EXAMINING CHANGES IN THE PHYSICAL ACTIVITY, HEALTH-RELATED QUALITY OF LIFE, AND PSYCHOLOGICAL DISTRESS OF FIRST YEAR UNIVERSITY STUDENTS

by

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BHK, The University of British Columbia, 2011

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

in

THE COLLEGE OF GRADUATE STUDIES

(Interdisciplinary Studies)

[Health and Exercise Sciences]

THE UNIVERSITY OF BRITISH COLUMBIA

(Okanagan)

September 2013

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Abstract

Once thought to be a period of optimal health, young adulthood is now being associated with numerous health concerns. Particularly, individuals transitioning out of high school and into university are most susceptible to disproportionate declines in rates of physical activity. The purpose of the present study was to test the effects of a pedometer-based intervention on the physical activity behaviour, health-related quality of life (HRQOL), and psychological distress of first year university students. Participants were randomly assigned to either an intervention group, where they received a personal pedometer and monthly follow-up emails, or a control group, where participants received no lifestyle modification treatment. Intervention participants were asked to track their steps on a monthly calendar for 3 months and aim for a daily goal of 10,000 steps. Data were analyzed using split-plot repeated measures MANOVA/ANOVA. Findings indicated that the pedometer-based intervention failed to produce any significant differences between the intervention and control group for physical activity, $F(3, 165) = 1.29, p = .28$, HRQOL, $F(2, 176) = .22, p = .80$, or psychological distress, $F(1, 176) = .13, p = .72$, from baseline to follow-up. A significant main effect for time indicated that all participants experienced an increase in mild physical activity, $F(1, 167) = 7.08, p < .01$, and psychological distress, $F(1, 176) = 20.67, p < .001$, and a decrease in vigorous physical activity, $F(1, 167) = 4.13, p = .04$, and mental health status, $F(1, 177) = 16.43, p < .001$, across the duration of the study. No change in moderate physical activity, $F(1, 167) = .76, p = .39$, or physical health status, $F(1, 177) = .06, p = .81$, was observed. These results support the need to address specific health concerns in first-year university students and suggest several implications for future interventions.
Preface

Ethical approval for this project was obtained from the University of British Columbia Okanagan’s Behavioral Research Ethics Board (H12-01945).
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Acknowledgements

I would like to begin by acknowledging my numerous mentors for their continued support which has allowed me to grow both professionally and personally throughout my time spent at UBC Okanagan. I would like to thank my supervisor, Dr. Cristina Caperchione, for her undaunting support and belief in my abilities throughout the year. I look forward to working with you on future endeavors, and yes, I may come back to do a PhD, someday. I would also like to thank my committee for their support and guidance in completing this thesis. A special thank you to Dr. Sally Willis-Stewart for sparking my passion in health promotion and providing boundless encouragement and support over the years. Josh Stehmeier and Meghan Freeburn for our numerous philosophical, and often heated discussions in the “Think Tank”, which I still refuse to call the PHAB Lab. Furthermore, I would like to thank the countless unnamed faculty, staff and students of UBC Okanagan for their insight and help.

Finally, I wish to express my sincerest thanks to my family and friends for their support and encouragement of my academic pursuits throughout the years. I couldn’t have done it without you.
1 Introduction

1.1 Layout of Thesis

This thesis has been organized into six sections. Chapter one provides an overview and introduces the overall purpose for the present research. Chapter two presents a review of literature that will set the foundation for the present thesis by reporting on the existing literature regarding university student’s physical activity, HRQOL, and psychological health, as well as previous physical activity interventions conducted on the young adult population. Emphasis will be placed on the critical transitional period as individuals enter post-secondary education. Chapter three outlines, in detail, the methodology of the randomized control trial designed to investigate changes in physical activity, HRQOL, and psychological distress of first year students undertaking a 12-week pedometer intervention. Chapters four and five detail and discuss the results of the intervention. The sixth and final chapter provides a summary of conclusions, strengths, and limitations of the present research.

1.2 Overview

Population health trends have led to growing concerns over the effect physical inactivity has on an individual’s health. Across developed countries rates of obesity and associated health concerns are on the rise in all age groups (Stevens et al., 2012). The ramifications of physical inactivity were once thought to become apparent only later in life, however, precursors to chronic disease are developing as early as the second and third decades of life (Barton, Baretella, & Meyer, 2012; Strong et al., 1999). For example, in a sample of 564 university students, 60% had a body fat percentage above
desirable levels accompanied by unfavorable levels of cholesterol, triglyceride, and serum glucose (Sacheck, Kuder, & Economos, 2010). Researchers concluded that excess body mass and low physical fitness were associated with several metabolic risk factors that increase students’ risk of chronic disease (Sasceck et al., 2010). Research has consistently revealed that lifestyle behaviours of the young adult population are putting individuals at an increased risk for the development of numerous chronic diseases later in life (Sparling, 2003). Encouragingly, the majority of the negative health outcomes that arise from physical inactivity are largely preventable with lifestyle changes.

Using physical activity as a preventative approach to many negative health outcomes is well documented and widely recognized. Engaging in regular physical activity is associated with the prevention and management of over 25 chronic conditions including coronary artery disease, stroke, hypertension, diabetes, osteoporosis, and several types of cancer (Katzmarzyk & Ardern, 2004; Warburton, Nicol, & Bredin, 2006; Warburton, Charlesworth, Ivey, Nettleford, & Bredin, 2010). Individuals who maintain an active lifestyle show positive changes in fitness, general health, and overall longevity. Even low levels of physical activity can reduce anxiety, stress, and depression and improve mood and cognitive functioning (McKercher et al., 2009; Stewart-Brown et al., 2000). Individuals who participate in regular activity report higher self-esteem, improved sleep patterns, and generally feel more energetic (Penedo & Dahn, 2005).

To achieve these benefits, a clear dose response relationship exists between levels of physical activity and health benefits (Warburton et al., 2010). It is suggested that this relationship is likely curvilinear, whereby the largest increase in health benefits is seen when the least active individuals make minor increases in their physical activity levels.
Systematic reviews indicate that a physical activity energy expenditure of approximately 1000 kcal per week is associated with a 20-30% reduction in all-cause mortality, with greater benefits being achieved at higher volumes and intensities of exercise (Warburton et al., 2006). To disseminate these values, considerable effort has been made to develop national guidelines that promote an active lifestyle.

The Canadian Physical Activity Guidelines for Adults (Tremblay et al., 2011) recommend that, to achieve health benefits, adults age 18-64 should accumulate at least 150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of ten minutes or more. It is also beneficial to add muscle- and bone- strengthening activities that use major muscle groups, at least 2 days per week. More physical activity provides greater health benefits (Tremblay et al., 2011). Consistent with global recommendations, these guidelines are widely accepted as important components to a healthy lifestyle. Despite compelling evidence supporting the benefits of regular physical activity, population statistics consistently report poor rates of adherence.

A representative sample of Canadian adults showed that 85% were not sufficiently active to meet these guidelines (Colley et al., 2011). Further, individuals spent approximately 9.5 hours per day, or 69% of waking hours, performing sedentary activities (e.g., car travel, sitting, reclining, standing; Colley et al., 2011). These results indicate that a large portion of adults are foregoing the benefits of physical activity and putting themselves at risk for significant health concerns.

Unfortunately, the trend of inactivity is becoming more apparent in younger generations as well. The transition to young adulthood has been identified as a period for
dramatic declines in physical activity rates (Irwin, 2004; Kwan, Cairney, Faulkner, & Pullenayegum, 2012). Of particular concern, these trends are often more pronounced among individuals who attend post-secondary education. A meta-analysis of post-secondary students found that 40-50% of students were physically inactive (Keating, Guan, Pinero, & Bridges, 2005). International data from 23 countries suggest that the prevalence of inactivity may be even higher, reporting that 70% of university students were insufficiently active to achieve health benefits (Haase, Steptoe, Sallis, & Wardle, 2004). Furthermore, the transitional nature of young adulthood, in combination with academic burdens, often has adverse effects on an individual’s health-related quality of life (HRQOL) and psychological well-being (Inam, Saqib, & Alam, 2003; Kadison & DiGeronimo, 2004), resulting in increased levels of depression, anxiety, stress, and negative mood (Regehr, Glancy, & Pitts, 2013). Importantly, these declines in physical activity (Bray & Born, 2004) and well-being (Gall, Evans, & Bellerose, 2000) begin to manifest at the immediate onset of post-secondary education.

Understandably, university students have been identified as an important population for health promotion efforts (Budgen et al., 2011; Laska, Pelletier, Larson, & Story, 2012). As physical activity trends during this period often persist throughout the years spent at university (Keating et al., 2005), several benefits may be accrued by preemptively mitigating declines. First, if positive physical activity behaviors are reinforced early, the risk of associated chronic diseases may be reduced later in life. Second, the promotion of regular physical activity may contribute to the improvement of HRQOL and psychological well-being (Hawker, 2012).
One promising intervention tool to increase physical activity participation is the use of personal step counters, known as pedometers (Tudor-Locke & Bassett, 2004). The first pedometer was manufactured in Japan in 1965, called a manpo-kei, which translates to a “10,000 steps meter”. The goal of 10,000 steps, equivalent to 4-5 miles of walking (Choi, Pak, Choi, & Choi, 2007), remains a commonly promoted target. Pedometer-based interventions can significantly increase the physical activity of healthy adults (Bravata et al., 2007; Richardson et al., 2008; Kang, Marshall, Barreira, & Lee, 2009). Among university students, Jackson and Howton (2008) showed that pedometer counts increased from 7,000 steps per day to almost 10,000 steps over a 12-week period. Additionally, the portion of students performing sedentary or low physical activity was reduced from 65% to 25% during this time (Jackson & Howton, 2008).

