages related to smoking (Armitage et al., 2008), binge drinking (Scott, Brown, Phair, Westland, & Schüz, 2013), fruit and vegetable consumption (Napper, Harris, & Klein, 2014), and physical inactivity (Cooke, Trebaczyk, Harris, & Wright, 2014). However, to our knowledge, no studies have examined the effects of self-affirmation on promoting adaptive responses to health risk information related to sedentary behavior. The purpose of *Study 3* was therefore to test whether a self-affirmation manipulation could improve university students' processing of and reactions to health risk information related to sedentary behavior.

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CHAPTER VI: STUDY 3

Study 3

The Effects of Self-Affirmation on University Students' Processing of and Reactions to Health Risk Information Related to Sedentary Behavior

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Abstract

High levels of sedentary behavior are associated with negative health outcomes. University students can be highly sedentary. Little is known about how students process health risk information related to sedentary behavior. The present study tested whether a self-affirmation manipulation could improve students' processing of and reactions to risk messages related to sedentary behavior. Eighty-eight students (females=53; males=35; M_{age}=21.74, SD=5.36) were randomly assigned to a self-affirmation (n=43) or no-affirmation condition (n=45) and then watched a video highlighting conceptual and health risk information related to sedentary behavior. Participants then completed measures of message acceptance, derogation, risk perceptions, negative affect, and intentions to reduce sedentary behavior. Self-affirmation had no effect on any outcome variables, speculatively, because students did not feel threatened by the message and did not consider sitting less to be an important or addressable behavior because of barriers. Implications and future research avenues are discussed.

Introduction

Evidence suggests that sedentary behavior – defined as any waking activity characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture (Tremblay et al., 2017) – is a distinct risk factor for morbidity and mortality, independent of physical activity (Biswas et al., 2015; de Rezende et al., 2014). Several systematic reviews have found that after controlling for physical activity levels, high levels of sedentary behavior, primarily prolonged sitting time, are associated with an increased risk of cardiovascular disease (Ford & Caspersen, 2012), type 2 diabetes (Henson et al., 2013), depression (Teychenne, Ball, & Salmon, 2010), anxiety (Rebar, Vandelanotte, van Uffelen, Short, & Duncan, 2014), and mortality (Koster et al., 2012). Sedentary behavior has arisen as a public health concern given its high prevalence. Large population studies indicate that most adults in contemporary societies spend 9-10 hours per day in engaged in sedentary behaviors (Clark & Sugiyama, 2015; Colley et al., 2011).

In many developed nations, university students represent a large segment of the overall adult population. For example, in 2017, over 21 million students were enrolled in universities and colleges across Canada and the United States of America (Facts and stats - Universities Canada, 2018; National Center for Education Statistics, 2018). Evidence suggests that university students spend a considerable proportion of their waking hours sitting whilst engaged in academic and leisure-time pursuits (e.g., sitting in lectures, in the library, at home engaged in private study, watching TV, using a mobile phone) (Barkley & Lepp, 2016; Moulin & Irwin, 2017). A systematic review of 23 studies comprising data collected from 6,533 university/college undergraduate students from seven countries (US, Canada, Portugal, New Zealand, Republic of Korea, Turkey, Belgium) found that mean daily sedentary time, as measured by domain-specific

questionnaires and accelerometers, was 11.10 hours per day and 10.69 hours per day, respectively (Moulin, Truelove, Burke, & Irwin, 2019). The prevalence of high sedentary time among university students is concerning. Castro and colleagues (2018) conducted a systematic review of 129 studies and found significant associations between higher sedentary time among college students and obesity markers (e.g., BMI, fat percentage, abdominal obesity) (Castro et al., 2018). Further, Vainshelboim et al. (2019) found in their study of 94 male and female college students that 69% of females and 46% of males spent ≥6 hours per day sitting and that sitting time that surpassed this threshold was inversely associated with lean body mass (r = -0.58, p = .01) in females and 1 RM (repetition maximum upper body strength) in males. Additionally, females who sat ≥7.5 hours per day had an approximate 10-fold increased chance of being obese [odds ration = 9.6, 95% confidence interval (1.5 - 62.7), p = .019] relative to females who sat ≤7.5 hours per day. Given evidence that sedentary patterns established during the university/college years (18-25 years of age) have a high likelihood of tracking into later stages of adulthood (Biddle, Pearson, Ross, & Braithwaite, 2010), addressing the sedentary behavior of university students is important from a public health perspective.

Health campaigns are widely used to alert people to behaviors that increase health risks (e.g., smoking, excessive drinking, unhealthy eating) and to encourage behavior change (Good & Abraham, 2011). The growing evidence-base suggesting that sedentary behavior may be a distinct risk factor for chronic disease independent of physical activity has generated media attention and led to many health campaigns to now feature risk messages related to sedentary behavior (Knox, Biddle, Esliger, Piggin, & Sherar, 2015). To motivate behavior change, many campaigns, including those aimed at encouraging sedentary behavior change, attempt to increase perceptions of personal risk (Armitage, Harris, Hepton, & Napper, 2008; Sherman, Nelson, &

Steele, 2000). Research in social psychology has revealed that campaigns that employ such tactics face an important obstacle. People tend to react defensively when they learn their behavior may be putting their health at risk because the information threatens their sense of self-adequacy (Ditto & Lopez, 1992).

According to self-affirmation theory (Sherman & Cohen, 2006; Steele, 1988), people are highly motivated to maintain a positive, global self-image; a view of themselves as "adaptively and morally adequate" (Steele, 1988, p. 262). Health risk information can challenge self-integrity by implying to those whose behavior puts them at risk that they have not acted adaptively or wisely (Sherman et al., 2000). People respond to such threats in various ways. For example, smokers exposed to information about the health risks of smoking may resist the threat to their self-integrity by denigrating or dismissing the information (Armitage et al., 2008). Self-affirmation theorists suggest that one method of off-setting this defensive responding is through reflecting on cherished values, actions or attributes, which can restore or reinforce a person's sense of self-worth in the face of perceived threats to self-integrity. As indicated by Cohen and Sherman (2014), when people focus on important values that transcend the self (e.g., past acts of kindness or compassionate behavior) (Sherman & Cohen, 2006; Steele, 1988), they are given an opportunity to remind themselves of "who they are" in a global sense. This act, although brief, can make people more open and receptive to health risk information they would otherwise perceive as threatening and can increase the likelihood of subsequent behavior change (Armitage, Harris, Hepton, & Napper, 2008; Harris & Napper, 2005; Sherman, Nelson, & Steele, 2000; Sherman & Cohen, 2006; Steele, 1988).

Previous studies have found that self-affirming prior to exposure to threatening health information related to smoking (Harris, Mayle, Mabbott, & Napper, 2007), alcohol intake (Harris

& Napper, 2005; Sherman et al., 2000), fruit and vegetable consumption (Napper, Harris, & Klein, 2014), sunscreen use (Jessop, Simmonds, & Sparks, 2009), and physical activity (Cooke, Trebaczyk, Harris, & Wright, 2014) can beneficially impact health cognitions, health behavior, and other health-related responses (Harris & Epton, 2009). A meta-analysis of 144 experimental tests of self-affirmation found that self-affirmation manipulations generate, on average, small but significant effects on measures of message acceptance (d = .17), intentions to change (d = .14), and actual behavior change (d = .32) (Epton, Harris, Kane, Koningsbruggen, & Sheeran, 2015).

Self-affirmation may be a particularly suitable intervention technique to promote adaptive responses to risk messages related to sedentary behavior among university students given that: (a) many students are highly sedentary (Moulin et al., 2019), (b) high levels of sedentary time among students appears to be associated with compromised physiological health (Vainshelboim et al., 2019), and (c) preliminary findings suggesting that students feel threatened by risk messages related to sedentary behavior (Pachu, Strachan, Ripat, McMillan, & Webber, 2019). To our knowledge, only two studies have examined the effects of self-affirmation in a sedentary behavior context (Falk et al., 2015; Kang et al., 2018). Both studies aimed to understand neural mechanisms induced by self-affirmation during exposure to sedentary behavior risk messages. Falk et al.'s (2015) study was conducted in a community sample of sedentary adults (n=67; mean age=33.42 years) while Kang et al.'s (2018) study was conducted in a sample of sedentary and obese/overweight adults (n=220, mean age=33.75). Findings from both studies revealed that, during message exposure, participants who self-affirmed exhibited greater activity in the ventromedial prefrontal cortex (VMPC; a brain region associated with self-related processing and positive valuation) relative to controls and that increased VMPC activity was associated with subsequent reductions in sedentary behavior among self-affirmed participants (Falk et al., 2015;

Kang et al., 2018). While these investigations provide important insight into the neural mechanisms induced by self-affirmation, the effects self-affirming has on message processing, affective, and social cognitive variables commonly reported in the literature (e.g., message acceptance, derogation, risk perceptions, negative affect, intentions to reduce sedentary behavior) remains unclear. To our knowledge, no studies have examined the effects of self-affirmation on such variables in a general adult or university student population.

The purpose of this study was to test the effects of a self-affirmation manipulation on university students' processing of and immediate reactions to health risk information related to sedentary behavior. We hypothesized that students who self-affirmed prior to viewing sedentary behavior risk messages would report greater message acceptance, less message derogation, higher risk perceptions, less negative affect, and stronger intentions to reduce sedentary behavior relative to non-affirmed participants.

Methods

Participants

An *a priori* power analyses indicated that the minimum sample size required to detect a small effect size of $d = 0.14$ with 80% power would be 98 participants. Our aim was to recruit 100 university students from a large Canadian university using posters and leaflets. To be eligible, participants had to be 18 years of age or older and registered full-time. All recruitment materials presented the study as one that sought to explore students' perceptions related to sedentary behavior. The study protocol was approved by the university's research ethics board.

Procedure

Interested participants emailed the Principal Investigator (Navjot Pachu; author of this thesis) using the email address provided on all recruitment materials. The Principal Investigator

sent participants a reply email containing a link to a confidential study website where they completed eligibility, informed consent, and a demographic questionnaire (e.g., age, gender, ethnicity). Eligible participants were randomly assigned to a self-affirmation condition or a no-affirmation condition using a computer-generated sequence. Participants in the self-affirmation condition completed a self-affirmation exercise whereas participants in the no-affirmation condition completed a control activity (see condition descriptions below). Next, all participants watched a video highlighting information about the concept and health risks associated with sedentary behavior and then completed measures of message acceptance, message derogation, risk perceptions, negative affect, and intentions to reduce sedentary behavior. The study materials took participants approximately 30 minutes to complete. Upon finishing, participants were informed of the true nature and purpose of the study and provided a description of what participants in each condition experienced as part of their respective intervention.

Intervention Materials

***Self-Affirmation Exercise*.** Participants assigned to the self-affirmation condition completed The Personal Attributes Inventory (Reed & Aspinwall, 1998); a 10-item survey asking questions about past acts of kindness and compassionate behavior that is designed to induce self-affirmation. For each item, participants indicated whether they had ever performed the behavior, and if so, they were asked to provide a written example. Sample items are *"Have you ever been generous and selfless to another person?"* and *"Have you ever looked out for another person's interest before your own?"* We deemed the Personal Attributes Inventory as a suitable method to induce self-affirmation in our sample given previous research suggesting that university students consider 'kindness' a highly important personal value and because the

measure has been successfully used to induce self-affirmation in university students (Reed & Aspinwall, 1998).

Control Activity. Participants assigned to the no-affirmation condition completed the Personal Opinion Survey (Reed & Aspinwall, 1998). In this survey, participants are presented with ten statements and asked to indicate whether each statement reflects their opinion, and if so, to write a brief explanation why they agree with the statement. Sample items are *"I think the beach is a great place to vacation"* and "*I think sewing is an important skill to possess"*.

Sedentary Behavior Health Risk Information. All participants watched a video titled "*Health risks associated with sedentary behavior: Why sitting too much is bad for your health*". The video consisted of a series of slides narrated over by the Principal Investigator. The first part of the video presented participants with the consensus definition (Tremblay et al., 2017) and examples of sedentary behavior to familiarize them with the concept. The second part of the video presented participants with research evidence identifying university students as highly sedentary (Moulin et al., 2019). The third part of the video presented participants with research evidence linking high volumes of sedentary time with six different adverse health outcomes: cardiovascular disease (Biswas et al., 2015), weight gain (Smith, Thomas, Bell, & Hamer, 2014), depression (Rebar et al., 2014), type 2 diabetes (de Rezende et al., 2014), cancer (Schmid & Leitzmann, 2014), and mortality (Wilmot et al., 2012). Each slide contained text and graphic imagery depicting the specific disease in question.

Manipulation Check. Given evidence suggesting that completing even simple items to determine if self-affirmation occurred (e.g., asking participants to indicate how good they feel about themselves) can be a self-affirming experience in and of itself for control participants (Mcqueen & Klein, 2006; Steele, Spencer, & Lynch, 1993), we did not include a manipulation

check for self-affirmation in this study. To determine the extent to which participants attended to the information presented in the video, they were asked if they: (i) watched the video (yes/no), (ii) could describe what the video was about in a sentence or two, and (iii) could identify whether the video narrator's voice was that of a female or male.

Measures

Message Acceptance. Message acceptance was measured using an adapted item from Sherman et al. (2000) and Armitage et al. (2008). Participants were asked: "*How important is it for people to minimize the time they spend being sedentary (sitting, reclining, lying down) to avoid developing the kinds of health problems highlighted in the video?* (*1=Not at all important, 7=Extremely important*).

Message Derogation. Using two items from Koningsbruggen and Das (2009), participants rated the extent to which they felt "*The message was exaggerated*" and "*The message was too extreme"* (*1=Strongly disagree, 7=Strongly agree*). The items demonstrated high internal consistency (α=0.95). A mean score was computed for each student, with higher scores indicating greater message derogation.

Risk Perceptions. We measured participants' risk perceptions using two items from Klein, Harris, Ferrer and Zajac (2011). Participants were asked: "*How likely do you think it is that you will develop the kinds of health problems highlighted in the video because of how much time you spend being sedentary?"* (*1=Extremely unlikely, 7=Extremely likely*) and "*What are the chances you will develop health problems because of sedentary behavior relative to the average University of Manitoba student your age?"* (*1=Much lower than average, 7=Much higher than average*). The items were averaged to form a reliable composite scale (α=0.81). A mean score was computed for each participant with higher scores indicating greater risk perceptions.

Negative Affect. Negative affect was assessed using a measure from Ruiter, Verplanken, Kok, and Werrij (2003). Participants indicated the extent to which the video made them feel: (i) *afraid*; (ii) *frightened*; (iii) *worried*; and (iv) *uncomfortable* (*1=Strongly disagree, 7=Strongly agree*). The items demonstrated high internal consistency (α = 0.92). A mean score was computed for each participant, with higher scores indicating greater negative affect.

***Intentions*.** To measure intentions, we used an adapted item from Harris et al. (2007). Participants were asked: *"Over the next 7 days, I intend to reduce the time I spend being sedentary (sitting, reclining, or lying down) during my waking hours."* (*1=Strongly disagree, 7=Strongly agree*).

Data Analysis and Statistical Analysis

The data was cleaned and analysed using SPSS (version 24.0. Aramonk, NY: IBM Corp.). Following recommendations by Tabachnick and Fidell (2007), data cleaning involved checking for missing values and correcting errors in the datafile. Preliminary assumption testing was conducted to assess for normality, univariate and multivariate outliers, linearity, and multicollinearity and singularity. No violations were noted. A one-way between-groups multivariate analysis of variance (MANOVA) was performed to examine effects of condition (self-affirmation vs. no-affirmation) on a combined set of dependent variables: message acceptance, derogation, risk perceptions, negative affect, and intentions. The effect of condition (self-affirmation vs. no-affirmation) on the combined set of dependent variables was determined by the Wilks' Lambda value and its associated *p* value <.05 generated by the MANOVA.

Results

Of the 100 participants who completed the study, 12 participants were excluded from the analyses. Six participants were excluded from the self-affirmation condition for leaving all

questions in the Personal Attributes Inventory blank (n=2), or for providing one-word responses (n=4), which we deemed as insufficient exposure to induce self-affirmation. Six participants were excluded from the no-affirmation condition for failing to indicate whether they watched the video (n=2), for not describing what the video was about (n=2), or for misidentifying the voice of the video narrator (n=2).

The final sample consisted of 88 students (females=53; males=35; M_{age}=21.74, SD=5.36; self-affirmation condition [n=43]; no-affirmation condition, [n=45]). Approximately half (55%) of the sample was in their first year of university. Students self-identified as White (48%); South Asian/East Indian (22%); Chinese (11%); Black (8%); Filipino (7%); or as "other" (4%). Most (86%) were living off-campus and were either working part-time (55%) or unemployed (43%) at the time of the study.

Random Assignment Check

To check the success of random assignment, we compared demographic characteristics of participants assigned to the self-affirmation and no-affirmation conditions. No significant differences emerged between groups in terms of age [$M_{\text{affirmation}}$ = 21.42, SD = 4.70, $M_{\text{no-affirmation}}$ = 21.98, SD = 5.86, $t(86) = -.493$, $p = .62$], gender [$X^2 (1, N = 88) = 1.29$, $p = .26$, $phi = -.14$], or ethnicity [$X^2 (5, N = 88) = 8.68$, $p = .26$, $phi = .12$], which suggests that random assignment was successful.

Main Results

We ran intercorrelations to assess relationships between dependent variables (acceptance, derogation, risk perceptions, negative affect, intentions) in the self-affirmation condition (Table 1), no-affirmation condition (Table 2), and combined self-affirmation and no-affirmation conditions (Table 3). A one-way between-groups MANOVA was conducted to examine the

effect of condition (self-affirmation versus no-affirmation) on the combined set of dependent variables. Preliminary assumption testing to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity revealed one violation for equality of variances on message acceptance. A more conservative alpha level of 0.025 was set to determine the significance of this variable, as recommended by Tabachnick and Fidell (2007). The MANOVA revealed no statistically significant difference between self-affirmation and no-affirmation conditions on the combined set of dependent variables, $F(5, 82) = .501$, $p = .775$; Wilk's Lambda = .97; partial eta squared = .03. Table 4 presents the estimated means and standard deviations for all dependent variables. Table 5 presents the results of the tests of between-subjects' effects.

Discussion

This study tested the effects of a self-affirmation manipulation on university students' processing of and immediate reactions to sedentary behavior health risk messages. We predicted that students who self-affirmed prior to viewing risk messages related to sedentary behavior would report higher levels of message acceptance, less message derogation, greater risk perceptions, more negative affect, and stronger intentions to reduce sedentary behavior relative to non-affirmed students. Contrary to predictions, self-affirmation did not lead to group differences on any of the dependent variables.

Regardless of condition, participants accepted the message (i.e., felt it was important to minimize sedentary behavior to avoid developing health problems) ($M_{\text{affirmation}} = 6.42$, $SD = .63$; $M_{\text{no-affirmation}} = 6.30$, $SD = .69$; scale range = 1 – 7), engaged in low levels of message derogation (i.e., they did not feel the message was exaggerated or too extreme) ($M_{\text{affirmation}} = 2.95$, $SD = 1.47$; $M_{\text{no-affirmation}} = 2.91$, $SD = 1.67$; scale range = 1 – 7), and reported moderate risk perceptions (i.e.,

felt it would be somewhat likely that they might develop health problems in the future because of how sedentary they are) ($M_{affirmation}$ = 3.39, *SD* = 1.22; $M_{no\text{-}affirmation}$ = 3.61, *SD* = 1.32; scale range 1 – 7). These findings are inconsistent with previous research where self-affirmation was found to increase acceptance of threatening health risk messages (e.g., UK adult smokers' acceptance of messages about the risks of smoking) (Armitage et al., 2008; Crocker, Niiya, & Mischkowski, 2008; Sherman et al., 2000), decrease message derogation (e.g., individuals at risk of diabetes' derogation of messages about risk factors for diabetes) (Jessop et al., 2009; Koningsbruggen & Das, 2009), and increase risk perceptions (e.g., ratings of breast cancer risk from alcohol consumption among young female drinkers) (Harris & Napper, 2005; Sherman et al., 2000). Our null findings, however, add to a small number of studies that have found null effects of self-affirmation on similar measures (Dillard, Mccaul, & Magnan, 2005; Harris et al., 2007; Napper et al., 2014). Two examples from the smoking literature include a study by Harris et al. (2007) who found no effect of self-affirmation on self-risk judgments for smoking-related diseases among smokers shown on-pack warnings and Dillard et al. (2005) who reported no effect of self-affirmation on smokers' ratings of the seriousness of the risks of smoking on the on-pack warnings.

Several reasons may explain why self-affirmation may not have had a beneficial impact on students' processing of and immediate reactions to risk messages related to sedentary behavior. From a theoretical perspective, self-affirmation theory proposes that people are highly motivated to maintain a sense of self-integrity (Steele, 1988). For affirmations to yield benefits, individuals must perceive health risk messages, and what they imply, as threatening to their sense of personal adequacy (Cohen & Sherman, 2014). In this study, participants may not have perceived the message (i.e., that university students can be highly sedentary and that excessive sedentary

behavior is associated with adverse health outcomes) as a threat to their sense of personal adequacy. The null-effect of self-affirmation may have also been due to participants perceiving sedentary behavior as an unimportant behavior to address. Reviews of the self-affirmation literature (Cohen & Sherman, 2014; Vohs, Park, & Schmeichel, 2013) have found that the beneficial effects of self-affirmation appear to be clear for (and potentially limited to) people who see a threat as important and addressable. One reason why students may have felt that being less sedentary is not important is because they perceived themselves to be sufficiently active to counteract any risks posed by excessive sedentary time. Such an explanation is plausible given evidence that although many students can be highly sedentary, many are also potentially meeting physical activity guidelines. For example, Vainshelboim et al. (2018) found in their study of 94 college students that 69% of females and 49% of males sat ≥6 hours per day, but that most students (84-94%) were meeting physical activity guidelines. Since we did not measure participants' baseline physical activity levels, we cannot determine whether this was indeed the case in our study. Future studies in this area should measure and determine baseline physical activity levels and evaluate whether these moderate the effect of self-affirmation on processing of risk messages related to sedentary behavior.

Another reason why students may not have been threatened by the information is because they perceived the risks of *sitting too much* as distal, which in turn, would have rendered the seriousness of the risks as low or moderately threatening rather than highly threatening. Such an explanation is in line with findings from threat appeal and communication research showing that younger adults tend to perceive physical threats (e.g., heart disease) as less threatening than social threats (e.g., peer rejection) because physical threats are perceived as distal, and thus less immediately relevant (Dickinson-Delaporte & Holmes, 2011). Further research to examine

whether the effects of self-affirmation are moderated by outcome proximity may provide insights about the role outcome proximity plays in influencing the impact of self-affirmation on message processing variables and subsequent sedentary behavior change.

Self-affirmation theory proposes that affirmations make it less likely that people will deny or derogate health risk information, but only when a threat is perceived as addressable (Vohs et al., 2013). Because university students spend a considerable proportion of their waking hours sitting in class and studying (Moulin & Irwin, 2017), it is possible they perceived reducing sedentary behavior as less important relative to fulfilling academic responsibilities. It is also possible students did not perceive sedentary behavior as an 'addressable' behavior because of personal, social, and environmental barriers to sitting less. In a qualitative study of 145 Canadian undergraduates, Moulin et al. (2017) identified sitting in class and studying outside of class as significant barriers to engaging in a less sedentary lifestyle. Because students spend considerable time in environments that promote sitting (e.g., classrooms, libraries, home), they may have perceived themselves as having little to no control over their ability to actually be less sedentary. Previous studies have found that self-affirmation can enhance predictors of intentions, such as perceived control, self-efficacy, and response efficacy to perform advocated health behaviors (Epton & Harris, 2008; Harris et al., 2007; Jessop et al., 2009; Reed & Aspinwall, 1998). We did not assess such effects in this study. Therefore, further research is needed to understand whether self-affirmation can enhance perceptions of control and self-efficacy to enact behaviors to be less sedentary (e.g., increase active study breaks).

A key reason why people reject health risk information is to control the negative affect (e.g., fear, anxiety) it engenders (Cohen & Sherman, 2014). Previous studies have found that participants who self-affirm prior to being exposed to threatening health risk messages tend to

report higher levels of negative affect post-messages (Harris et al., 2007; Harris & Napper, 2005; Jessop et al., 2009). In the present study, students who self-affirmed did not report significantly higher levels of negative affect after viewing health risk messages related to sedentary behavior relative to non-affirmed students (scale range = 1 – 7; $M_{\text{affirmation}}$ = 3.60, *SD* = 1.37; $M_{\text{no-affirmation}}$ = 3.42, *SD* = 1.62; *p* = .43). Serious health threats typically evoke strong negative affect (Harris & Napper, 2005), the control of which through avoidance or denial of risk ("fear control") is a potent cause of message rejection that interferes with people's motivation and ability to think about changing their behavior to reduce their risk ("danger control") (Leventhal, 1970; Witte, 1992). Self-affirmation has been shown to be an effective means of promoting danger control over fear control (Koningsbruggen & Das, 2009). Yet, it appears that self-affirmation is most beneficial for those most at risk (Armitage et al., 2008; Harris et al., 2007; Harris & Napper, 2005). We did not measure students' baseline sedentary behavior levels because we assumed, given evidence suggesting that most students are highly sedentary (Moulin et al., 2019), that participants were *likely to be* highly sedentary. However, because we did not measure participants' baseline sedentary behavior levels, we could not evaluate the effects of self-affirmation on high versus low risk participants. Future studies should measure participants' baseline sedentary behavior levels, preferably using objective methods (e.g., accelerometers), to examine the effects of self-affirmation when threat and risk levels vary.