Previous research on post-secondary students physical activity has focused primarily on the anthropometric and physical benefits (Keating et al., 2005; Laska et al., 2012), disregarding many of the psychological benefits. As psychological health concerns are abundant in university students, it is important to explore the additional psychological health benefits associated with increased physical activity (Jackson & Howton, 2008).

1.3 The Current Study

The purpose of this study was to explore the effects of a pedometer-based intervention on the physical activity rates, HRQOL, and psychological distress of first year students transitioning out of high school. This was addressed by conducting a 12-week randomized control trial in 184 students. Intervention participants were provided with a personal pedometer, monthly step logs, and monthly emails. Intervention
participants were encouraged to log their steps daily and aim for a goal of 10,000 steps per day. All participants completed self-reported measures of physical activity, HRQOL, and psychological distress at baseline and 12-week follow-up.

1.4 Hypotheses
It is hypothesized that:

1. Participants assigned to the intervention group will report greater levels of physical activity than the control group, from baseline to follow-up.

2. Intervention participants will report greater HRQOL and less psychological distress than the control group, from baseline to follow-up.
2 Review of Literature

2.1 Young Adulthood: A Unique Transitional Stage

Over the past half-century, population-level demographic shifts towards higher education, delayed marriage, and delayed childbearing have lengthened the transition to adulthood into a more defined stage of life. This period of “emerging adulthood” (age 18-25 years) has been considered a distinct cohort due to the exploratory and volitional nature of these individuals (Arnett, 2008). The transitional stage begins with high school graduation and involves a complex process in which individuals gain financial, emotional, and residential independence (Park, Mulye, Brindis, & Irwin, 2006). This period is characterized by change, such as leaving home, beginning post-secondary education, and exploring possible life directions in love, work, and worldviews. Recent research has shown that the most substantial changes in personality traits occurs during this transition, with notable disparities between individuals on different life paths (Lüdtke, Roberts, Trautwein, & Nagy, 2011). For example, individuals attending university were found to show lower increases in conscientiousness and higher increases in agreeableness than their more vocationally oriented peers. Once considered an age of optimal health, the transition from adolescence to young adulthood is now more recognized as an important period for the onset of many negative health behaviours (Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008). More specifically, the dramatic change in lifestyle during this time may have profound effects on the physical activity rates, quality of life, and psychological well-being of this population.

An increasing number of young adults are pursuing post-secondary education. During the 2009/2010 school year, 40% of Canadian young adults age 18-24 years attended college or university (Public Health Agency of Canada, 2011). The time spent at
university typically involves numerous sedentary pursuits (Keating et al., 2005). University students are faced with a combination of recreational (e.g., T.V, computer games) and obligatory (e.g., class time, studying) sedentary behaviour. Undergraduates individuals reported upwards of 30 hours a week of sedentary behaviour spread between studying, computer use, and watching TV/videos (Buckworth & Nigg, 2004). In addition to alarming rates of sedentary behaviour, declining rates of physical activity are also a concern. For many, the transition to university marks the most profound decline in physical activity rates experienced in their lifespan (Kwan et al., 2012; Sparling & Snow, 2002).

2.2 Physical Activity and the Transition to University

Physical activity is known to decrease across a lifetime, however, the rate of decline is not linear. Major life events have a strong effect on physical activity behaviour (Engberg et al., 2012). A recent Canadian study examined age-related declines in physical activity between adolescence and midlife. The percentage of individuals undertaking ≥5 hours of physical activity per week decreased from 70% to 17% during this period (Larouche, Laurencelle, Shephard, & Trudeau, 2012). Investigators highlighted four important transitional periods as adolescence, the beginning of postsecondary education, entry into the labor market, and parenthood (Larouche et al., 2012).

Transitioning from adolescence to young adulthood is of particular interest as this period is associated with significant lifestyle changes (Terenzini et al., 1994). Cross-sectional (Barnett, Gauvin, Craig, & Katzmarzyk, 2007) and longitudinal data (Kwan et al., 2012) have demonstrated that the transition to early adulthood is a critical period of
disproportionate declines in physical activity. Kwan et al. (2012) found that individuals’ physical activity levels decreased on average 24% during the transition to young adulthood. Furthermore, Larouche et al. (2012) reported that physical inactivity increased almost 4-fold among individuals that transitioned into post-secondary education. In a sample of Canadian young adults, the portion of students performing adequate levels of vigorous physical activity dropped from 66% during high school to 44% during their first 8 weeks at university (Bray & Born, 2004). One third of these students who were active in high school became insufficiently active to gain health benefits once at university (Bray & Born, 2004). Males transitioning into post-secondary education appear to be the most susceptible to steep declines; however, their female counterparts were significantly less active at baseline (Kwan et al., 2012).

Following the dramatic initial decline, research suggests that physical activity will remain particularly low throughout years spent at university. Irwin (2007) assessed the prevalence of physical activity maintenance in a sample of Canadian university students and found that the portion of students that met the Canadian Physical Activity Guidelines dropped from 51% at baseline to 35% at 1-month follow-up. Racette, Deusinger, Strude, Highstein, & Deusinger (2005) found that 30% of first year students reported no physical activity during the fall semester. During the spring semester of their second year, rates of physical activity showed little change with 29% of students still reporting no physical activity. Perhaps most concerning is that these trends of inactivity, when established during an individual’s time at post-secondary school, are often carried across their adult years (Sparling & Snow, 2002; Calfas, et al., 2000; Gall, et al., 2000). Additionally, physical inactivity in young adults is directly correlated with the incidence of disease,
diabetes, hypertension, cancer, and obesity later in life (Leslie, Sparling, & Owen, 2001; Keating et al., 2005).

2.3 HRQOL and Psychological Distress During the Transition to University

In addition to dramatic declines in physical activity, the transition to young adulthood is also coupled with considerable psychological health concerns. Canadian population health surveys report higher levels of stress and depression among the young adult population when compared to their older counterparts (Stephens, Dulberg, & Joubert, 1999). In a cross-sectional sample of 9,953 Ontarians, nearly 25% of young adults aged 15-24 suffered from one or more psychiatric disorders, whereas middle aged and older adults reported a significantly lower prevalence. In fact, researchers have found that the majority of psychological and cognitive disorders have their origins during young adulthood, prior to the age of 24 (Horwath, Johnson, Klerman, & Weissman, 1992; Kessler et al., 2005).

Comparable to rates of physical activity, these problems are often exacerbated among individuals attending post-secondary education. It is suspected that the academic stress, changing interpersonal relationships, and irregular sleep patterns of university students result in a considerably higher prevalence of psychological stress (Inam et al., 2003; Kadison & DiGeronimo, 2004). In fact, Stallman (2008) estimated the prevalence of mental health problems among university students at 19%, with 67% reporting clinically recognizable symptoms. Further, the incidence of distress was associated with lower academic achievement (Stallman, 2010). Adlaf, Glikman, Demers, & Newton-Taylor (2001) used the 12-item General Health Questionnaire (GHQ-12) on a national sample of 7,800 Canadian undergraduate students to assess mental health. Results
suggested that 30% of students in the sample reported elevated psychological distress, significantly higher than that of the general Canadian population. Roberts, Golding, Towell, & Weinreb (1999) measured British university students using the GHQ-12 and found that 29% of students reported mental health scores greater than the population mean for their respective age and sex. Similar to declines in physical activity, negative psychological effects begin early at the onset of post-secondary education. Gall et al. (2000) found that Canadian undergraduate students reported their lowest levels of well-being upon entry into university. A meta-analytic review suggested that these results are consistent with several other international studies (Regehr et al., 2013). A large longitudinal study in the United Kingdom involving 16,460 undergraduate students observed changes in anxiety and depression over the course of their university careers (Bewick, Koutsopoulou, Miles, Slaa, & Barkham, 2010). Student anxiety scores were highest in their second and final year at university, whereas depression scores rose steadily over time. At no point during university did psychological distress fall to pre-admission levels (Bewick et al., 2010). A Turkish study of 1,616 university students reported rates of moderate depression in 27%, anxiety in 47%, and stress in 27% of the sample (Bayram & Bilgel, 2008). Finally, in a sample of 729 American college students, only 16% reported no symptoms of depression, while 30% reported moderate depression and an additional 23% reported moderately severe or severe depression (Garlow et al., 2008). Vaez, Voss, & Laflamme (2010) found that HRQOL deteriorated across time spent at university and found strong associations with psychosomatic symptoms, such as depression, stress, and anxiety. HRQOL is also negatively associated with chronic disease, chronic pain, a visit to a clinical specialist, and a visit to the emergency room in
the past year (Klemenc-Ketis, Kersnik, Eder, & Colaric, 2011). The promotion of a physically active lifestyle may have positive influences on an individuals’ quality of life and psychological well-being. A growing body of literature supports the benefits that increased levels of physical activity have upon stress, anxiety, depression, and overall well-being (Penedo & Dahn, 2005).