Most models of behavior change propose that forming an intention to change (Triandis, 1980) is crucial to the behavior change process (Conner & Norman, 2005). Intentions capture one's motivation to act (Ajzen, 1991) and have been shown to exert a causal impact on subsequent behavior (Webb & Sheeran, 2006). Previous reviews indicate that self-affirmation has positive effects on predictors of intentions (e.g., attitude, perceived control, self-efficacy,

response efficacy), actual intention formation, and subsequent health-related behavior change (Harris & Epton, 2009). Contrary to predictions, in the present study, students who self-affirmed did not report significantly higher intentions to reduce their sedentary behavior (over the next 7 days) relative to non-affirmed students ($M_{\text{affirmation}}$ =5.53, *SD* =1.16; $M_{\text{no-affirmation}}$ =5.58, *SD* =1.18; scale range = 1 – 7). One reason why self-affirmation may not have influenced intentions is that the message was not persuasive enough to motivate students to reduce their sedentary behavior. Self-affirmation opens people up and makes them more accepting of health risk information they would otherwise perceive as threatening, but in order to do so, the message must be sufficiently persuasive and convincing (Cohen & Sherman, 2014). Although we endeavoured to create a persuasive and convincing message using research-informed information, we did not test the persuasiveness of the message. In retrospect, we should have determined if our message increased intentions pre- and post-message. Further, because we did not embed any tips and strategies in the message about how participants could reduce their sedentary behavior, it is possible they were not convinced they could reduce their sedentary behavior if they intended to.

Strengths

This study had several strengths. We tested a self-affirmation intervention that was carried out using a brief, user-friendly, and convenient online format. Harris and Epton (2009) advocate for this type of practical and scalable experimental manipulation. We also targeted a genuine health threat among university students (i.e., sedentary behavior) given evidence suggesting that sedentary behavior is prevalent among students (Moulin et al., 2019) and that high volumes of sedentary time are associated with compromised physiological health outcomes among students (e.g., obesity indicators). Our study is also the first to report the effects of self-affirmation on

message processing variables commonly reported in the self-affirmation literature (i.e., message acceptance, message derogation, risk perceptions). By including measures of affect (fear, anxiety) and intentions, our study also adds to a small, but growing body of self-affirmation studies that have included measures of negative affect and intentions (Harris & Epton, 2009).

Limitations

This study had several limitations. We did not measure students' baseline physical activity and sedentary behavior levels, which prevented us from determining the degree to which risk level moderated the effect of self-affirmation on students' processing of and immediate reactions to risk messages relating to sedentary behavior. Despite past research suggesting that most students are highly sedentary (Moulin et al., 2019), we could have confirmed this by measuring participants' baseline sedentary behavior. Our sample also consisted of university students, two-thirds of whom (66%) were female, which limits the generalizability of our findings. We also did not include a manipulation check, and therefore, could not determine whether students successfully self-affirmed. A further limitation is that we did not include a direct measure of threat – a common limitation of self-affirmation studies (Harris & Epton, 2009). Although we attempted to create risk messages related to sedentary behavior that were informative, threatening, and relevant to students (e.g., by defining the term, highlighting data identifying students as highly sedentary, outlining adverse effects of excessive sedentary behavior), pilot research would have allowed us to assess how threatening students perceived the message to be and make necessary adjustments to the message to enhance its persuasiveness and impact.

Conclusion

Through this study, we were the first researchers, that we know of, to test the effects of a self-affirmation manipulation on university students' processing of and immediate reactions to

health risk information related to sedentary behavior. Self-affirmation had no effect on measures of message acceptance, message derogation, risk perceptions, negative affect, or intentions to reduce sedentary behavior. Speculative explanations for this null effect include that students did not perceive health risk information related to sedentary behavior as a threat to their sense of personal adequacy and self-integrity. In addition, students may not have perceived sedentary behavior as an 'addressable' behavior because of personal, social, and environmental barriers to sitting less.

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Table 1

Intercorrelations Between Message Processing Variables in the Self-Affirmation Condition

Variable	1	2	3	4	5
1. Acceptance	—	-.22	-.22	.11	.47**
2. Derogation	-.22	—	.19	-.19	-.32*
3. Risk Perceptions	-.22	.19	—	.13	-.27
4. Negative Affect	.11	-.19	.13	—	.15
5. Intentions	.47**	-.32*	-.27	.15	—

*$p < .05$. **$p < .01$

Table 2

Intercorrelations Between Message Processing Variables in the No-Affirmation Condition

Variable	1	2	3	4	5
1. Acceptance	—	-.17	.20	.06	.29
2. Derogation	-.17	—	.30*	.36*	-.41**
3. Risk Perceptions	.20	.30*	—	.33*	-.12
4. Negative Affect	.06	.36*	.33*	—	.03
5. Intentions	.29	-.41**	-.12	.03	—

*$p < .05$. **$p < .01$

Table 3

Intercorrelations Between Message Processing Variables in the Combined Self-Affirmation and No-Affirmation Conditions

Variable	1	2	3	4	5
1. Acceptance	—	-.19	.01	.09	.37**
2. Derogation	-.19	—	.25*	.13	-.37*
3. Risk Perceptions	.01	.25*	—	.23*	-.19
4. Negative Affect	.01	.13	.23*	—	.08
5. Intentions	.37**	-.37**	-.19	.08	—

*$p < .05$. **$p < .01$

Table 4

Estimated Means (Standard Deviations) of Scores on Message Processing Variables Between Self-affirmation and No-Affirmation Conditions

	Condition	
Variable	Self-Affirmation	No-Affirmation
Acceptance	6.41 (.63)	6.29 (.69)
Derogation	2.95 (1.47)	2.91 (1.67)
Risk Perceptions	3.39 (1.22)	3.61 (1.32)
Negative Affect	3.60 (1.37)	3.42 (1.62)
Intentions	5.53 (1.16)	5.58 (1.17)

Table 5

Tests of Between Subjects Effects on Message Processing Variables Between Self-Affirmation and No-Affirmation Conditions

Variable	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Acceptance	1	.334	.764	.385	.009
Derogation	1	.038	.030	.864	<.001
Risk Perceptions	1	1.024	.015	.902	<.001
Negative Affect	1	.742	.630	.430	.007
Intentions	1	.040	.328	.568	.004

CHAPTER VII: SUPPLEMENTAL ANALYSES

The following supplemental analyses pertain to *Study 3*, related to the self-affirmation intervention.

The Effect of Self-Affirmation on Self-Efficacy and Outcome Expectations

Because self-affirmation can enhance a general sense of self-integrity (Steele, 1988), researchers contend that it may have a particularly strong effect on self-efficacy perceptions. Several studies have documented positive effects of self-affirmation on self-efficacy beliefs related to enacting health-related behaviors (Epton & Harris, 2008; Jessop et al., 2009; Reed & Aspinwall, 1998; Zhao & Nan, 2010). For example, Epton and Harris (2008) found that undergraduates who self-affirmed prior to reading messages highlighting the benefits of fruit and vegetable consumption were significantly more confident they could meet the "five portions of fruit and vegetables per day" guideline relative to non-affirmed students.

While being confident that one can enact a health behavior is one thing, believing that the behavior will bring about positive and meaningful outcomes (outcome expectations) is another. Theory and research suggest that because self-affirmation can increase people's acceptance of health risk information, it may have a particularly strong effect on outcome expectations. For example, in the same study by Epton and Harris (2008) described above, undergraduates who self-affirmed prior to reading messages on the benefits of fruit and vegetable consumption were significantly more likely to indicate that meeting the "five portions of fruit and vegetables per day" guideline would lower their risk of heart disease and cancer relative to non-affirmed students, suggesting that self-affirmation can enhance the persuasive effects of health messages.

Theory and research supporting positive effects of self-affirmation on self-efficacy and outcome expectations prompted further investigation to determine whether self-affirmation might positively impact university students' self-efficacy and outcome expectations beliefs

related to reducing sedentary behavior. The following supplemental analyses section describes the methods used to address this research question, a description of the results, and an interpretation of the findings.

Methods

Participants

The sample consisted of the same participants from *Study 3* – 88 students from the University of Manitoba (females=53; males=35; M_{age}=21.74, *SD*=5.36), who were randomly assigned to a self-affirmation condition (n=43) or a no-affirmation condition (n=45).

Procedure

After watching the video highlighting health risk information related to sedentary behavior (see *Study 3*), all participants completed measures of acceptance, derogation, risk perceptions, negative affect, and intentions to reduce sedentary behavior. All participants also completed measures of self-efficacy (task, context-specific, self-regulatory) and outcome expectations/values (physical, social, self-evaluative) related to reducing sedentary behavior. Results pertaining to the effects of self-affirmation on self-efficacy and outcome expectations were not included in the manuscript for *Study 3* due to space constraints.

Data Analysis

A one-way between-groups multivariate analysis of variance (MANOVA) was performed to assess the effects of condition (self-affirmation vs. no-affirmation) on a combined set of dependent variables: self-regulatory efficacy, context-specific self-efficacy, task self-efficacy, outcome expectations, and outcome values. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. No serious violations were noted.

Results

The MANOVA analysis revealed no significant difference between conditions (self-affirmation vs. no-affirmation) on the combined set of dependent variables, $F(5, 82) = .720$, $p = .610$; Wilks' Lambda = .958; partial eta squared = .042. The proportion of variance in self-efficacy and outcome expectations that was explained by condition (self-affirmation vs. no affirmation) was 4.2% which, according to generally accepted criteria (Cohen, 1988, p. 284), is considered a small effect size. Students who self-affirmed prior to viewing risk messages related to sedentary behavior did not report significantly higher levels of self-efficacy and outcome expectations related to reducing sedentary behavior relative to non-affirmed students. Table 1 displays estimated means and standard deviations for all dependent variables. Table 2 displays results of the tests of between-subjects' effects.

Interpretation of Findings

Interpreting null effects of self-affirmation can be difficult given the many factors that can influence the effects (or lack of effects) of self-affirmation manipulations. As Harris and Epton (2009) indicate in their narrative review on the effects of self-affirmation on health cognitions, health behavior and other health related responses:

The predicted beneficial effects of self-affirming are clear for (and potentially limited to) those who should find the message threatening (i.e., at-risk participants). However, this raises difficulties when interpreting null effects, as failure to obtain significant effects of self-affirmation may stem from (i) a lack of defensiveness among non-affirmed participants, (ii) the arguments being weak or otherwise unpersuasive, (iii) insufficient power to detect effects, or (iv) failure of the manipulation to induce self-affirmation. (p. 965)

With respect to Harris and Epton's (2009) first point, it is possible self-affirmation may not have elevated students' self-efficacy and outcome expectations because the threat communicated in the message (i.e., that students are highly sedentary and that high sedentary time is associated with negative health-related outcomes) was not sufficiently threatening to challenge their sense of self-integrity. The notion that people are highly motivated to maintain a sense of self-adequacy and self-integrity lies at the heart of self-affirmation theory (Steele, 1988). This notion is relevant to health risk information (e.g., health warnings), as such information can threaten people's view of themselves as healthy, adaptive, adequate, and able to control important outcomes in life (Cohen & Sherman, 2014). However, self-affirmation is expected to have little beneficial effect on the way individuals process and act upon self-relevant health risk information if a threat to self-integrity is absent (Vohs et al., 2013). Findings from *Study 2* indicated that some students were threatened by health risk information on sedentary behavior. However, findings from *Study 2* also revealed that students perceived potential health risks of sedentary behavior as distal. The lack of a perceived threat to students' self-integrity – an important condition that must be met for self-affirmation to yield benefits (Ferrer & Cohen, 2019) – may explain why self-affirmation appeared to have had no observable impact on self-efficacy and outcome expectation beliefs related to reducing sedentary behavior.

As Epton and Harris (2009) suggest, null effects of self-affirmation can also be due to participants perceiving health risk information as weak and unpersuasive. Although great care was taken in creating the video conveying health risk information related to sedentary behavior, there may have been something about the nature of the message and/or its online delivery format that influenced its impact and persuasiveness. While the online format offered participants a user-friendly and convenient means of accessing and completing the study, the online format of

the study may have affected participants' ability to attend closely to the information and engage fully in the self-affirmation activity. The experiment was not conducted in a controlled laboratory setting. Therefore, it is possible that external distractions may have influenced the degree to which participants perceived the message as persuasive and impactful.

Null effects of self-affirmation may also stem from insufficient power to detect effects (Harris & Epton, 2009). For *Study 3*, an *a priori* power analysis for a MANOVA with two levels (self-affirmation vs. no affirmation) and five dependent variables (task, context-specific, self-regulatory self-efficacy, outcome expectations, outcome values) was conducted in G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) to determine the sample size using an alpha level of 0.05, a power of 0.80, and an effect size of d =.14. The decision to use this effect size to inform sample size requirements was based findings from a meta-analytic review of 144 experimental tests of the effects of self-affirmation on intentions that found small but reliable positive effects of self-affirmation on intentions (d = .14, CI = .05 to .23) (Epton et al., 2015). Based on these assumptions, 98 participants were needed to meet power demands. While 100 students were recruited, 12 participants were excluded (see *Study 3*), resulting in a final sample of 88 participants. While it is possible the loss of these 12 participants affected the sensitivity of the MANOVA to detect statistically a significant difference between conditions, the difference in mean self-efficacy and outcome expectations scores between conditions was extremely small (Table 1), suggesting that the null effect of self-affirmation on participants' self-efficacy and outcome expectation beliefs was likely not due to insufficient power to detect effects.

Failure of the manipulation method to induce self-affirmation may also explain null effects of self-affirmation interventions. A systematic review of experimental methods to induce self-affirmation concluded that there is no consensus among researchers as to which self-affirmation

manipulation technique is "best" (Mcqueen & Klein, 2006). In *Study 3*, our manipulation involved participants completing the Personal Attributes Inventory (Reed & Aspinwall, 1998); a 10-item survey that asks about past acts of kindness and compassion. This tool was deemed appropriate to induce self-affirmation in university students given previous research suggesting that university students view 'kindness' as a highly important personal value (Reed & Aspinwall, 1998) and evidence suggesting that it may be sufficient to have all participants self-affirm their kindness (Mcqueen & Klein, 2006). To evaluate the likelihood that participants self-affirmed, the Principle Investigator (Navjot Pachu; author of this thesis) and Dr. Shaelyn Strachan (the Principal Investigator's PhD supervisor and a co-author on *Study 3*) reviewed the depth and quality of participants' responses to items in the Personal Attributes Inventory (Reed & Aspinwall, 1998). The results of the analyses suggested that participants who completed the survey successfully carried out the self-affirmation task. It is therefore unlikely that null effects were due to failure of the manipulation to successfully induce self-affirmation.

Self-affirmation theory (Cohen & Sherman, 2014; Steele, 1988) indicates that for affirmations to yield benefits, participants must view a threat as important to them and addressable (Vohs et al., 2013). Findings *from Study 2* revealed that one reason why students were unlikely to actually reduce their sedentary behavior was because they did not perceive *sitting less* to be an important priority, especially relative to studying. Participants in *Study 2* often spoke about how most of their daily sitting time is spent in academic pursuits (e.g., sitting in class, the library, while studying) and how succeeding academically was their top priority. Finding from *Study 2* also revealed that many students did not perceive sedentary behavior to be an addressable behavior because of the many personal, social, and environmental barriers to being less sedentary (e.g., habit, enjoyment/relaxation, class schedules/duration, insufficient

activity breaks, lack of standing desks). Given previous research (Moulin & Irwin, 2017) and findings from *Study 2*, it is reasonable to suspect that self-affirmation may not have had predicted beneficial effects on students' self-efficacy and outcome expectations beliefs because they did not perceive sedentary behavior as an addressable behavior.

To summarize, the present supplemental analyses indicate that self-affirmation did not significantly elevate self-efficacy and outcome expectations beliefs related to reducing sedentary behavior. Possible explanations for this null effect are that students did not perceive sedentary behavior and its potential health risks as a threat to their self-integrity and did not consider sedentary behavior to be an important or addressable behavior because of personal, social, and environmental barriers to sitting less. Such explanations are in line with the theoretical proposition that for self-affirmation to yield beneficial effects, individuals must perceive health risk information as threatening to their sense of personal adequacy and self-integrity (Cohen & Sherman, 2014; Steele, 1988) and must view the behavior in question as addressable (Vohs et al., 2013).

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Table 1

Estimated Means (Standard Deviations) for Three Self-Efficacy Subtypes (Self-Efficacy, Context-Specific, Task), Outcome Expectations, and Outcome Values

	Condition	
Variable	Self-Affirmation	No-Affirmation
SRE	69.82 (20.01)	67.65 (20.26)
CSSE	51.69 (22.26)	57.51 (21.51)
TSE	67.78 (21.49)	69.97 (20.15)
OEs	3.78 (.59)	3.79 (.54)
OVs	4.26 (.47)	4.24 (.58)

Note. SRE= self-regulatory efficacy; CSE=context-specific self-efficacy; TSE=task self-efficacy; OEs=outcome expectations; OVs=outcome values

Table 2

Tests of Between Subjects Effects on Social Cognitive Theory Variables Between Self-Affirmation and No-Affirmation Conditions

Variable	*F*	Sig.	Partial Eta Squared
SRE	.254	.615	.003
CSSE	1.554	.216	.018
TSE	.245	.622	.003
OEs	.010	.920	<.001
OVs	.015	.902	<.001

Note. SRE= self-regulatory efficacy; CSE=context-specific self-efficacy; TSE=task self-efficacy; OEs=outcome expectations; OVs=outcome values

CHAPTER VIII: GENERAL DISCUSSION

GENERAL DISCUSSION

This general discussion section is structured and organized into several sections. The first section provides an *Overview of the Context and Aims of the Thesis*. This is followed by a *Summary of Key Findings* from *Studies 1, 2, 3*, and the *Supplemental Analyses* related to *Study 3*. This is followed by a description of the unique *Contributions* of the thesis and its findings to knowledge in the research area, a section on the *Implications* of the work, a section highlighting *Future Research* ideas, and a *Conclusion.*

Overview of the Context and Aims of the Thesis

Sedentary behavior, as distinct from a lack of moderate-to-vigorous physical activity (MVPA), has emerged as a distinct risk behavior associated with negative health outcomes (Bankoski et al., 2011; Biswas et al., 2015). University students represent a segment of the adult population for whom excessive sedentary behavior is prevalent and potentially problematic. A systematic review of 23 studies comprising self-report and objective data collected from 6,533 undergraduates across seven countries found that students spend an average of 10-11 hours per day sedentary (Moulin, Truelove, Burke, & Irwin, 2019). This is concerning given evidence that high volumes of sitting (≥6 hours per day) have been shown to be associated with compromised physiological health determinants in university students (Vainshelboim, Brennan, Lorusso, Fitzgerald, & Wisniewski, 2019).

Understanding psychological factors that influence sedentary behavior in university students is critical for informing interventions (Castro, Bennie, Vergeer, Bosselut, & Biddle, 2018). To address this need, the aim of this thesis was to use Social Cognitive Theory (SCT; Bandura, 2004) as a framework to explore university students' knowledge, self-efficacy, and outcome expectations related to reducing sedentary behavior. An additional aim was to examine

whether a self-affirmation intervention could improve university students' processing of health risk information related to sedentary behavior and could elevate students' self-efficacy and outcome expectation beliefs related to reducing sedentary behavior.

Summary of Key Findings

Study 1. Ninety-six students from the University of Manitoba (females=49; males=47; M_{age}=20.1) completed online questionnaires assessing knowledge, self-efficacy (task, context-specific, self-regulatory) and outcome expectations/values (physical, social, self-evaluative) related to reducing sedentary behavior and a modified sedentary behavior questionnaire. Most students appeared to understand the concept of sedentary behavior. However, a small, but meaningful proportion (16%), did not understand the concept – the most common misconception being that sedentary behavior and physical inactivity (i.e., not meeting physical activity guidelines) are synonymous. Most students (90%) were relatively knowledgeable and aware of health risks associated with a sedentary lifestyle. On average, students self-reported 10.83 hours (*SD*=3.62) of sedentary time per day. Self-regulatory efficacy (i.e., confidence to self-monitor, set goals, problem solve, recover from setbacks) was the only SCT variable significantly associated with actual sedentary time.

Study 2. Four focus groups were conducted with a total of 19 students from the University of Manitoba (females=13; males=6; undergraduate=17; graduate=2). A thematic analysis (Braun, Clarke, & Weate, 2016) of transcribed focus group data revealed three main themes: (1) *conceptual confusion*, (2) *confident, but unlikely to change*, and (3) *ideas and recommendations*. The *conceptual confusion* theme revealed that while some students understood the concept of sedentary behavior, others did not. Mirroring findings from *Study 1*, a common misunderstanding among participants in *Study 2* was that sedentary behavior and physical

inactivity are one and the same thing. Students also demonstrated conceptual knowledge deficits in their understanding of postural aspects of sedentary behavior and their understanding of what activities qualify as 'sedentary' behavior (e.g., studying is not sedentary because it requires concentration/mental energy expenditure whereas watching TV is sedentary because it is lazy/unproductive). The *confident, but unlikely to change* theme illustrated how students were confident they could be less sedentary if they wanted to, but unlikely to actually try and be less sedentary. Common reasons for this included that: (i) sitting less in not an important priority, (ii) the health risks of being too sedentary are distal, (iii) simply replacing sitting with standing and light activity would not provide meaningful health benefits, and (iv) classroom norms and infrastructure promote sitting and are barriers that are not under their control to change. Common *ideas and recommendations* of ways universities could motivate and support students to be less sedentary included making students more knowledgeable and aware of the concept, health risks, and benefits of being less sedentary. Signage (e.g., posters on campus) combined with group education/support sessions led by health professionals were identified as potentially effective means of achieving this. Additionally, students recommended that classrooms should be equipped with standing desks and argued that professors ought to provide sufficient activity breaks during long lectures.

Study 3. *Study 3* evolved from the finding from *Study 2* that some students found health risk information related to sedentary behavior to be threatening (see *Linking Chapter* between *Studies 2* and *3*). Students' reactions to sedentary behavior risk messages provided a rationale and logical link for *Study 3*, the purpose of which was to test whether a self-affirmation intervention could improve students' processing of and social cognitive reactions to risk messages related to sedentary behavior. Eighty-eight students (females=53; males=35;

M_{age}=21.74, *SD*=5.36) were randomly assigned to a self-affirmation condition (n=43) or a no-affirmation condition (n=45). Participants in the self-affirmation condition self-affirmed by writing about past acts of kindness and compassion whereas participants in the no-affirmation condition completed an innocuous control activity. All participants then watched a video highlighting health risk information related to sedentary behavior and completed measures of message acceptance, message derogation, risk perceptions, negative affect, intentions, self-efficacy, and outcome expectations. Self-affirmation was found to have had no significant beneficial effect on any outcome variables.

Contributions

Study 1. *Study 1* offers a distinct contribution to knowledge in the research area as it is the first study to have applied SCT – a well-established theory of health behavior change – to explore university students' conceptual and health risk knowledge of sedentary behavior. It is also the first study to have examined cross-sectional associations between different self-efficacy subtypes (task, context-specific, self-regulatory), outcome expectations/values (physical, social, self-evaluative), and actual sedentary behavior. Self-regulatory efficacy was the only SCT variable associated with sedentary behavior. That no other self-efficacy subtypes or outcome expectations were associated with sedentary behavior contributes to knowledge by providing insight about the utility of SCT as a framework to understand intrapersonal psychological factors that influence the sedentary behavior of university students. That students reported 10.83 hours (*SD*=3.62) of sedentary time per day is consistent with systematic review evidence indicating that undergraduates spend 10-11 hours per day sedentary (Moulin et al., 2019) and confirms university students as a population subgroup at high-risk for excessive sedentary time. By measuring sedentary behavior using a reliable and valid self-report questionnaire – the Sedentary

Behavior Questionnaire (Rosenberg et al., 2010) – *Study 1* also contributes important domain-specific data on how much time students spend being sedentary in different contexts (Moulin et al., 2019).

Study 2. To date, only one study (Deliens, Deforche, De Bourdeaudhuij, & Clarys, 2015) has employed a qualitative approach to explore university students' perceptions of sedentary behavior. Deliens et al. (2015) used focus groups to investigate determinants of physical activity and sedentary behavior in Belgian university students and found participants' understanding of the concept of sedentary behavior to be lacking. Aside from this study, no other qualitative investigations have sought to explore university students' perceptions of sedentary behavior. Being only the second study to have employed a qualitative approach to explore topics related to sedentary behavior in a university student population, *Study 2* makes a distinct and unique contribution to a limited body of qualitative research in the area. Also, *Study 2* makes an important contribution to the literature by being the first study to have used a qualitative approach (focus groups) to explore Canadian university students' knowledge, self-efficacy, outcome expectations, barriers, and ideas related to reducing sedentary behavior.

Study 3. Only two studies have tested the effects of self-affirmation in the sedentary behavior domain (Falk et al., 2015; Kang et al., 2018). *Study 3* was the first to examine effects of self-affirmation on university students' processing of and social cognitive reactions to health risk information related to sedentary behavior. While self-affirmation was found to have had no effect on any message processing or social cognitive variables, findings from *Study 3* nonetheless make a contribution to the literature by adding to a small number of studies that have found no effect of self-affirmation on outcomes similar to those assessed in *Study 3* (Dillard, Mccaul, & Magnan, 2005; Harris, Mayle, Mabbott, & Napper, 2007; Napper, Harris, & Klein, 2014).