2.4 Physical Activity, HRQOL, and Psychological Distress

It is well understood that increased levels of physical activity have positive physical benefits, however, unbeknownst to many, are the numerous psychological benefits. A positive correlation between physical activity and the reduction of mental health problems has been consistently demonstrated (Tyson, Wilson, Crone, Brailsford, & Laws, 2010). Physical activity as an intervention for treating anxiety is as effective as any other medication free treatment (Biddle and Mutrie, 2008). Epidemiological research provides convincing evidence of the beneficial effects of physical activity on anxiety and depression (Stathopoulou, Powers, Berry, Smits, & Otto, 2006; Teychenne, Ball, & Salmon, 2008). Hawker (2012) performed a literature review on physical activity and mental health in student nurses and hypothesized that promoting physical activity will not only improve physical health, but also improve mental health through increases in self-esteem and life satisfaction in combination with decreased anxiety and depression. In fact, it appears that even relatively short durations of leisure physical activity are associated with better mental health (McKercher et al., 2009; Stewart-Brown et al., 2000). A cross-sectional study of physical activity and depression in young adults found that as little as 1.25 hours per week of leisure time physical activity was associated with a 45% lower prevalence of depression in women (McKercher et al., 2009). This is
consistent with several studies reporting that moderate levels of exercise significantly increase life satisfaction (Grant, Wardle, Steptoe, 2009; Thogersen-Ntoumani, Fox, & Ntoumanis, 2005). In a sample of 17,246 university students from 21 countries, physical activity was positively associated with life satisfaction and psychological well-being (Grant et al., 2009). Furthermore, Bray & Born (2004) found that active students reported lower levels of tension and fatigue along with higher levels of vigor when compared with those who were insufficiently active.

2.5 Promoting Physical Activity in Universities

University campuses themselves offer a unique opportunity to target physical activity. Universities can provide a supportive environment through pedestrian-friendly campuses, healthy living courses, promotional programs, and various other avenues (Sparling, 2007). Universities are well positioned to promote physical and mental health among young adults because they encompass several important aspects of students lives including academics, health services, residences, social networks and extracurricular activities (Mowbray et al., 2006). Additionally, universities provide access to a large, receptive, and diverse population not common in the general public, making them an optimal location for physical activity promotion (Eisenberg, Goldberstein, & Gollust, 2007; Leslie et al., 2001).

The accumulated evidence suggests that young adults entering post-secondary education present a critical window of opportunity for physical activity and health promotion efforts for several reasons: (1) The transitional nature of the young adult population leaves individuals at risk for negative lifestyle behaviours and health concerns; (2) The commencement of post-secondary education coincides with a dramatic
decline in physical activity rates; (3) The promotion and management of physical activity may have consequential positive effects on other common health concerns among university students including high levels of stress, anxiety, depression, and diminished well-being; and (4) The university setting offers a unique opportunity to influence the health behaviours of a large diverse audience, atypical of the general adult population. Unfortunately, physical inactivity among young adults has been a less publicized issue than other health concerns, such as the reduction of smoking and problem drinking (Kwan et al., 2012). This focus has overshadowed other key health behaviours, including the promotion of physical activity (Sparling, 2007).

2.6 Physical Activity Promotion

Health promotion efforts are devised with the objective to reduce negative behaviour (e.g. sedentary activities) and promote positive behaviour (e.g. physical activity; Nahas, Goldfine, & Collins, 2003). However, research suggests that individuals will not change their behaviour simply because evidence indicates they should. For example, merely providing information to young adults on the benefits of physical activity is not effective in facilitating changes in physical activity behaviour (Nahas et al., 2003). Instead, contemporary research attempts to utilize supported intervention techniques to elicit behaviour change. Rapidly advancing technologies have resulted in the development of several mechanical devices to help promote physical activity. One such device is known as a pedometer.

2.6.1 Pedometer Utilization

Pedometers are simple mechanical tools that offer an estimate of ambulatory physical activity (i.e., walking behaviour) in the form of steps taken. These small motion
sensor devices, traditionally worn on the hip, are used to calculate the number of steps taken over a period of time (Tudor-Locke, Bassett, Shipe, & McClain, 2011; Tudor-Locke & Lutes, 2009). One of the greatest benefits of pedometers is their ability to provide a quantifiable measure of physical activity behaviour. Feedback provided by the pedometer is immediate and personalized. Unfortunately, pedometers are limited in measuring physical activities other than walking. Pedometers use a pendulum-style mechanism that must remain vertical otherwise their accuracy falters (Tudor-Locke & Lutes, 2009). For example, activities such as cycling or swimming will not produce a reliable measure of activity level because the pedometer is tilted off the vertical plane. Additionally, traditional pedometers do not measure activity intensity (Tudor-Locke & Lutes, 2009), limiting their utility in measuring activities that require higher energy expenditure such as running or pushing a lawn mower. For this reason, pedometers may not be as useful in populations that already perform high levels of moderate-to-vigorous physical activity (Tudor-Locke & Lutes, 2009). While the use of a more expensive devise (e.g., accelerometer) would provide more accurate data, pedometer-based interventions have grown in popularity over the past decade due to their cost-effectiveness, ease of implementation, and ability to increase rates of physical activity in a large and diverse population (Bravata et al., 2007). Further, the information provided to the end user is more easily understood and readily available than that of an accelerometer (Tudor-Locke & Lutes, 2009). As such, pedometers have been increasingly used to promote physical activity in epidemiological research (Koring et al., 2013; Croteau, Richeson, Vines, & Jones, 2007; Clarke et al, 2007). A large-scale systematic review of physical activity interventions identified pedometers as a valuable means of increasing
rates of physical activity among healthy adults (Greaves et al., 2011). Three recent meta-analyses examined the impact of pedometer-based interventions on the healthy adult population and indicated increased walking behaviour (Bravata et al., 2007) and overall physical activity (Richardson et al., 2008) as well as modest reductions in weight among participants (Kang et al., 2009). On average, pedometer-based interventions were found to have a moderate effect size (0.68) and increase physical activity by approximately 2,000 steps per day (Kang, et al., 2009). However, it is important to note that participants in pedometer-based interventions have been predominantly women of low activity levels (4,500-7,000 steps per day) who were overweight at baseline. It is unclear how these results translate to other populations. Further, it is unknown whether it is possible to continue to increase benefits over long-term adherence. Richardson et al. (2008) identified pedometer interventions ranging from 4 weeks to 1 year. Of the reviewed studies, a longer duration was associated with greater weight loss. It is also unknown the extent to which these observed changes are sustained, however, Chan & Tudor-Locke (2008) reported promising evidence to this regard. In their study of individuals living with type two diabetes, participants increased daily steps from approximately 7,800 steps/day to 12,000 steps/day at the conclusion of the 12-week intervention. At the 1-year follow-up, participants’ steps per day remained elevated at approximately 11,000 steps/day, indicating that, although pedometer steps deteriorated slightly, overall ambulatory physical activity remained elevated from baseline (Chan & Tudor-Locke, 2008).
While the literature provides clear evidence that pedometers help to increase physical activity, much less is know about why they work. In an attempt to better understand why pedometers work, behaviour change theories are used.

2.6.2 Theoretical Underpinning

Behaviour change theories help direct research through their explanatory power in studying the biological, structural, and psychological foundations of a behaviour (Nigg, Borrelli, Maddock, & Dishman, 2008). However, among pedometer-based interventions, a specific theoretical model is often not used (Lutes & Steinbaugh, 2010; Tudor-Locke & Lutes, 2009). Lutes & Steinbaugh’s (2010) review of literature on the use of theoretical models in pedometer interventions reported that less than 25% of studies cited a specific theory.

Currently, there is a debate in the literature regarding how theory should be used in interventions. Some researchers have called upon physical activity interventionists to utilize all constructs within a theory and avoid combining multiple theories so that the explanatory power of that theory may be evaluated (Painter, Borba, Hynes, Mays, & Glanz, 2008). Contrarily, many contend that only pertinent theory-derived constructs should be used (Abraham & Michie, 2008; Greaves et al., 2011; Lutes & Steinbaugh, 2010). It is argued that using a collection of core constructs is a more realistic and appropriate approach in which redundancies are eliminated. Lutes and Steinbaugh (2010) emphasize that there needs to be a shift away from the development of a single theory for the foundation of all physical activity interventions, to a more integrative approach using multiple theory-supported constructs and techniques.
With regards to this thesis, the constructs of self-regulation, derived from Bandura’s Social Cognitive Theory (SCT) will be the foundation of the present intervention (Bandura, 2004; Lutes & Steinbaugh, 2010; Tudor-Locke & Lutes, 2009). According to SCT, the main contributors to physical activity behaviour change are outcome expectations, social/environmental support, self-regulation, and self-efficacy. However, certain constructs play a larger role than others. Self-efficacy and self-regulation commonly emerge as two of the strongest predictors of physical activity behaviour (Anderson, Wojcik, Winett, & Williams, 2006; Tudor-Locke & Lutes, 2009). Further, Anderson et al. (2006) found that, when the effects of self-regulation were controlled for, self-efficacy had little effect on physical activity. Similarly, in a sample of young adults, social cognitive determinants of physical activity were evaluated (Rovniak, Anderson, Winett, Stephens, 2002). Results indicated that SCT explained 55% of the variance observed in physical activity. Consistent with previous research (Anderson et al., 2006; Bandura, 2004), self-regulation was found to mediate self-efficacy and be the most influential social-cognitive variable in the model. Thus, young adults with greater self-regulatory skills may be more likely to engage in physical activity (Rovniak et al., 2002). Accordingly, interventions targeting the improvement of participant’s self-regulatory skills have been found to significantly influence physical activity behaviour (Doerksen, Umstattd, & McAuley, 2009; Greaves et al., 2011). Self-regulation involves skills for planning, organizing, and managing physical activity behaviour (Bandura, 1997). Among pedometer-based interventions, the self-regulatory techniques of self-monitoring and goal setting have been identified as important elements of successful interventions (Bravata et al., 2007; Tudor-Locke & Lutes, 2009).
Self-monitoring techniques are central to the process of self-regulation because it requires an individual to pay deliberate and detailed attention to a specific behaviour (Bandura, 1998; Bandura, 2004). By encouraging an individual to monitor their rates of physical activity and be aware of recommended guidelines, a greater increase in that particular behaviour has resulted. Self-monitoring is a common component among physical activity interventions (Greaves et al., 2011), including those targeted at young adults (Jackson & Howton, 2008; Leslie et al., 2001; Sallis, Calfas, Alcaraz, Gehrman, & Johnson, 1999). For example, a 9-week pilot study conducted with Canadian university students used an online self-reported record-keeping tool to track physical activity in two of three intervention groups (Cholewa & Irwin, 2008). Physical activity significantly increased among individuals that used the physical activity logbook in the record-keeping only and combination groups.