Speculative explanations for the null effect of self-affirmation include that students did not perceive health risk information on sedentary behavior as a threat to their sense of personal adequacy. Students also may not have perceived reducing their sedentary behavior to be urgent or important priority and may not have perceive sedentary behavior to be an 'addressable' behavior because of personal, social, and environmental barriers to sitting less. Such explanations are in line with the central theoretical tenet upon which self-affirmation theory (Cohen & Sherman, 2014; Steele, 1988) is based. For self-affirmation to yield benefits, individuals must perceive health risk information as threatening to their sense of self-integrity and must view the behavior in question as important and addressable (Ferrer & Cohen, 2019). *Study* 3 makes an important contribution to the literature by being the first study to report null-effects of self-affirmation on university students' processing of and social cognitive reactions to sedentary behavior risk messages.

Implications

Having summarized the key findings and contributions of *Studies 1, 2* and *3,* it is important to consider the broader implications of the thesis and its findings to theory, research, and practice in the area. Given that this thesis was driven by SCT, let us consider the implications of the work in sequence, starting with knowledge.

This thesis contributes to our understanding of the SCT variable, knowledge, in the context of university students' understanding of the concept of sedentary behavior. Findings from *Studies 1* and *2* revealed that while most students understood the concept, some students did not fully understand the concept. That students confused the concepts of sedentary behavior and physical inactivity as being synonymous, were confused about postural aspects of sedentary behavior, and were unsure about what qualifies a behavior as 'sedentary' reflects the multiple

knowledge deficits in their conceptual understanding of sedentary behavior. From the perspective of SCT, the implication of this is that policy-makers, researchers, and health educators need to increase efforts to educate students about the distinct concept of sedentary behavior and related terms (physical inactivity, physical activity [including recommended guidelines], exercise), as such efforts may assist in creating the knowledge precondition Bandura (2004) posits as necessary for behavior change. Interventions that aim to motivate students to be less sedentary will likely be more successful if students have a clear and precise understanding of the exact behavior they should be aiming to change.

Most students perceived the term 'sedentary behavior' to have negative connotations and associated it with negative health outcomes. However, *Study 2* showed that some students were unaware that sedentary behavior may be a distinct risk factor for chronic diseases and health conditions independent of physical activity. Thus, in addition to a need for increased efforts to educate students about the distinct concept of sedentary behavior, *Study 2* suggests that increased efforts should also be directed towards making students more aware of the potential independent health consequences of excessive sedentary behavior. An overview of the best available systematic reviews (up to 2013) of studies examining the relationship between sedentary behavior and health outcomes (de Rezende, Lopes, Rey-Lopez, Matsudo, & Odo, 2014) found strong evidence of a relationship between sedentary behavior and all-cause mortality, cardiovascular disease, type 2 diabetes, and metabolic syndrome, independently of physical activity. While further prospective and experimental research is needed to confirm causal and dose-response relationships between sedentary behavior and specific health outcomes (de Rezende et al., 2014), there exists sufficient evidence to warrant interventions to include

educational components to alert university students to the potential cardiometabolic and mortality risks of excessive sedentary time, independent of physical activity.

Studies 1 and *2* provide a distinct contribution to knowledge in the research area by providing a nuanced assessment of self-efficacy, the primary determinant of behavior according to SCT, and its association with sedentary behavior. Self-efficacy was examined both quantitatively (*Study 1*) and qualitatively (*Study 2*). This allowed for a multidimensional analysis of the construct in the context of reducing sedentary behavior. *Study 1* revealed self-regulatory efficacy, but not task or context-specific self-efficacy, was the only self-efficacy subtype associated with students' actual sedentary behavior, suggesting that reducing sedentary behavior may have less to do with students' ability to perform the physical tasks required to reduce sedentary time by a specific amount each day (e.g., 30-90 minutes), or to be less sedentary in specific contexts (e.g., watching TV, studying), and more to do with their ability to apply self-regulatory skills (e.g., set goals, self-monitor, problem solve) to manage sedentary and activity behaviors on a daily basis. This finding suggests that self-regulatory efficacy may be an important cognitive antecedent of the self-regulation of sedentary behavior and that this construct may also represent a modifiable psychological correlate of sedentary behavior that can be targeted in interventions. Findings from a systematic review of behavior change techniques used in adult sedentary behavior interventions showed that interventions that include self-regulatory training components, such as self-monitoring, action planning, and goal-setting, are particularly promising in actually reducing sedentary time (Gardner, Smith, Lorencatto, Hamer, & Biddle, 2016). While further studies are needed to confirm the relationship between self-regulatory efficacy and sedentary behavior, findings from *Study 1* suggest that incorporating self-regulatory

training components in interventions to decrease excessive sedentary time in university students may be particularly effective.

Outcome expectations were not associated with actual sedentary behavior in *Study 1*. Regardless of whether students anticipated beneficial and valued outcomes from being less sedentary, these beliefs had little to do with their actual sedentary time. A possible explanation for this lack of association is that, as *Study 2* showed, students perceived many of the potential health consequences of being sedentary as distal and that interrupting important (e.g., studying) or enjoyable (e.g., TV viewing) sedentary activities would be disruptive. One way to potentially motivate students to be less sedentary may be to persuasively convey immediate, beneficial, and salient outcomes of being less sedentary such as improvements in academic performance. A recent study conducted with 120 undergraduates found that interrupting prolonged periods of sitting time every 10-20 minutes via short light-intensity activity breaks may optimize cognitive operations (e.g., concentration, memory) associated with academic performance (Felez-Nobrega, Hillman, Dowd, Cirera, & Puig-Ribera, 2018). Highlighting proximal outcomes of being less sedentary that students perceive as salient (e.g., improvements in academic performance), may be more motivational and impactful to students relative to conveying physical outcomes they perceive as distal and less immediately salient, such as reductions in chronic disease risk.

Another reason why outcome expectations may not have been associated with actual sedentary behavior in *Study 1* is that participants may not have had an explicit goal to reduce their sedentary behavior. According to Bandura (2004), “Health promotion should begin with goals, not means” (p. 143) and that “the health goals people set for themselves and the concrete plans and strategies for realizing them” (p. 144) are a core determinant of behavior. From a SCT perspective, if students did not have a goal to be less sedentary, this may have rendered their

beliefs concerning self-efficacy and outcome expectations related to reducing sedentary behavior obsolete. Future studies that apply SCT as a framework to understand university student sedentary behavior should include an assessment of goals and determine the degree to which having a goal to reduce sedentary behavior (or not having one) moderates the relationship between self-efficacy and outcome expectations beliefs related to reducing sedentary behavior and actual sedentary behavior.

SCT outlines barriers and facilitators as key determinants of behavior (Bandura, 2004). With respect to barriers, findings from *Study 2* revealed that students perceived there to be many academic-related (e.g., studying), personal (e.g., habits, enjoyment), social (e.g., norms), environmental (e.g., infrastructure), and policy-related barriers to being less sedentary (e.g., class schedules, insufficient movement breaks during lectures). The influence of real and/or perceived barriers to being less sedentary may help explain, in part, the lack of association between self-efficacy, outcome expectations, and actual sedentary behavior in *Study 1*. According to SCT (Bandura, 2004), barriers may play an important moderating role in the relationship between self-efficacy and sedentary behavior, such that barriers to behavior change may weaken the strength of the relationship between self-efficacy beliefs to enact a specific behavior and actual behavioral engagement. To date, only one study has explicitly examined barriers to reducing sedentary behavior in a university student population (Moulin et al., 2017), highlighting the dearth of research in this area. Developing a more complete understanding of barriers students perceive to exist within and across the different contexts and situations in which high sedentary time occurs (e.g., home, school, work, leisure time) may be critical for informing future interventions. Although facilitators to reducing sedentary behavior were not explicitly investigated in this thesis, *Study 2* did explore students' ideas and recommendations for how

universities could motivate and support them to be less sedentary. Education, providing students with sufficient activity breaks during lectures, modifying class schedules, and equipping classrooms with standing desks were commonly highlighted ideas. These findings are consistent with and add to existing research (Benzo, Gremaud, Jerome, & Carr, 2016) suggesting that targeting these factors in interventions may be both feasible and effective solutions to reduce sedentary time among students in university/college campus settings.

In *Study 3*, self-affirmation appeared to have had no impact on students' processing of or social cognitive reactions to health risk information related to sedentary behavior. Speculative reasons to explain the null effects of self-affirmation include that students did not perceive messages related to sedentary behavior and its potential health risks as threatening to their sense of personal adequacy and self-integrity, the message was perceived as weak/unpersuasive, and/or students did not consider reducing sedentary behavior to be an important and addressable. Such explanations are in line with the theory that for self-affirmation to yield beneficial effects, individuals must perceive there to be a threat to self-integrity and they must view the behavior in that is in need of modification as addressable (Ferrer & Cohen, 2019).

Study 3 evolved from the finding from *Study 2* that some students were threatened by health risk information related to sedentary behavior (see *Linking Chapter* between *Studies 2* and *3*). Findings from *Study 3*, however, suggest this may not have been the case. While some students were indeed surprised to learn that excessive sedentary behaviour is associated with adverse health outcomes independent of physical activity, the degree to which students legitimately perceived the information as threatening to their sense of personal adequacy is unclear. In future self-affirmation studies, the use of theories and models that explicitly include elements of perceived risk severity, such as Protection Motivation Theory (Rogers, 1975) or the

Health Action Process Approach (Schwarzer, 1992), may provide a systematic method of evaluating the degree to which participants perceive health risk information as threatening to their sense of personal adequacy.

Self-affirmation theory suggests that for self-affirmation to yield benefits, individuals must perceive a behavior that health messages highlight as requiring modification as 'addressable' (Vohs, Park, & Schmeichel, 2013). *Study 2* revealed that students perceived there to be many personal, social, and environmental barriers to being less sedentary, many of which they felt were out of their control to change (e.g., class schedules, having to sit in class, having to spend long periods of time studying). The influence of perceived and/or real barriers to being less sedentary may explain the null effect of self-affirmation in *Study 3*. Further, the moderately high self-efficacy levels to be less sedentary that were found in *Studies 1*, *2*, and *3* suggest that students were not highly confident they could actually reduce their sedentary behavior. Findings from *Study 3* reinforce the theoretical premise that for self-affirmation to yield beneficial results, specific conditions must be met (Ferrer & Cohen, 2019), namely that individuals must perceive the behavior health messages highlight as in need of modification as 'addressable' (Cohen & Sherman, 2014; Vohs et al., 2013). Interventions may be more successful if they persuade students of the importance of being less sedentary, modify classroom norms and infrastructural barriers, and convince students that sedentary behavior is a behavior they can realistically and feasibly address.

SCT served as a useful framework to explore students' social cognitive perceptions of sedentary behavior and how these perceptions influence students' actual sedentary behavior. Three advantages of SCT are worth noting. First, that SCT posits knowledge as an important determinant of behavior is unique in that 'knowledge' is not explicitly included in many other

models and theories of behavior change. Using SCT thus offered an important opportunity to explore what students know and understand about sedentary behavior – questions that may not have been addressed had another behavioral model or theory been used. Second, the finding that only one self-efficacy subtype (self-regulatory efficacy) was associated with sedentary behavior in *Study 1* provides researchers and practitioners with a more nuanced understanding of the self-efficacy construct in the context of reducing university student sedentary behavior and highlights a specific self-efficacy subtype (i.e., self-regulatory) that may be useful to target in future interventions. Third, that self-regulatory efficacy emerged as the only social cognitive correlate of sedentary behavior in *Study 1* raises important questions about the extent to which individual-level behavioral change theories and constructs are useful in helping researchers understand, explain, and change sedentary behavior. Explicit applications and tests of commonplace theories and models of health behavior, such as the Health Belief model (Becker et al., 1977), the Transtheoretical model (Prochaska & DiClemente, 2005), and the Theory of Planned Behavior (Ajzen, 1991) may provide further insight into cognitive and motivational factors that influence sedentary behavior. However, it is increasingly recognized that intra-individual level theories and models may be too narrow to account for the broader social and environmental contexts in which sedentary behavior occurs. As findings from *Study 2* showed, addressing the problem of excessive sedentary time in university students will undoubtedly require multi-faceted solutions that extend beyond the targeting of individual level cognitive predictors of behavior change. While intra-individual level behavioral theories can be useful for identifying cognitive and motivational correlates of sedentary behavior (e.g., self-efficacy, attitudes, motivation), approaches that focus too narrowly or exclusively on modifying intra-individual psychological factors will likely be insufficient, unless the social and physical environments in which sedentary

behavior occurs also encourage and support behavior change. Developing a more complete understanding of the multiple intra-individual, interpersonal, and environmental factors that are likely to impinge upon and influence the sedentary behavior of university students will be critical to inform the development of effective evidence-based interventions.