As previously mentioned, the cumulative and readily available feedback provided by pedometers proves to be an excellent tool for self-monitoring (Tudor-Locke & Lutes, 2009). Pedometer use is complimented when combined with a record-keeping tool that helps to reinforce physical activity behaviour. Bravata’s systematic review (2007) of pedometer-based interventions found that studies utilizing step logs (i.e., tracking steps on a simple monthly calendar) were significantly more effective than those that did not. Participants reported that the act of tracking pedometer data provided additional visual feedback, illuminated behavioural patterns, and produced a quantifiable record of personal success (Croteau, 2004; Heesch, Dinger, McClary, & Rice, 2005; Lauzon, Chan, Myers, & Tudor-Locke, 2008). Researchers further noted that requiring
participants to submit their data provided an additional sense of accountability (Heesch et al., 2005).

Another important predictor of increased physical activity is the use of goal setting (Bravata et al., 2007, Pearson, 2011). Goal setting is a powerful approach to direct attention and effort towards activities relevant to a goal away from unrelated activities (Locke & Latham, 2002). Importantly, Locke & Latham (2002) report that, when a goal is assigned to a new task, individuals will engage in deliberate planning to develop strategies that will allow them to attain that goal. Therefore, by incorporating daily step goals into pedometer-based interventions, it is believed that participants will be motivated to increase their rates of physical activity behaviour. In fact, in Bravata’s review of pedometer-based interventions (2007), the three studies that did not use step goals resulted in no significant effect on physical activity levels. When used in combination, step logs and step goals demonstrate significantly greater increases in physical activity among pedometer-based interventions (Greaves et al., 2011).

As discussed previously, a daily goal of 10,000 steps is often recommended for health benefits. The value itself is simple and easy to remember (Tudor-Locke & Bassett, 2004). Individuals that accumulate at least 10,000 steps per day have less body fat, lower blood pressure, and lower resting heart rate than less active individuals (Chan et al., 2004; Tudor-Locke & Bassett, 2004). Furthermore, individuals obtaining at least 10,000 steps per day tend to also meet physical activity recommendations of 30 minutes of moderate activity per day (Welk et al., 2000). The value itself is equivalent to an energy expenditure of 300 to 400 kcal/day, depending on walking speed and body type (Le Masurier, Sidman, & Corbin, 2003). In comparison, thirty minutes of moderate intensity
activity is equal to about 150kcal/day. Krumm, Dessieux, Andrews, & Thompson (2006) explored differences in goals by placing individuals into either a 10,000 steps or 30 minutes per day walking group. Individuals in the 10,000 steps group walked on average 1,900 more steps per day than the 30 minute group.

2.7 Interventions Targeting University Students

According to the seminal meta-analysis conducted on post-secondary students’ physical activity behaviours (Keating et al., 2005), most studies have focused on describing student physical activity patterns, physical activity determinants, and stages of behaviour change. Only 3 physical activity interventions were conducted prior to this analysis, Project GRAD, Project TEAM, and Project ARTEC (Buckworth, 2001; Leslie et al., 2001; Zabinski, Calfas, Gehrman, Wilfley, & Sallis, 2001). All three programs used a curricular-based approach focused on SCT and the Transtheoretical Model. Outcome measures included physical activity adherence, physical fitness, and anthropometric measures. Sample sizes in each of the programs were in the hundreds, however, only one (Project GRAD) utilized a control group. Researchers reported only a small effect (.03-.13) on physical activity following the 15-week intervention (Sallis et al., 1999) and no long-term effects at 2-year follow-ups (Calfas et al., 2000).

A recent systematic review that targeted weight gain prevention in young adults identified 37 studies assessing weight, BMI, body composition, diet, and/or physical activity, as primary outcomes (Laska et al., 2012). Researchers noted that the majority of interventions conducted on young adults have taken place within universities and focused on weight loss, rather than weight gain prevention. Of the reviewed studies, six focused specifically on physical activity (Cardinal, Jacques & Levy, 2002; Claxton & Wells,
22

2009; Jackson & Howton, 2008; Jung & Heald, 2009, Sallis et al., 1999; Ornes & Ransdell, 2007; Parrott, 2006). Three of these studies reported positive effects on rates of physical activity (Jackson & Howton, 2008; Ornes & Ransdell, 2007; Parrott, 2006), while others reported mixed or null results (Cardinal et al., 2002; Claxton & Wells, 2009). Researchers concluded that there is an urgent need to develop effective weight gain prevention strategies for young adults and highlighted several promising areas for future research. Notably, Laska et al. (2012) identified the use of self-regulatory techniques as an important intervention tool for future studies.

2.7.1 Pedometer-based Physical Activity Interventions Targeting University Students

Given the success of pedometer-based interventions in the general adult population, it is important to see how these results translate to other cohorts. Unfortunately, it is only within the past half-decade that pedometers have been used as tools for health promotion among university students. Tully and Cupples (2011) aimed to determine the feasibility of conducting a 10,000 step pedometer intervention in the university setting. Twelve sedentary (n=12) students were randomly assigned to a 6-week intervention or control group. Both groups conducted pre and post measures of height, weight, hip circumference, and aerobic fitness as well as recorded daily step counts. Participants in the intervention group were asked to accumulate 10,000 steps whereas the control group was asked to not modify any aspect of their lifestyle. Participants in the intervention group successfully increased their daily steps to meet the goal of 10,000 steps per day, whereas no significant change in daily steps was found for control participants. Further, blood pressure was significantly reduced among intervention participants. No change in physical fitness or anthropometric measures were
found. Researchers suggested that an unsupervised walking program may lead to a significant increase in physical activity in sedentary university students.

Jackson and Howton (2008) conducted a curriculum-based pedometer intervention to observe differences in walking behaviour according to body mass index (BMI). Students (n=326) wore a pedometer, developed personal step goals, and logged their steps each day. Researchers examined differences between student’s average steps based on their weight status; underweight, normal weight, or overweight. Encouragingly, all groups experienced a significant increase in steps taken during the 12-week intervention with the greatest increases observed among normal and overweight participants. Researchers noted that an emphasis should be placed on health benefits rather than weight management to maximize the efforts from all participants. It was further speculated that by increasing physical activity in first- and second-year students, further declines throughout the college years could be mitigated. Participants indicated high satisfaction with the program, with 60% of participants indicating they would continue to wear the pedometer, were in better physical condition, and would participate in a similar project in the future (Jackson & Howton, 2008).

LeCheminant, Smith, Covington, Hardin-Renschen, and Heden (2011) conducted a randomized control pilot study in forty-six university freshmen throughout their first year at university. Contrary to others, results indicated no significant difference in physical activity rates or body composition between the control and 10,000 steps groups. However, by tracking ambulatory activity across a school year, specific trends of inactivity were illuminated. Results revealed that the physical activity rates of university students fluctuated throughout the academic year, with higher rates reported during the
beginning of terms and steep drop-offs during holiday seasons and weeks approaching exams.

Tayama et al. (2012) conducted a one-week pedometer-based intervention with thirty-nine female university students. Participants attended a 160-minute lecture on self-monitoring and goal setting prior to participating in one week of pedometer wearing. Researchers grouped students according to their baseline self-efficacy score and believed that participants with higher baseline self-efficacy would have greater improvements on physical activity and psychological stress. Among all groups, daily steps did not significantly increase between pre- and post-intervention measures. Researchers speculated that, although short duration pedometer interventions have been seen to significantly increase step counts among healthy adults, a one-week intervention may not be long enough to illicit change among university students. Regardless, researchers noted that step counts were higher in the high self-efficacy group than the low-self-efficacy group.

Future interventions should be devised based on previous successes with consideration of methodological limitations. Given their success in the general adult population, pedometer-based interventions may be a cost-effective and easily implemented strategy to promote physical activity among university students. However, the available evidence provides mixed results for pedometer-based interventions conducted on this population (Jackson & Howton, 2008; LeCheminant et al., 2011). Notably, sample sizes have been small in much of the current research and may be a cause for the ambiguity of findings (LeCheminant et al., 2011; Tully & Cupples, 2011). Finally, the current physical activity literature conducted on young adults and university
students focuses primarily on physical activity rates, fitness outcomes, and anthropometric measures (Keating et al., 2005). As psychological health concerns are exacerbated among this cohort, it is important to explore the psychological benefits that may be accrued by being physically active.
3 Methods

3.1 Participants

The present study utilized a convenience sample of full-time, first year university students from the University of British Columbia Okanagan (UBCO) campus. UBCO is a small but rapidly growing Canadian university campus located in Kelowna, British Columbia. The campus is located approximately 10 kilometers from the city centre and offers on-site student housing, food services, gymnasium, and walking trails. In the 2012/13 school year, UBCO encompassed a student body of just over 8,000 individuals including approximately 2,300 first year students and offers undergraduate degrees across 6 faculties.

This sample was chosen because: 1) It has been reported that poor physical activity adherence begins at the immediate onset of higher education and persists throughout (Kwan et al., 2012), and 2) The transitional nature of individuals entering young adulthood put them at greater susceptibility for poor physical activity adherence (Gordon-Larsen, Nelson, & Popkin, 2004, Nelson et al., 2008). The required sample size was calculated using the statistical concept of power and effect size. Based on the aforementioned literature, a medium effect size (0.5) was chosen for the present study. Using Cohen’s (1988) power table, it was estimated that a sample size of 64 participants per group (128 total) was needed to detect a significant difference between groups (2-tailed) with 80% power. Therefore, the total number of participants needed for the study was 128. Traditionally, it is recommended to recruit an additional 20% during behavioural research to account for participant attrition rates throughout the study (Dishman, 1988), however, researchers note a higher dropout rate among the young adult
population ranging from 30%-40% (Irwin, 2007; LeCheminant et al., 2011). Efforts were made to recruit a further 40 participants to account for an expected 30% attrition rate.

### 3.2 Recruitment

Participant recruitment was coordinated through professors of first year courses. Professors representing each of the six faculties at UBCO (School of Arts and Sciences, Faculty of Creative and Critical Studies, Faculty of Education, Faculty of Applied Science, Faculty of Health and Social Development, and Faculty of Management) were initially contacted via email. Efforts were made to contact professors from a broad set of disciplines to promote program diversity among participants. In the initial email ten professors were contacted; those who did not respond were sent a follow-up reminder email one week later. A second wave of emails was sent to an additional twenty professors to increase potential areas of recruitment. Non-respondents from the second wave were also sent a follow-up reminder email one week after their first email. Professors were provided with details of the study including their responsibilities, participant eligibility, and researcher contact information (Appendix A). Interested professors were encouraged to contact a researcher (Sharp or Caperchione), at which point questions were answered and final arrangements of dates and times were made. Ten professors of fifteen classes agreed to allow a researcher to address their students during class time. Summated registration for the fifteen classes was approximately 1,600 individuals, however the total reach of recruitment is likely much lower due to student absence, ineligibility, and overlap between classes.

Classroom recruitment was arranged for the beginning of Term 1 in early September 2012. The face-to-face classroom recruitment presentations lasted
approximately 10-15 minutes and included an introduction of the study, invitation to participate, overview of eligibility criteria, and a verbal explanation of the consent form. To be eligible for the study, individuals were required to be full-time undergraduate students at UBCO, graduated high school within the past year, 17 years of age or older, speak and read English fluently, and capable of performing ambulatory (walking) physical activity. Individuals who did not meet the eligibility criteria or had been told by their physician that they should not perform physical activity were not accepted into the study.

Eligible individuals were invited to meet with the researcher (Sharp) in the Physical Health and Activity Behavior Laboratory during pre-arranged office hours. During this time the purpose of the study and informed consent was explained once again, and any further questions or concerns were addressed. All students who agreed to participate and signed the informed consent form were entered to win an iPod Nano, which was drawn at the end of the study period (December 2012).

3.3 Measures

In addition to demographic variables, participants completed self-report measures of physical activity, HRQOL, and psychological distress using the Modified Godin Leisure-Time Exercise Questionnaire, 12-Item Short Form Health Survey, and General Health Questionnaire, respectively (Appendix B). Details of these measures are provided below.

3.3.1 Demographic information

Demographic information collected from participants included contact information, sex, date of birth, ethnicity, height, weight, employment status, housing
situation, and time spent engaging in sedentary behaviour (Appendix B.1). BMI was calculated based on participants self reported pre and post height and weight. These characteristics were collected for descriptive purposes.

3.3.2 Modified Godin Leisure-Time Exercise Questionnaire

Physical activity was measured using the modified Godin Leisure-Time Exercise Questionnaire (Irwin, 2007; Appendix B.2). The original questionnaire (Godin & Shephard, 1985) has been widely used to assess physical activity rates of varying populations and has demonstrated strong validity and test-retest reliability (Godin & Shephard, 1985; Sallis, Buono, Roby, Micale, & Nelson, 1993). The modified version, developed by Irwin (2007), was created for use in a sample of university students and reports physical activity results on three levels: mild, moderate and vigorous. This version instructs participants to consider a 7-day period and enter the number of days per week, approximate 15-minute blocks, and approximate 30-minute blocks of strenuous, moderate, and mild physical activity they performed. For example, if a person walks her dog twice a day for 15 minutes each time on Mondays, Wednesdays, and Fridays, she would indicate moderate activity on 3 days a week and a total of six (6) 10-15 minute blocks and zero (0) 30-minute continuous blocks (Irwin, 2007). One-week re-test reliability was conducted with 146 undergraduate students and validated using 1-week physical activity logs (Irwin, 2007). The modified questionnaire has since been used in a sample of 392 Canadian undergraduate students to determine physical activity rates and reported a significant correlation with physical activity logs (Irwin, 2007). Analysis of the results was conducted in accordance with Irwin’s methodology (2007) and recommendations (J. Irwin, personal communication, April 16, 2013).
### 3.3.3 12-Item Short Form (SF-12) Health Survey

The SF-12 originates from the SF-36 and has become one of the most widely used instruments for monitoring HRQOL (Ware, Kosinski, & Keller, 1996; Ware, 2000). Due to reduced respondent burden, the SF-12 has become a popular alternative for population-based research (Ware et al. 1996), including use amongst university students (Bovier, Chamot, & Perneger 2004; Extremera & Fernández-Berrocal, 2006). The SF-12 is composed of eight health dimensions: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health (psychological distress and well-being) (Appendix B.3).

Scoring of the SF-12 was done using QualityMetric Health Outcome Scoring Software (Version 4.0) to provide composite scores of physical and mental health status. SF-12 composite scores closely represent SF-36 scores and have shown strong correlations ranging from 0.93 to 0.97 in empirical cross-validation studies (Ware, et al., 1996). Composite scores are normalized values ranging from 0 to 100, based on the general U.S population, with a mean of 50 and standard deviation of 10. Higher scores represent better health.

### 3.3.4 General Health Questionnaire (GHQ-12)

The 12-item General Health Questionnaire (GHQ-12) (Goldberg & Williams, 1988) was used to assess the psychological distress of participants (Appendix B.4). The GHQ-12 uses a 4-point Likert scale and has demonstrated strong validity and test-retest reliability (Werneke, Goldberg, Yalcin, & Ustün, 2000). The questionnaire is used widely in research investigating psychological distress (Goldberg & Williams, 1988). The GHQ has been previously used in the university population (Sun, Buys, Wang, 2011;
Bray & Kwan, 2006; Zulkefly & Baharudin, 2010) and demonstrated strong validity and reliability, leading researchers to identify the GHQ-12 as a good measure for assessing psychological distress of students. The GHQ-12 was scored using a 0-0-1-1 method (opposed to the common 0-1-2-3 Likert scale) as advocated by the test’s author (Goldberg & Williams, 1988; Zulkerfly et al., 2010). Zulkerfly et al. (2010) suggests that this method may eliminate bias of individuals favoring responses 1 and 4 or 2 and 3. Therefore, scores were a summation ranging from 0 to 12, with higher scores representing greater psychological distress.

3.4 Procedures

3.4.1 Baseline

Interested and eligible individuals met with the researcher (Sharp) during pre-arranged office hours in the Physical Health and Activity Behaviour Lab during the first two weeks of September 2012. During this meeting, the researcher re-introduced the study, clarified any questions, and obtained written informed consent (Appendix C). All individuals were provided with an information form, attached to the consent form, that outlined the study and highlighted the benefits and risks associated with participation. Individuals were made aware that their involvement was voluntary and all responses would be treated as confidential. Written and verbal informed consent was obtained from all participants stating that they understood their rights as a participant and that the information they provided would be only accessible to the researchers for research purposes. Upon providing written informed consent, one hundred and eighty-four (n=184) participants were randomly assigned to either the intervention group or control group using a computer generated randomization table (http://www.randomizer.org/). All
participants provided demographic information and completed baseline measures comprised of the self-reported questionnaires as outlined above (Modified Godin Leisure-Time Exercise Questionnaire, SF-12, and GHQ-12).