Future Research

The findings from *Studies 1, 2,* and *3* offer several avenues for future research. Given the multiple knowledge deficits in students' understanding of the concept, independent health risks, and benefits of reducing sedentary behavior, further research to identify effective means of disseminating information pertaining to sedentary behavior to university/college students is needed. Evidence suggests that many university/college students do not receive information on any health-related topics. Kwan et al. (2010) sought to identify the health topics that 1,202 college students received information about, how students obtained health-related information, and the perceived believability of those sources. The authors found that 46% of students reported receiving no information on any health topics. The Internet was the most common source for health-related information but was perceived as the least believable source. Students perceived university health educators as the most credible sources of health information. Given evidence that sedentary behavior interventions that incorporate education ('increasing knowledge or understanding') are particularly promising (Gardner, Lally, & Wardle, 2012), research is needed to identify effective means of communicating conceptual and health risk information related to sedentary behavior to university students. As students perceive health educators as credible sources of health information, exploring ways health professionals and educators can be encouraged to develop programs and initiatives to educate and assist students to be less sedentary may be particularly fruitful. Further research examining the effects of increasing knowledge on

students' self-efficacy and outcome expectation beliefs related to reducing sedentary behavior may also be informative.

Students expressed how they felt moderately confident that they *could* be less sedentary, but how it would be unlikely that they would *actually* try to be less sedentary. One of the main reasons for this was that they felt that simply breaking up sitting every 10-20 minutes with light-intensity activity breaks would not confer meaningful health benefits and would decrease their productivity. A systematic review of prospective experimental studies that examined the beneficial effects of breaking up prolonged sitting time on cardiometabolic risk factors concluded that there is considerable evidence supporting beneficial effects of breaking up prolonged sitting on metabolic outcomes (Benatti & Ried-Larsen, 2015). A recent study that examined the relationship between objectively-measured sedentary behaviour and physical activity with academic achievement found that, independently of physical activity, interrupting prolonged periods of sitting every 10-20 minutes with short activity breaks was associated with improvements in cognitive operations associated with academic achievement. Informing students about the potential metabolic and academic benefits that can potentially be derived from breaking up prolonged sitting time may be one way of motivating them to be less sedentary. Research examining the effects of increasing students' understanding of the benefits of breaking up sitting with light activity on their self-efficacy, outcome expectations, and actual sedentary behavior may also provide useful insights to guide future interventions.

Self-regulatory efficacy emerged as a correlate of sedentary behavior. Given evidence that interventions that incorporate self-regulatory skill training components have shown promise in reducing sedentary behavior (Gardner et al., 2016), intervention components that aim to enhance university students' confidence and ability to self-regulate their sedentary and activity behaviors

may be particularly effective. One way of encouraging students to self-regulate sedentary behavior is through signage. Southard et al. (2018) found that a signage intervention (posters and table tents) encouraging active study breaks in a college library increased active study breaks over the three-week intervention period, suggesting that visual reminders may be an effective way of educating and encouraging students to self-regulate their sedentary behavior via active study breaks. Future research should examine the longer-term effects of signage interventions on active study breaks. Further, exploratory research to examine the effects of embedding information and advice into signage encouraging students to self-regulate their sedentary behavior may also be fruitful. For example, future studies could examine the effects of messages encouraging students to self-monitor how they feel during prolonged sitting bouts and to be alert to signs suggesting they may need to get up and move (e.g., back pain, fatigue, numbness in the legs, muscle/joint pain). There are many potential opportunities for students to reduce excessive sedentary time at school, at home, and in transportation (through increased active travel). Exploring effective ways of encouraging students to sit less and move more in the different contexts and settings in which students spend time being sedentary each day is an avenue that future research could fruitfully explore and provide insights that may be used to guide future interventions.

Study 3 assessed the effects of self-affirmation on students' processing of and social cognitive reactions to health risk messages related to sedentary behavior. We did not, however, examine the effects of self-affirmation on actual sedentary behavior change. Given the null effect of self-affirmation in *Study 3*, it is unlikely that self-affirmed participants would have subsequently reduced their sedentary behavior post-self-affirmation manipulation. Assessing whether self-affirmed participants did in fact subsequently reduce their sedentary behavior post-

manipulation would have nonetheless been interesting and potentially informative. Overall, there is good evidence that self-affirming leads to immediate and subsequent health behavior change (Harris & Epton, 2009). However, meta-analyses have shown that the effects are typically small and variable (Epton, Harris, Kane, Koningsbruggen, & Sheeran, 2015; Sweeney & Moyer, 2015). While preliminary evidence indicates that self-affirmation can lead to actual reductions in sedentary behavior, the evidence base is currently limited to just two studies (Falk et al., 2015; Kang et al., 2018), both of which did not provide explanations as to how self-affirming led to actual reductions in subsequent sedentary behavior. Further research to understand when, where, and for whom self-affirmation may be most effective for (in a sedentary behavior context), may offer important insights to support or refute the effectiveness of self-affirmation as an impactful intervention technique to reduce sedentary behavior in targeted populations is needed.

Self-affirmation has been shown to facilitate behavior change among individuals who engage in risky behavior relative to those who do not engage in risky behavior (Harris & Napper, 2005; Klein, Harris, Ferrer, & Zajac, 2011). It was assumed that because sedentary behavior is prevalent among most university students (Moulin et al., 2019), all students should feel at risk. However, it is possible that individual differences in sedentary behavior may have influenced the degree to which students felt threatened, and thus at risk. Because we did not measure students' baseline sedentary behavior levels prior to self-affirming them, we could not determine their relative risk levels. In consideration of this methodological limitation of *Study 3*, future self-affirmation studies should collect baseline sedentary behavior data prior to self-affirming participants to evaluate the effects of self-affirmation in high versus low risk participants.

While the aforementioned research avenue may provide information about who self-affirmation is most likely to work best for (i.e., high versus low risk participants), there may be

something inherently unique about sedentary behavior that makes it less of a consistent threat to people. Self-affirmation has been shown to be effective for groups under consistent psychological threat, such as students who face negative stereotypes, African Americans, and women in science (Sherman & Cohen, 2006; Sherman, 2013). Self-affirmation is expected to have little, if any, effect on individuals who are not under consistent psychological threat (Sherman & Cohen, 2006; Sherman, 2013). Because sedentary behavior and its risks do not appear to pose a significant and consistent psychological threat to young adult university students (*Study 3*), identifying individuals who do perceive sedentary behavior and its risks as more of a consistent psychological threat (e.g., perhaps office workers or older adults), and who are thus more likely to benefit from self-affirmation may provide insights into using self-affirmation in a sedentary behavior context.

Prior to *Study 2*, only one study (Moulin & Irwin, 2017) has previously explored barriers to reducing sedentary behavior in university students. What findings from *Study 2* and Moulin and Irwin's (2017) study make clear is that students perceive there to be many academic barriers to being less sedentary. Sitting in lectures, studying, classroom norms (i.e., insufficient activity breaks) and infrastructure (i.e., lack of standing desks) were commonly highlighted barriers to sitting less at university. While some students highlighted non-academic-related barriers to sitting less (e.g., habits, peer influences, enjoyable/absorbing qualities of screen-time activities), further research to identify barriers students perceive to exist in the home, school, work, and leisure-time domains as well as facilitators to being less sedentary in different contexts and situations would be useful for guiding future interventions.

Further strategic and systematic applications of the ecological model (Castro et al., 2018; Sallis & Owen, 2015) are also needed to identify correlates of sedentary behavior in university

students that cover the full ecological breadth. Given the complexity of sedentary behavior, there are likely a multitude of factors that influence the sedentary behavior patterns of university students. Developing a more complete understanding of the intrapersonal (e.g., psychological), social (e.g., peer influence), and environmental (e.g., infrastructural) factors that likely influence university student sedentary behavior as well as understanding the strength of the relationships between these factors and students' actual sedentary behavior will be critical for informing effective evidence-based interventions that target the strongest and most modifiable correlates.

Conclusion

University students represent a large population subgroup for whom excessive sedentary behavior can be highly prevalent (Moulin et al., 2019) and problematic (Vainshelboim et al., 2019). Understanding psychological factors that influence sedentary behavior among university students is important to inform future interventions. SCT offered a useful framework to explore students' knowledge and perceptions of self-efficacy, outcome expectations, and barriers related to reducing sedentary behavior. However, a key takeaway from this thesis is that while applications of individual-level theories and frameworks, such as SCT, can offer insights into the role that psychological perceptions (e.g., motivation, self-efficacy) play in influencing sedentary behavior, researchers are increasingly recognizing that efforts to motivate and support people to be less sedentary will be limited if the social and environmental contexts do not also support behavior change.

As has been noted previously (King, 2015), the choice of approaches to address health behaviors, such as sedentary behavior, tends to be influenced by the disciplinary backgrounds of researchers rather than what may be the best approach. Psychological influences highlight the importance of individually focused solutions. However, a disadvantage of focusing too heavily

or exclusively on modifying psychological influences of sedentary behavior is that can lead to narrow, silo-type approaches to analyzing and addressing the problem of sedentary behavior (Biddle, 2018). Behavioral risk factors, such as insufficient physical activity and excessive sedentary behavior, are complex issues that require multi-faceted solutions that draw upon the knowledge and expertise of individuals across many scientific disciplines. Taken together, this thesis and its findings illuminate an important challenge for researchers, health professionals, and policy-makers to develop innovative and impactful methods of educating, motivating, and supporting university students to sit less and move more at any intensity whenever and wherever possible. Encouraging and assisting students to lead less sedentary and more active lifestyles during their university-years is important to help them establish behavioral patterns that may profoundly and beneficially impact their current and future health and wellbeing.

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Appendices

Appendix 1. Study 1 Ethics Approval Certificate

UNIVERSITY OF MANITOBA | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Email: humanethics@umanitoba.ca

PROTOCOL APPROVAL

TO: **Navjot Pachu** **(Advisor: S. Webber & S. Strachan)**
Principal Investigator

FROM: **Zana Lutfiyya, Chair**
Education/Nursing Research Ethics Board (ENREB) [redacted]

Re: **Protocol #E2017:073 (HS21029)**
"Examining knowledge of sedentary behaviour and associations between psychosocial cognitions related to reducing sedentary behaviour and self-reported sedentary time in university students"

Effective: August 23, 2017 **Expiry:** August 23, 2018

Education/Nursing Research Ethics Board (ENREB) has reviewed and approved the above research. ENREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.*

This approval is subject to the following conditions:

1. Approval is granted only for the research and purposes described in the application.
2. Any modification to the research must be submitted to ENREB for approval before implementation.
3. Any deviations to the research or adverse events must be submitted to ENREB as soon as possible.
4. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.
5. A Study Closure form must be submitted to ENREB when the research is complete or terminated.
6. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans.*

Funded Protocols:
- **Please mail/e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer in ORS.**

Appendix 2. Study 1 Recruitment Poster

Appendix 3. Study 1 Consent Form

University of Manitoba

Applied Health Sciences PhD Program
Faculty of Graduate Studies

Faculty of Graduate Studies
500 University Centre
Winnipeg, Manitoba
Canada R3T 2N2
Phone: (204) 474-8038
Fax: (204) 261-7553

RESEARCH PARTICIPANT INFORMATION AND CONSENT FORM

Research Project Title: An examination of university students' knowledge and perceptions related to sedentary behavior.

Principal Investigator:
Navjot Pachu, PhD (Candidate)
Applied Health Sciences PhD program
University of Manitoba
Phone: [redacted]
Email: [redacted]

Research Supervisors:
Dr. Sandra Webber, PhD
Associate Professor, Department of Physical Therapy
University of Manitoba
Phone: [redacted]
Email: [redacted]

Dr. Shaelyn Strachan, PhD
Associate Professor, Faculty of Kinesiology and Recreation Management
University of Manitoba
Phone: [redacted]
Email: [redacted]

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information. If you would like to be emailed a copy of this consent form for your records, please email the Principal Investigator (Navjot Pachu).

Purpose of the Research: To examine university students' knowledge of sedentary behavior and perceptions related to reducing sedentary behavior.

Procedures: You will be asked to complete a series of online questionnaires. You will only complete the questionnaires this one time. It is expected that it will take you approximately 30 minutes to complete the study.

Risks: Participation in this study may involve some risks. You will be answering questions related to your knowledge about sedentary behavior and perceptions related to reducing sedentary behavior. Some questions may cause you to feel uneasy. If this is the case, please contact your health care provider and/or discontinue your participation at any time. You will also be asked to disclose personal information, such as your age and gender. Disclosing this information may cause you to feel slightly uneasy. However, please note that all data collected in this study will be made anonymous (i.e., will contain no personal identifiers) and be kept strictly confidential. Once all the data has been collected, the results will be stripped of any identifiers (such as your name) so that no one will be able to link your data back to you. A final risk is that it is anticipated that it will take approximately 30 minutes to complete this study, which may be a time commitment that for some participants may be an inconvenience. However, the risks associated with this research are not expected to surpass the risks associated with everyday life.

Benefits: You may experience some benefits from participating in this study. Through your participation, you will be making a valued and important contribution to research on sedentary behavior and may learn more about sedentary behavior. These benefits however are not guaranteed.