The intervention occurred over a 12-week period during the first term of classes (September 2012-December 2012) and included 2 assessment periods, at baseline and post intervention (week 12). Figure 1 provides an overview of participant flow from recruitment to follow-up.
Classroom recruitment at UBC Okanagan in 15 classrooms

Interested individuals completed informed consent and randomized (n=184)

Baseline

Intervention participants completing baseline measures (n=95)
Control participants completing baseline measures (n=89)

12-week Intervention

12 Week Follow-Up

Intervention Participants completing follow-up measures (n=72)
non-responders (n=21)
dropout (n=2)

Control participants completing follow-up measures (n=65)
non-responders (n=24)

Figure 1. Participants Flow through Randomized Control Trial
3.4.2 Intervention Group

Intervention participants (n=95) were provided with a Yamax Digi-Walker SW-200 pedometer (Yamasa Tokei Keiki Co., Ltd., 50mm x 38mm x 14mm) for use throughout the study. Yamax pedometers have been consistently used in pedometer-based interventions for their strong reliability and validity (Bravata et al., 2007; Schneider, Crouter, & Bassett, 2004), including those involving university students (Jackson & Howton, 2008). At self-selected walking speeds, the Digi-walker has been demonstrated to record average value for steps within 1% of actual count (Bassett et al., 1996). Participants were asked to wear their pedometers daily for the duration of the study and only remove the pedometer while sleeping and in the water. While the purpose of their use varies between studies, personal pedometers are commonly used as a self-regulatory tool to promote physical activity behaviour (Tudor-Locke & Bassett, 2004). For the present study, pedometers were used to assist participants with goal-setting/achievement and self-monitoring of their daily physical activity. Used in combination with daily step goals, pedometers act to motivate an individual to achieve this goal (Gardner & Campagna, 2011).

Monthly step log calendars (Appendix D) were provided to record accumulated daily steps and aid in self-monitoring. Upon receiving their pedometer and step log calendar, intervention participants received detailed verbal instructions about the study followed by a brief introductory email to clarify any questions (Appendix E.1). Participants were asked to record their daily steps at the end of each day. For moderate and vigorous activities that did not register on the pedometers (e.g., swimming, weight lifting), participants were asked to calculate the equivalent number of steps with the equations provided and add it to their daily values (10 minutes of moderate physical
activity = 1,000 steps; 10 minutes of vigorous activity = 2,000 steps) (Tudor-Locke, Williams, Reis, Pluto, 2004). For example, if an individual went for a 30-minute bike ride (moderate intensity) they would add an additional 3,000 steps when recording their daily step count. Participants were encouraged to increase their daily steps by 500 each week to a goal of 10,000 steps per day (Tudor-Locke & Bassett, 2004). Individuals who obtained this goal were encouraged to maintain or increase their daily steps for the duration of the study. Step logs were collected at the end of each month to provide participants with a sense of accountability (Heesch et al., 2005). Participants’ usage of the monthly step logs were used to measure adherence to the intervention and reported as number of daily step counts recorded per week. Accumulated steps were not used as a measurement objective for this study, but rather a means to motivate and promote self-regulation among intervention participants, as the intent was to compare differences in physical activity between groups.

Three brief monthly emails were sent to intervention participants reminding them to drop off their step logs at the Physical Health and Activity Behaviour Lab. Emails included additional encouragement to engage in physical activity, including campus trail maps, opportunities to increase steps, and information regarding the benefits of regular physical activity. Monthly emails are included in Appendices E.2-E.4. A single follow-up email per month was sent to participants that did not return monthly logs.

3.4.3 Control Group

Control participants (n=89) were made aware of the intervention group but received no encouragement to change their daily behaviour. Upon completion of the study, control participants were provided with a personal pedometer for their own use.
3.4.4 Follow-up

All participants received a reminder email inviting them to complete the posttest (follow-up) measures one week prior to the conclusion of the study. Upon conclusion of the 12-week study, participants returned to the Physical Health and Activity Behaviour Lab during prearranged drop-in hours and completed the follow-up questionnaire. During the follow-up assessment period, participants were reminded of their rights as a participant and reread the consent form. Participants who were non-responsive and did not attend the follow-up assessment were sent a single follow-up email followed by a single phone call one week later. Intervention participants were required to return their Digi-Walker pedometer and November step logs at this time. All participants that returned for follow-up measures received a surprise ‘Thank-you’ package for completing the study, which included a skipping rope, an alternative pedometer, steps log, and a toothbrush. Items for the ‘Thank-you’ package were donated by Healthy Families BC, ParticipACTION, and the UBC Okanagan Bookstore.

3.5 Data Analysis

All hard copy data were stored in a secure and locked location only accessible by the researchers. All electronic data were stored on a password protected computer only accessible by the researchers. Pretest and posttest data regarding demographic characteristics and outcome variables (physical activity behaviour, HRQOL, and psychosocial distress) were evaluated. A significance level of \( p < 0.05 \) was accepted as statistically significant.

Prior to analysis, underlying assumptions of univariate and multivariate analyses were tested in accordance with Tabachnick & Fidell’s recommendations (2007). Variables were examined for accuracy of data entry, missing/out-of-range values, and
plausible means and standard deviations. Standardized scores (z-scores) were used to identify univariate outliers. Any data point that was three or more standard deviations (±3 SD) away from the mean was considered an outlier and not used in analyses. Univariate outliers were identified for pre and post scores of mild, moderate, and vigorous physical activity, as well as mental and physical health scores. The total number of outliers accounted for less than 5% of total values for each variable. Using a Mahalanobis distance of p < .001, no multivariate outliers were detected. Pre and post-test scores of psychological distress and minutes of weekly mild, moderate, and vigorous physical activity were moderately skewed. In accordance with Tabachnick & Fidell’s (2007) recommendation for transforming moderately positively skewed scores, the square root of these values was used for analyses, as it produced the most normal distribution.

Analyses were carried out according to intention-to-treat principles, such that all participants who completed the pre-test questionnaire were included, even if they did not complete the follow-up questionnaire. In such cases, the pre-test score was substituted for the missing value so that no change was assumed. Baseline participant randomization was tested through a series of independent t-tests (continuous variables) and chi-square tests (categorical variable) for demographic and outcome variables.

The present study employed both between-subject factors (group) and within-subject factors (time) for all outcome variables. To investigate the proposed hypotheses, the interaction effect between these factors was observed. Therefore, univariate and multivariate analysis of variance (ANOVA) were chosen as the primary means for investigating outcome variables and will be described in further detail in the results section (Chapter 4) as it applies to the hypotheses. For all analyses, Levene’s test for
equality of variance and Boxer’s test of covariance were performed. All underlying assumptions of ANOVA and MANOVA were satisfied (Tabachnick & Fidell, 2007). Following the primary analyses, hierarchical regression was used as a secondary analysis. Results provided no additional information and were not reported. All statistical analyses were conducted using IBM’s Statistical Package for Social Sciences (SPSS Version 21.0).
4 Results

4.1 Sample Description

4.1.1 Baseline

A total of 184 participants from 15 first year university classes completed baseline questionnaires. Participants were predominantly Caucasians (65%) living on campus in student housing (69%) and from the School of Arts and Sciences (65%). There was a relatively equal distribution of female (53%) to male (47%) participants. The mean age for participants was 17.9 years (SD = .69). The mean BMI score of participants at baseline, 22 kg/m^2 (SD = 4.1) fell within a normal weight classification (Wadden, Brownell, & Foster, 2002). Table 1 presents a categorical breakdown of participants’ baseline BMI according to World Health Organization classifications (Wadden et al., 2004). At baseline, 53% of participants met or exceeded Canadian physical activity guidelines of 150 minutes of moderate to vigorous physical activity per week, while 47% did not. Roughly one third (35%) of participants reported sedentary activity for more than 5 hours per day.

Table 1. Body Mass Index Classifications

<table>
<thead>
<tr>
<th>Classification</th>
<th>Participants n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>17 (9)</td>
</tr>
<tr>
<td>Normal Weight</td>
<td>138 (75)</td>
</tr>
<tr>
<td>Overweight</td>
<td>23 (13)</td>
</tr>
<tr>
<td>Obese</td>
<td>5 (3)</td>
</tr>
</tbody>
</table>
Participants did not differ between groups at baseline in age, sex, ethnicity, BMI, employment, housing, sedentary time, or how often they worked up a sweat (Table 2). Of all baseline demographic measures, only faculty differed between groups $\chi^2 (4, N = 184) = 10.57, p = .03$. Participants in the two groups did not differ significantly on minutes of physical activity $t(176) = .52, p = .601$ (two-tailed) or physical health status $t(179) = -1.55, p = .123$ (two-tailed) at baseline. At baseline, mental health status $t(181) = 3.02, p = .003$ and psychological distress scores $t(176) = -2.00, p = .047$ differed between groups. Although proper random assignment of groups prevents selection bias, it does not guarantee that groups are equivalent at baseline (Altman et al., 2001). As such, subsequent analyses must consider these group differences.
Table 2. Baseline Demographic Characteristic Comparison of Groups

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Intervention (n=95)</th>
<th>Control (n=89)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age ± SD [years]</td>
<td>18 ± .75</td>
<td>18 ± .62</td>
<td>.511&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sex [n]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>41</td>
<td>45</td>
<td>.314&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female</td>
<td>54</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>Ethnicity [n]</td>
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<td></td>
</tr>
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<td>Caucasian</td>
<td>58</td>
<td>61</td>
<td>.666&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chinese</td>
<td>10</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>South Asian</td>
<td>11</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Aboriginal</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Japanese</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>6</td>
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<tr>
<td>Missing</td>
<td>1</td>
<td>0</td>
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</tr>
<tr>
<td>Faculty [n]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Arts and Sciences</td>
<td>65</td>
<td>55</td>
<td>.032&lt;sup&gt;a&lt;/sup&gt; *</td>
</tr>
<tr>
<td>Applied Sciences</td>
<td>11</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>8</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Creative and Critical Studies</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Health and Social Development</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Body Mass Index ± SD [kg/m&lt;sup&gt;2&lt;/sup&gt;]</td>
<td>22 ± 3.6</td>
<td>22 ± 3.0</td>
<td>.790&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Employment Status [n]</td>
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<td></td>
<td></td>
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<tr>
<td>Unemployed</td>
<td>75</td>
<td>61</td>
<td>.137&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Part-time Employment</td>
<td>19</td>
<td>28</td>
<td></td>
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<tr>
<td>Full-time Employment</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Housing Situation [n]</td>
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<td></td>
<td></td>
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<tr>
<td>Off Campus</td>
<td>24</td>
<td>33</td>
<td>.083&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>On Campus</td>
<td>71</td>
<td>56</td>
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</tr>
<tr>
<td>Sedentary Hours Per Day [n]</td>
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<td></td>
</tr>
<tr>
<td>&gt;1</td>
<td>7</td>
<td>10</td>
<td>.774&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>1-2</td>
<td>18</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>37</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td>18</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>7-8</td>
<td>8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>&gt;8</td>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Work Up a Sweat [n]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Often</td>
<td>33</td>
<td>42</td>
<td>.229&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sometimes</td>
<td>54</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>8</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

<sup>p < .05</sup>

Chi-square test<sup>a</sup>

Independent t-test (two-tailed)<sup>b</sup>
4.1.2 Follow-up

At 12-week follow-up, 72 intervention and 65 control participants completed follow-up questionnaires, representing 76% and 73% retention, respectively. There were no significant differences between baseline measures of intervention participants that completed follow-up measures and those that did not. 77% of intervention participants returned their September step log, 60% returned their October step log, and 45% returned their November step log. Table 3 outlines the average number of days logged per week by intervention participants.

Table 3. Average Number of Days Logged Per Week on Monthly Step Calendar

<table>
<thead>
<tr>
<th>Week (7 day period)</th>
<th>Average Number of Days Logged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.16</td>
</tr>
<tr>
<td>2</td>
<td>6.09</td>
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<tr>
<td>3</td>
<td>6.24</td>
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<tr>
<td>4</td>
<td>5.79</td>
</tr>
<tr>
<td>5</td>
<td>5.77</td>
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<tr>
<td>6</td>
<td>5.85</td>
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<tr>
<td>7</td>
<td>5.70</td>
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<tr>
<td>8</td>
<td>5.53</td>
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<tr>
<td>9</td>
<td>5.67</td>
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<tr>
<td>10</td>
<td>5.70</td>
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<tr>
<td>11</td>
<td>5.89</td>
</tr>
<tr>
<td>12</td>
<td>4.53</td>
</tr>
</tbody>
</table>

A preliminary correlation matrix suggested that baseline BMI, \( r(167) = -0.12, p = 0.12 \), sex, \( r(169) = 0.04, p = 0.65 \), and ethnicity, \( r(168) = -0.08, p = 0.29 \) were not associated with changes in overall physical activity. A significant positive correlation between an individual’s housing situation and changes in mild physical activity, \( r(179) = 0.16, p = 0.04 \), suggested that living on campus in student housing was associated with increases in mild, but not moderate, \( r(179) = 0.06, p = 0.40 \), or vigorous physical activity, \( r(173) = 0.11, p = 0.16 \). Further, baseline rates of mild, \( r(179) = -0.53, p < 0.001 \), moderate, \( r(179) = -0.63, p < 0.001 \),
.001, and vigorous physical activity, r(173) = -.55, p < .001, were strongly negatively correlated to changes in their respective scores. That is to say, individuals with higher baseline physical activity experienced less change across the duration of the study.

4.2 Outcome Variables

4.2.1 Comparison of Weekly Physical Activity Between Groups

Physical activity was measured on three levels: mild, moderate, and vigorous. Accordingly, a two-way mixed design multiple analysis of variance (MANOVA) was used to test the interventions effect on physical activity. The MANOVA was chosen as the primary means of analysis to protect against an inflation of type I errors as all three levels of the dependant variable are considered simultaneously (Tabachnick & Fidell, 2007; Huberty & Morris, 1989). Results showed that there was no significant difference between intervention and control group on overall physical activity, F(3, 165) = 1.29, p = .28. Subsequent univariate tests further indicated no intervention effect on physical activity behaviour for mild, F(1, 167) = 1.26, p = .26, moderate, F(1, 167) = 1.47, p = .23, or vigorous physical activity F(1, 167) = 1.79, p = .18. Furthermore, no main effect was found for group, F(3, 165) = 1.12, p = .34.

As no group by time interaction effect was found, it was therefore appropriate to examine participant changes in overall physical activity across time, regardless of group. Multivariate analysis of overall physical activity indicated a significant change in physical activity behaviour over time, F(3, 165) = 4.10, p < .01. Univariate analyses indicated significant changes in mild, F(1, 167) = 7.08, p < .01, and vigorous, F(1, 167) = 4.13, p = .04, physical activity behaviour over time such that participants’ weekly minutes of mild physical activity increased while weekly minutes of vigorous physical
activity decreased. No significant change in moderate physical activity over time was observed, $F(1, 167) = .76, p = .39$.

In summary, the first hypothesis that participants assigned to the intervention group will report greater levels of physical activity than the control group, from baseline to follow-up, was not supported. However, analyses identified a positive trend in minutes of mild physical activity and negative trend in minutes of vigorous physical activity over time. Table 4 represents mean changes in mild, moderate, and vigorous physical activity between the control and intervention group from baseline to 12-week follow-up.

### Table 4. Descriptive Statistics for Physical Activity Variables (Unadjusted)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline (T0)</th>
<th>Follow-up (T1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>INTERVENTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild Physical Activity&lt;sub&gt;a&lt;/sub&gt;</td>
<td>118</td>
<td>123</td>
</tr>
<tr>
<td>Moderate Physical Activity</td>
<td>100</td>
<td>118</td>
</tr>
<tr>
<td>Vigorous Physical Activity&lt;sub&gt;a&lt;/sub&gt;</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>CONTROL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild Physical Activity&lt;sub&gt;a&lt;/sub&gt;</td>
<td>98</td>
<td>112</td>
</tr>
<tr>
<td>Moderate Physical Activity</td>
<td>110</td>
<td>136</td>
</tr>
<tr>
<td>Vigorous Physical Activity&lt;sub&gt;a&lt;/sub&gt;</td>
<td>106</td>
<td>101</td>
</tr>
</tbody>
</table>

Note: Physical activity was measured in average minutes per week. A significant main effect for time is denoted by the subscript a.
4.2.2 Comparison of HRQOL and Psychological Distress Between Groups

HRQOL included the assessment of two components, physical health status and mental health status. A two-way mixed design MANOVA was used to test the intervention’s effect on HRQOL. The results indicated no difference between intervention and control group on HRQOL over time, $F(2, 176) = .22, p = .80$. Univariate tests also indicated no intervention effect on physical, $F(1, 177) = .37, p = .55$, or mental health status, $F(1, 177) = .17, p = .68$. Although a significant overall main effect for group was found, $F(2, 176) = 4.04, p = .02$, it was suspected that this finding was a result of the aforementioned differences between groups at baseline in mental health status, and must be interpreted with caution. Univariate analysis supports this hypothesis indicating significant mean group differences in mental health status, $F(1, 177) = 16.43, p < .001$, but not physical health status, $F(1, 177) = .06, p = .81$. Furthermore, these results were superseded by a nonsignificant group by time interaction and arguably less meaningful as individual differences are not accounted for (Tabachnick & Fidell, 2007).

As no group by time interaction was found, subsequent observation of participant changes over time, regardless of group, were observed. Multivariate analysis show a significant change in HRQOL from baseline to follow-up, $F(2, 176) = 8.42, p < .001$. Successive univariate analysis indicate that mental health status significantly decreased over time (mean difference of 2.60), $F(1, 177) = 16.43, p < .001$. No significant change in physical health status was observed, $F(1, 177) = .06, p = .81$.

A two-way mixed design ANOVA was conducted to test for changes in psychological distress between groups, from baseline to follow-up. There was no significant group by time interaction effect for psychological distress, $F(1, 176) = .13, p =$
A significant main effect for group, F(1, 176) = 6.21, p = .01, was superseded by aforementioned baseline differences in psychological distress between groups and a nonsignificant group by time interaction. A significant main effect for time, F(1, 176) = 20.67, p < .001, indicates that participants’ psychological distress increased from baseline to follow-up, regardless of group.

In summary, the second hypothesis that intervention participants will report greater health related quality of life and less psychological distress than the control group, from baseline to follow-up, was not supported. However, analyses indicated an overall negative trend in HRQOL and positive trend in psychological distress over time. Table 5 represents mean changes in physical health status, mental health status, and psychological distress between the control and intervention group from baseline to 12-week follow-up.

Table 5. Descriptive Statistics for Health Related Quality of Life and Psychological Distress Variables (Unadjusted)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline (T0)</th>
<th>Follow-up (T1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td><strong>EXPERIMENTAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Health Status</td>
<td>51.18</td>
<td>6.50</td>
</tr>
<tr>
<td>Mental Health Statusa</td>
<td>50.11</td>
<td>7.73</td>
</tr>
<tr>
<td>Psychological Distressa</td>
<td>1.51</td>
<td>1.83</td>
</tr>
<tr>
<td><strong>CONTROL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Health Status</td>
<td>52.55</td>
<td>5.31</td>
</tr>
<tr>
<td>Mental Health Statusa</td>
<td>46.40</td>
<td>8.88</td>
</tr>
<tr>
<td>Psychological Distressa</td>
<td>2.10</td>
<td>2.06</td>
</tr>
</tbody>
</table>

Note: Possible scale ranges: Physical Health Status (0-100), Mental Health Status (0-100) [higher scores indicate greater health], Psychological Distress (0-12) [higher scores indicate greater psychological distress]. Significant main effects for time are denoted by the subscript a.
5 Discussion

Based on the hypotheses of this study, the discussion has been organized into two sections. The first will discuss changes in physical activity behaviour between groups and across time, while the second will discuss changes in HRQOL and psychological distress between groups and across time. Potential explanations and implications of the aforementioned findings are explored in detail.