Confidentiality: This is an online study. Data will be collected using the Q.A. Survey System. The Q.A. Survey system is a secure and password-protected website. The data collected using the Q.A. Survey system will be anonymous (contain no personal identifiers). The Q.A. Survey System web server and database are managed by the University of Manitoba's IT Department. Only the Principal Investigator and the University of Manitoba's IT Department will have access to the non-identifiable data stored on the Q.A. Survey System. Once all data has been collected, the non-identifiable data stored on the Q.A. Survey System will be transferred to a password-protected Excel spreadsheet and deleted permanently from the Q.A. Survey System. The Excel spreadsheet will be saved to the hard drive of the Principal Investigator's password-protected computer located in a locked graduate student laboratory in Frank Kennedy Centre. If you email the Principal Investigator to inquire about the study or request a summary of the results (once they are available), your email address will be entered into a password-protected Excel spreadsheet and deleted permanently from the Principal Investigator's University of Manitoba email account. The Excel spreadsheet will be stored separately from the non-identifiable data so no one will be able to trace your data back to you. After the study is complete and all participants have been sent the summary of the results, the Excel spreadsheet containing participants' email addresses will be deleted permanently from the hard drive. All data associated with this research will be kept strictly confidential. The results will be aggregated to provide a summary of the results, which will be stripped of any identifiers. This research will be presented in the Principal Investigator's PhD thesis, at academic conferences, and published in an academic journal article. The information you provide will be used solely by the Principal Investigator and only for the purposes of this research project. Neither your name nor your contact information will appear in any publications stemming from this study.

Conservation of Data: Once the data has been analyzed and all participants have been emailed a summary of the results (08/2018), the Excel spreadsheet containing participants' email addresses will be permanently destroyed from the Principal Investigator's lab computer. All non-

identifiable data will be saved to the hard drive of the PI's password-protected lab computer for five years (2022) and then permanently destroyed.

Compensation: This study does not include compensation, but as mentioned before, you may experience some benefits from participating in this study.

Voluntary Participation/Withdrawal from the Study: Your decision to take part in this study is completely voluntary. You can withdraw at any time and/or refuse to answer any questions without negative consequences. If you wish to withdraw, you can exit the study website (by closing the screen) or contact the Principal Investigator: [redacted]

Debriefing: At the end of the study, you will be debriefed about the study details. You will also be given an opportunity to leave your email address if you are interested in receiving a summary of the results once they are available. The feedback will consist of a 1-3 page summary of the results and will be sent to you within one year after all data has been collected and analyzed.

Questions: You are free to ask any questions you may have about your treatment and your rights as a research participant. If any questions come up during or after the study, please contact the Principal Investigator. For questions about your rights as a research participant, you can contact The University of Manitoba, Fort Garry Campus Research Ethics Board Office at (204) 474-7122. Do not provide consent to participate in this study unless you have had a chance to ask questions and received satisfactory answers to all of your questions.

By clicking "Yes" below indicates that you have understood to your satisfaction the information regarding participation in this research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way. This research has been approved by the University of Manitoba's Education and Nursing Research Ethics Board (Fort Garry campus). If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator at 204-474-7122.

- Do you wish to be a participant in this research study?
  Yes No

- If you would like a copy of this consent form to keep for your personal records, please enter an email address we can send a copy of the consent form to.
  [text box]

Notice Regarding Collection, Use, and Disclosure of Personal Information by the University

Your personal information is being collected under the authority of *The University of Manitoba Act*. The information you provide will be used by the University for the purpose of this research study, and to send you a copy of your consent form (if requested) and a copy of the aggregated results (if selected at the end of the survey). Your personal information will not be used or

disclosed for other purposes, unless permitted by *The Freedom of Information and Protection of Privacy Act* (FIPPA). If you have any questions about the collection of your personal information, contact the Access & Privacy Office (tel. 204-474-9462), 233 Elizabeth Dafoe Library, University of Manitoba, Winnipeg, MB, R3T 2N2.

Appendix 4. Demographic Questionnaire

1. Please indicate your gender (drop down menu)
    - Male
    - Female
    - Other

2. Do you self-identify as an Indigenous Person? (drop down menu)
    - Yes
    - No

3. If you answered "yes" to question #2, please indicate all that apply:
    ___ First Nation
    ___ Metis
    ___ Inuit

4. A member of a racialized community in Canada is someone (other than an Indigenous Person) who self-identifies as non-white in color or non-Caucasian in racial origin, regardless of birthplace or citizenship. Members of ethnic or national groups (such as Portuguese, Italian, Greek, etc.) are not considered to be racially visible unless they also meet the criteria above.

    Do you self-identify as a member of a racialized community? (drop down menu)
    - Yes
    - No

    If you answered "yes" to #4, please indicate all that apply:
    ___ Black (e.g., African, American, Canadian, Caribbean)
    ___ Chinese
    ___ Filipino
    ___ Japanese
    ___ Korean
    ___ Indigenous person from outside North America
    ___ South Asian/East Indian (e.g., Bangladeshi, Pakistani, Indian from India, East Indian from Guyana, Trinidadian, Sri Lankan, East African)
    ___ South East Asian (e.g., Burmese, Cambodian/Kampuchean, Laotian, Malaysian, Thai, Vietnamese, Indonesian)
    ___ Non-White West Asian (e.g., Iranian, Lebanese, Afghan)
    ___ Non-White North African (e.g., Egyptian, Libyan)
    ___ Arab
    ___ Non-White Latin American (including indigenous person from Central and South America)
    ___ Person of Mixed Origin (with one parent in one of the racialized groups listed above)
    ___ Other (please specify)

5. If you answered “no” to #4, please indicate if you are a White Caucasian.

    - Yes
    - No

6. Are you an undergraduate or graduate student? (drop down menu)
    - Undergraduate
    - Graduate

7. How many years have you been a university student? (text box)

8. What is your program of study (e.g., Nursing, Law, Engineering, etc.) (text box)

9. Please indicate the average number of hours you spend in class each week. (text box)

10. Do you live on-campus (in student residence) or off-campus. (drop down menu)
    - I live on-campus
    - I live off-campus

11. What is your employment status? (drop down menu)
    - Unemployed
    - Employed (part-time)
    - Employed (full-time)

12. If you are employed, what is your job role? (text box)

13. If you are employed, how many hours, on average, do you work per week? (text box)

13. What is your height? (drop down menu)
    a) Shorter than 4'8" (142 cm)
    b) 4'8" (142 cm)
    c) 4'9" (144.5 cm)
    d) 4'10" (147 cm)
    e) 4'11" (150 cm)
    f) 5' (152.5 cm)
    g) 5'1" (155 cm)
    h) 5'2" (157.5 cm)
    i) 5'3" (160 cm)
    j) 5'4" (162.5 cm)
    k) 5'5" (165 cm)
    l) 5'6" (167.5 cm)
    m) 5'7" (170 cm)
    n) 5'8" (172.5 cm)
    o) 5'9" (175 cm)
    p) 5'10" (177.5 cm)
    q) 5'11" (180 cm)

r) 6' (183 cm)
s) 6'1" (185.5 cm)
t) 6'2" (188 cm)
u) 6'3" (190.5 cm)
v) Taller than 6'3" (190.5 cm)

14. Please enter your weight (in pounds)? (text box)

Appendix 5. Knowledge of Sedentary Behavior Questionnaire

Please answer the following questions about sedentary behavior as honestly as you can.

1. Have you heard of the term “sedentary behavior” before? (Y/N)

2. What is “sedentary behavior”?
   Please write your response in the space provided. (open-ended)

3. Do you think sedentary behavior affects your health? (yes/no)
   If “yes”, please explain how you think sedentary behavior affects health. (open-ended)

Appendix 6. Outcome Expectations and Values Questionnaire

If you reduced the amount of time you spend being sedentary (i.e., time spent sitting, reclining, or lying down), certain outcomes might occur as a result of doing so. Please answer the following questions as honestly as you can using the scales provided.

1. a) Reducing sedentary time would improve my cardiovascular health.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to improve your cardiovascular health?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

2. a) Reducing sedentary time would reduce my chances of getting type 2 diabetes.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to reduce your chances of getting type 2 diabetes?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

3. a) Reducing sedentary time would improve my blood pressure, cholesterol, and blood sugar levels.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to improve your blood pressure, cholesterol, and blood sugar levels?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

4. a) Reducing sedentary time would reduce my chances of getting cancer.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
○	○	○	○	○

b) How important is it for you to reduce your chances of getting cancer?

Not at all important	Low importance	Neutral	Moderately important	Extremely important
○	○	○	○	○

5. a) Reducing sedentary time would help with weight control.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
○	○	○	○	○

b) How important is it for you to control your weight?

Not at all important	Low importance	Neutral	Moderately important	Extremely important
○	○	○	○	○

6. a) Reducing sedentary time would improve my muscle strength and joint flexibility.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
○	○	○	○	○

b) How important is it for you to have strong muscles and bones?

Not at all important	Low importance	Neutral	Moderately important	Extremely important
○	○	○	○	○

7. Respond with ‘strongly agree’ to this item.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
○	○	○	○	○

8. a) Reducing sedentary time would improve my posture.

○	○	○	○	○

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it to for you to improve your posture?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

9. a) Reducing sedentary time would reduce pain and stiffness in my muscles and joints.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to reduce pain and stiffness in your muscles and joints?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

10. a) Reducing sedentary time would create opportunities for me to socialize with friends and family.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to create opportunities to socialize with friends and family?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

11. a) Reducing sedentary time would make me feel a sense of personal accomplishment.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to feel a sense of personal accomplishment?

∘	∘	∘	∘	∘

Not at all important	Low importance	Neutral	Moderately important	Extremely important

12. a) Reducing sedentary time would prevent or help me manage mental health problems such as depression and anxiety.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to prevent and/or manage mental health problems such as depression and anxiety?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

13. a) Reducing sedentary would make me feel tired/fatigued.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to **avoid** feeling tired/fatigued?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

14. a) Reducing sedentary time would be frustrating and an inconvenience.

∘	∘	∘	∘	∘
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to **avoid** feeling frustrated and inconvenienced?

∘	∘	∘	∘	∘
Not at all important	Low importance	Neutral	Moderately important	Extremely important

15. a) Reducing sedentary time would make me feel awkward or embarrassed in social situations where other people are being sedentary.

∘	∘	∘	∘	∘

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to **avoid** feeling awkward or uncomfortable in social situations where others are being sedentary?

Not at all important	Low importance	Neutral	Moderately important	Extremely important

16. a) Reducing sedentary time would be disruptive and make me feel less productive.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

b) How important is it for you to **avoid** being disrupted and feeling unproductive?

Not at all important	Low importance	Neutral	Moderately important	Extremely important

Appendix 7: Salient Outcome Expectations Questionnaire

Please select five (5) outcomes from the list below that **are <u>most important to you</u>**.

1. Improving my cardiovascular health

2. Reducing my chances of getting type 2 diabetes

3. Improving my blood pressure, cholesterol, and blood sugar levels

4. Reducing my chances of getting cancer

5. Controlling my weight

6. Improving my muscle strength and joint flexibility

7. Improving my posture

8. Reducing pain and stiffness in my muscles and joints

9. Having opportunities to socialize with friends/family

10. Feeling productive a sense of personal accomplishment

11. Preventing or managing depression and anxiety

12. Not feeling tired

13. Not feeling anxious, frustrated or inconvenienced

14. Not feeling awkward or embarrassed in social situations

15. Not being distracted or feeling unproductive

Appendix 8. Self-Regulatory Efficacy Questionnaire

A number of skills are required to reduce sedentary behavior. Please rate how certain you are that you can get yourself to regularly do the things listed below to reduce your sedentary behavior.

Rate your degree of confidence by recording a number from 0 to 100 using the following scale.

0	10	20	30	40	50	60	70	80	90	100
Cannot do at all					Moderately certain can do					Highly certain can do

How confident are you that you can…	Confidence (0-100)
1. Set goals to reduce sitting time	_____
2. Self-monitor (plan, keep track of) your sedentary time	_____
3. Problem solve to overcome barriers that might make it difficult to reduce the amount of time you spend sitting	_____
4. Restart your efforts to reduce your sitting time, even if you fail to meet your sitting time reduction goals for a few days	_____

Appendix 9. Context-Specific Self-Efficacy Questionnaire

It is not uncommon for people to spend long periods of time sitting in different contexts of daily life. Please rate how certain you are that you could get yourself to **regularly** reduce the time you spend sitting in each of the contexts listed below.

Rate your degree of confidence by entering a number from 0 to 100 using the following scale.

0	10	20	30	40	50	60	70	80	90	100
Cannot do at all					Moderately certain can do					Highly certain can do

How confident are you that you can minimize prolonged sitting and break up long periods of sitting while…

	Confidence (0-100)
1. Studying (includes using a computer, reading)	_____
2. Watching TV (includes watching YouTube or Netflix on a computer or screened-based device [e.g., iPad, tablet, cell phone])	_____
3. Using a computer or other screened-based device (e.g., iPad, tablet, cell phone) during your leisure-time	_____
4. Socializing (i.e., hanging out/talking with friends/family)	_____

Appendix 10. Task Self-Efficacy Questionnaire

Please rate your degree of confidence by recording a number from 0 to 100 using the following below.

0	10	20	30	40	50	60	70	80	90	100
Cannot do at all					Moderately certain can do					Highly certain can do

How confident are you that you can decrease the amount of time you spend sitting every day by:

	Confidence (0-100)
20 minutes	_____
30 minutes	_____
45 minutes	_____
60 minutes	_____
75 minutes	_____
90 minutes	_____

Appendix 11. Sedentary Behavior Questionnaire (SBQ)

SEDENTARY BEHAVIOR QUESTIONNAIRE									
On a typical WEEK DAY, how much time do you spend sitting, reclining, or lying down (from when you wake up until you go to bed) while doing the following? *For each activity, only count the time when this was your main activity. For example, if you watched TV and ate dinner at the same time, this might be your TV time **or** mealtime, **but not both**.									
	None	15 min. or less	30 min	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs or more
1. Watching TV (includes watching movies, YouTube, NETFLIX on a computer, tablet, or mobile phone)									
2. Playing video games (on a computer, console [e.g., PlayStation, Xbox], or mobile phone)									
3. Listening to music									
4. Socializing (includes talking and texting on a mobile phone)									
5. Using a computer (for study, work, or leisure-time purposes)									
6. Reading (for study, work, or leisure purposes)									
7. Playing a musical instrument									
8. Doing artwork or crafts									
9. Riding in a car or bus									
10. Sitting for meals (includes breakfast, lunch, dinner and snacks)									

Rosenberg, D. E., Norman, G. J., Wagner, N., Patrick, K., Calfas, K. J., & Sallis, J. F. (2010). Reliability and validity of the Sedentary Behavior Questionnaire (SBQ) for adults. *Journal of Physical Activity and Health, 7*(6), 697-705.

SEDENTARY BEHAVIOR QUESTIONNAIRE									
On a typical WEEKEND DAY, how much time do you spend sitting, reclining, or lying down (from when you wake up until you go to bed) while doing the following? *For each activity below, only count the time when this was your main activity. For example, if you watched TV and ate dinner at the same time, this might be your TV time **or** mealtime, **but not both**.									
	None	15 min or less	30 min.	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs or more
1. Watching TV (includes watching movies, YouTube, NETFLIX on a computer, tablet, or mobile phone)									
2. Playing video games (on a computer, console [e.g., PlayStation, Xbox], or mobile phone)									
3. Listening to music									
4. Socializing (includes talking/texting on a mobile phone)									
5. Using a computer (for study, work, or leisure-time purposes)									
6. Reading (for study, work, or leisure purposes)									
7. Playing a musical instrument									
8. Doing artwork or crafts									
9. Riding in a car or bus									
10. Sitting for meals (includes breakfast, lunch, dinner and snacks)									

Rosenberg, D. E., Norman, G. J., Wagner, N., Patrick, K., Calfas, K. J., & Sallis, J. F. (2010). Reliability and validity of the Sedentary Behavior Questionnaire (SBQ) for adults. *Journal of Physical Activity and Health, 7*(6), 697-705.

Appendix 12: Study 2 Ethics Approval Certificate

UNIVERSITY OF MANITOBA | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Email: humanethics@umanitoba.ca

PROTOCOL APPROVAL

TO: **Navjot Pachu** **(Advisor: S. Webber & S. Strachan)**
Principal Investigator

FROM: **Zana Lutfiyya, Chair**
Education/Nursing Research Ethics Board (ENREB) [redacted]

Re: **Protocol #E2017:076 (HS21043)**
"University students' knowledge of sedentary behavior and psychosocial cognitions related to reducing sedentary behaviour: A qualitative study"

Effective: August 23, 2017 **Expiry:** August 23, 2018

Education/Nursing Research Ethics Board (ENREB) has reviewed and approved the above research. ENREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*.

This approval is subject to the following conditions:

1. Approval is granted only for the research and purposes described in the application.
2. Any modification to the research must be submitted to ENREB for approval before implementation.
3. Any deviations to the research or adverse events must be submitted to ENREB as soon as possible.
4. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.
5. A Study Closure form must be submitted to ENREB when the research is complete or terminated.
6. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

Funded Protocols:
- **Please mail/e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer in ORS.**

Appendix 13: Study 2 Recruitment Poster

PARTICIPANTS NEEDED

UNIVERSITY OF MANITOBA

SEDENTARY BEHAVIOUR
RESEARCH STUDY

IF YOU ARE:

- 18 YEARS OF AGE OR OLDER
- A FULL-TIME STUDENT AT THE UNIVERSITY OF MANITOBA

WE NEED YOU!

We are trying to understand university students' perceptions of sedentary behaviour and would like your input.

- This study will involve participating in a focus group that will last approximately 60 to 90 min.
- To sign-up, please email: Navjot.Pachu@umanitoba.ca
- Principal Investigator: Navjot Pachu
- Advisors: Dr. Sandra Webber & Dr. Shaelyn Strachan
- This research has been approved by the Education and Nursing Research Ethics Board.

Appendix 14. Focus Group Question Guide

Welcome and Introduction (10 minutes)

1. Principle Investigator welcomes participants

2. Participants complete consent form and demographic questionnaire

3. Principle Investigator provides overview of focus group process
    - Reminder of confidentiality of information shared
    - Encourage participants to talk to and respond to one another
    - We are here to learn from you – interested in everyone's opinion – consensus not required

Opening (25 minutes)

We are here because we are interested in learning more about your thoughts, opinions and views on sedentary behavior.

1. Tell me a little bit about what you know about sedentary behavior.
    a. Where did you hear about it?

2. What do you think is meant by the term "sedentary behavior"?
    a. Can you provide some examples of sedentary behavior?

3. What do you think is meant by the term "physical inactivity"?
    a. How do you think sedentary behavior relates to being physically inactive? How are these terms the same or different?

4. In what ways does sedentary behavior influence health?

Education Session #1 (2-3 minutes)

- We are now going to share some information with you about sedentary behavior. DELIVER POWERPOINT PRESENTATION: DEFINE AND GIVE EXAMPLES OF SEDENTARY BEHAVIOR, EXPLAIN DIFFERENCE BETWEEN SEDENTARY BEHAVIOR AND PHYSICAL INACTIVITY.

Exploration (20 minutes)

1. If you reduced sedentary behavior (i.e., minimized prolonged sitting and broke up sitting as often as possible) what kind of outcomes do think might occur as a result of doing so?
    - Prompts: Physical, social, self-evaluative outcomes behavior (e.g., lower risk of cardiovascular disease, diabetes, improve posture, create opportunities to socialize, make you feel accomplished?

Education Session #2 (5-8 minutes)

We are now going to share some more information with you about sedentary behavior.
DELIVER POWERPOINT PRESENTATION ENTITLED "TOP TEN HEALTH RISKS OF EXCESSIVE SITTING"

2. What are your thoughts about what you just heard about sedentary behavior?
    a. How does this information make you feel?

3. What sorts of things would make it hard for you to reduce sedentary behavior?
    a. Probes: Lack of time, effort, motivation, fatigue, it's not a priority, habit, not conscious of sitting time, unaware of the risks, social norms, no social support, bad weather.

4. How confident are you that you could minimize prolonged sitting and break up sitting as often as possible?

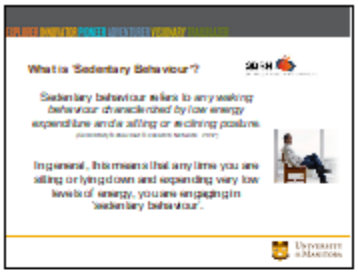
5. We are interested in developing interventions to help students reduce sedentary behavior. Can you provide us with some ideas or recommendations about how we might best be able to do that?

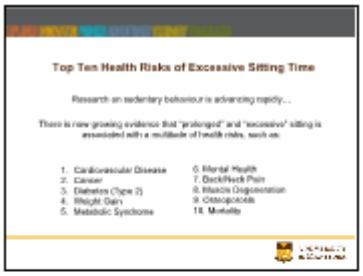
Conclusion (5 minutes)

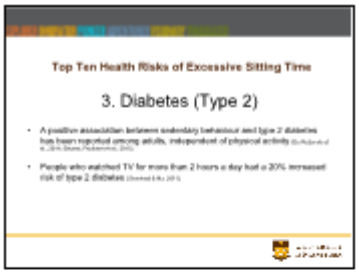
1. Is there anything else you would like to add that we have not already discussed?

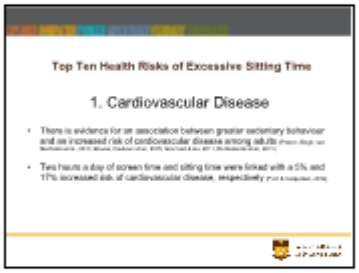
2. Thank participants for their time and participation.

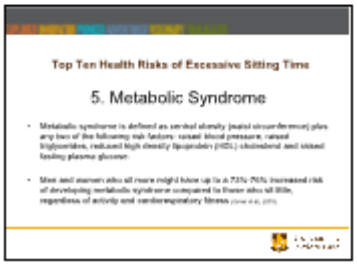
Appendix 15. Education Sessions 1 and 2

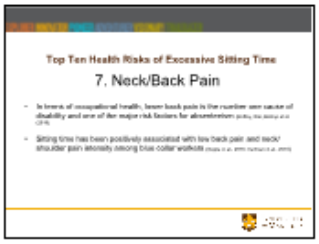


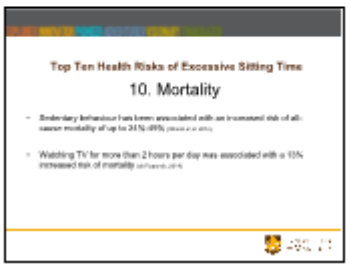


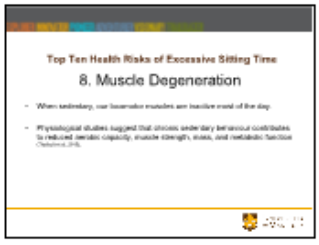












Appendix 16. Study 3 Ethics Approval Certificate

UNIVERSITY OF MANITOBA | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Email: humanethics@umanitoba.ca

PROTOCOL APPROVAL

TO: **Navjot Pachu** **(Advisors: S. Webber & S. Strachan)**
Principal Investigator

FROM: **Zana Lutfiyya, Chair**
Education/Nursing Research Ethics Board (ENREB) [redacted]

Re: **Protocol #E2018:022 (HS21614)**
"The effects of a self-affirmation intervention on the processing of sedentary behavior health risk information and psychosocial cognitions related to sedentary behavior change"

Effective: February 28, 2018 **Expiry:** February 28, 2019

Education/Nursing Research Ethics Board (ENREB) has reviewed and approved the above research. ENREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*.

This approval is subject to the following conditions:

1. Approval is granted only for the research and purposes described in the application.
2. Any modification to the research must be submitted to ENREB for approval before implementation.
3. Any deviations to the research or adverse events must be submitted to ENREB as soon as possible.
4. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.
5. A Study Closure form must be submitted to ENREB when the research is complete or terminated.
6. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

Funded Protocols:
- **Please mail/e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer in ORS.**

Appendix 17. Study 3 Recruitment Poster

Appendix 18. Personal Attributes Inventory

Self-Affirmation Condition Survey

For each item: ____Yes ____No

IF YES, EXAMPLE:

1. Have you ever forgiven another person when they have hurt you?
2. Have you ever been considerate of another person's feelings?
3. Have you ever been concerned with the happiness of another person?
4. Have you ever looked out for another person's interests before your own?
5. Have you ever been generous and selfless to another person?
6. Have you ever attended to the needs of another person?
7. Have you ever tried not to hurt the feelings of another person?
8. Have you ever felt satisfied when you've helped another person?
9. Have you ever gone out of your way to help a friend even at the expense of your own happiness?
10. Have you ever found ways to help another person who is less fortunate than you?

*A text box will be located under each item so if participants answer with a "yes" to any item, they can describe the event in writing.

Appendix 19. Personal Opinions Survey

Non-Affirmation Condition Survey

For each item: ____Yes ____No

IF YES, WHY?

1. I think the color blue looks great on most people.
2. I think that chocolate is the best flavor for ice cream.
3. I think that winter is the most satisfying season during the year.
4. I think that the most aromatic trees in the world are pine trees.
5. I think that cooking is an important skill to possess.
6. I think houseplants help to brighten a home.
7. I think that sewing is an important skill to possess.
8. I think that the beach is a great place to vacation.
9. I think that the subway is the best form of public transportation.
10. I think that fruit makes the best dessert.

*For each item participants will be provided with a text box in which they will be able to describe why they agree with the statement.

Appendix 20. Sedentary Behavior Health Risk Information