5.1 Changes in Physical Activity

Contradictory to the broader literature on pedometer-based physical activity interventions (Bravata et al., 2007; Kang, Marshall, Barreira, & Lee, 2009; Richardson et al., 2008), the present intervention found no significant difference in physical activity between the intervention and control group. These results may be due to several factors. The majority of available research on pedometer-based interventions has been conducted predominantly on overweight, sedentary women (Richardson et al., 2008; Tudor-Locke & Lutes, 2009). Participants in the present study had a roughly equal male to female ratio, of which three quarters (75%) fell within a normal BMI range and over half (53%) exceeded physical activity guidelines at baseline. It is suspected that the demographic discrepancies between the aforementioned literature and the present study may have played a role in the null findings. The following will explore each of these three variables (BMI, sex, and baseline physical activity) separately and provide suggestions as to why these factors may or may not have contributed to the findings.

First, it is possible that participants with a normal BMI score felt a sense of personal program irrelevance due to their healthy anthropometric scores. An exploratory
analysis of factors related to pedometer-based intervention adherence (Tudor-Locke & Chan, 2006) reported that those most likely to abide to protocol and complete the program were overweight or obese. However, among university students, Jackson & Howton (2008) reported that their 12-week pedometer intervention increased daily steps among overweight, normal weight, and underweight individuals, indicating that BMI was not associated with changes in daily steps. Accordingly, the present study found no correlation between BMI and changes in physical activity. These results, in conjunction with others (Bravata et al., 2007; Chan et al., 2004), suggest that the non-significant findings of the present study were not a result of participants having healthy BMI scores at baseline. With regards to sex, it has been observed that males attending university are the most susceptible to declines in physical activity rates, although their female counterparts report far less activity at baseline (Kwan et al., 2012). Researchers postulated that females might experience the greatest decline in physical activity prior to adolescence. As a result, Kwan, et al. (2012) suggested that campus-based physical activity interventions should aim to prevent physical activity declines in men and increase activity levels in women. Although these results imply that the heterogeneity of sex among participants in the present study may be a limiting factor, the broader literature on pedometer-based interventions has consistently found that sex is not a predictor of increased physical activity (Bravata et al., 2007; Tudor-Locke & Lutes, 2009). Accordingly, the present study found no correlation between sex and changes in physical activity. However, analysis identified a significant negative correlation between baseline physical activity and increased physical activity behaviour. These results, consistent with others (Chan, Ryan, & Tudor-Locke, 2004), suggest that individuals with lower baseline
steps per day show the greatest incremental increases in physical activity behaviour. To this point, students in Jackson and Howton’s (2008) successful pedometer intervention were classified as having low activity at baseline (5,000-7,499 steps per day). Contrarily, LeCheeminant et al.'s (2011) pedometer-based intervention included university freshman that were considered active at baseline (>10,000 steps per day). Similar to the present study, no significant change in self-reported moderate to vigorous physical activity between the intervention and control group was found. Therefore, it appears that the baseline physical activity rates of first year students are a stronger predictor of physical activity outcomes than BMI or sex and may have been a contributing factor to the results of the present intervention.

When considered together, these results suggest that interventions targeted at preventing declines in university student’s physical activity may need to be different than those promoting physical activity among sedentary students. For instance, presently active students may require a higher step threshold to maintain physical activity levels. LeCheeminant et al. (2011) noted that a goal of 10,000 steps might not be sufficient to sustain physical activity across the academic year. Although no current recommendations exist for university students, it has been suggested that for presently active adults a daily goal of 12,500 steps may be required to promote additional physical activity, above and beyond that required for minimum health benefits (Tudor-Locke, Hatano, Pangrazi, & Kang, 2008). Further, while self-regulatory strategies alone may be sufficient to promote physical activity among sedentary students, presently active students may require additional physical activity maintenance techniques, such as relapse prevention or coping strategies, to prevent declines in physical activity. Future research
targeted at university students should take particular care as to the baseline physical activity behaviour of the population and design interventions accordingly. This could be accomplished by incorporating the Transtheoretical Model (TTM) to direct behaviour change strategies. The TTM has been combined with SCT in pedometer-based interventions with relative success among the general adult population (Lutes & Steinbaugh, 2010) and provides the added utility of assessing an individual’s readiness to change (Prochaska, 1996). The TTM has also been recognized as beneficial when considering specific population needs and environmental barriers (Lutes & Steinbaugh, 2010). Given the transitional nature of young adults and uniqueness of the campus environment, incorporating the TTM could potentially be very advantageous. For example, active students could begin by planning ahead for periods of relapse in the academic year, as outlined by LeCheminant et al. (2011). Students could also develop strategies to manage and overcome common barriers that may adversely affect physical activity levels, such as academic stresses, poor time management, and lifestyle changes (Regehr et al., 2013; Terenzini et al., 1994).

Univariate comparisons between groups revealed no significant intervention effect on mild, moderate, or vigorous physical activity. However, trends in participants’ physical activity across time were illuminated. First, a significant main effect for time indicated that, overall, participant’s mild physical activity behaviour increased across the duration of the study. It may simply be that the lifestyle norms of first year university students require a greater level of daily ambulatory physical activity due to the built environment (Sisson, McClain, Tudor-Locke, 2008). For example, traveling between buildings from class to class may result in a higher level of daily steps. However,
campus walkability has been found to vary greatly between different institutions (Horacek et al., 2012), indicating that these results may not be generalizable to all first year students. Regardless, research has consistently found that individuals living in student housing are more active than those living off campus (Keating et al., 2005; LeCheminant et al., 2011; Sisson, McClain, Tudor-Locke, 2008). As student housing is often located at a greater distance from other campus buildings, this is likely a result of residents traveling to and from housing to attend class and utilize campus amenities. With over two thirds (69%) of participants in the present study reportedly living in student housing on campus, it is understandable that mild physical activity increased from baseline measures. While the aforementioned changes across time cannot be attributed to the intervention itself, as changes were observed with both control and intervention participants, it provides anecdotal evidence that may have implications for future research. For example, interventions may need to focus specifically on promoting moderate and vigorous physical activity. Assuming the increase in mild physical activity found in the present study is a result of increased daily ambulatory behaviour, such as walking to class, efforts could be made to increase the intensity of these activities. By educating individuals on simple measurements of intensity (e.g. rate of perceived exertion), it may be possible to increase rates of moderate-to-vigorous physical activity through activities of daily living.

Findings from the present study indicate that, at baseline, 53% of participants engaged in adequate levels of moderate-to-vigorous physical activity to meet physical activity guidelines. This prevalence of physical activity falls within the range found by Keating et al.’s systematic review (2005), reporting that 50% to 60% of college students
are sufficiently active. Likewise, Irwin (2007) reported that 51% of participants, drawn from two Canadian institutions, met physical activity guidelines at baseline. It is clear that nearly half of this student population is at risk for the health consequences associated with an inactive lifestyle. Furthermore, and perhaps most concerning, is a marked decline in activity over time.

Population statistics show a disproportionate decline in moderate-to-vigorous physical activity as adolescents transition into young adulthood, with notable declines in those entering post-secondary education. While participants’ mean minutes of physical activity exceeded physical activity guidelines at both time points (200 minutes and 188 minutes, respectively), a significant decline in vigorous physical activity from baseline to follow-up was observed. Consistent with others (Bray & Born, 2004), young adults transitioning from high school to first year university have been found to exhibit dramatic declines in vigorous physical activity. Bray and Born (2004) reported a 22% decline in vigorous physical activity between high school and university with only 44% of participants reporting an average of 3 or more bouts of vigorous activity lasting for 20 minutes or longer per week after their first two months of university. Findings from the present study indicated that participants’ vigorous physical activity significantly declined by 11% during the first 3 months of university. It is hypothesized that this decline is a result of the complex transition to adulthood and university life.

It is well understood that the demands and stresses of university life require higher levels of independence, initiative, and self-regulation (Chemers, Hu, & Garcia, 2001). A qualitative examination found that first year college students felt they had to adjust to the workload and make friends before they could focus on exercise (LaCaille,
Dauner, Krambeer, & Pedersen, 2011). Similar to the adult population, a lack of time and motivation were also identified as barriers to physical activity (Lacaille et al., 2011). As the academic curriculum is often quite vigorous, including large quantities of course work in a condensed timeframe, it is possible that physical activity will remain a low priority throughout years spent at university. For many students, the transition to university is also associated with a decline in structured forms of physical activity, such as recreational or competitive sport (Décamps, Boujut, & Brisset, 2012). In fact, participation in organized sport decreases steadily after adolescence (Bélanger, Townsend, & Foster, 2011; Ifedi, 2008). Upon the conclusion of youth and adolescent programming, it is possible that individuals will not reengage in these activities, resulting in an overall decline in moderate-to-vigorous physical activity.

Regardless of the complex mechanism causing this decline, these findings are important for several reasons. First, declines in physical activity among first year students have been found to persist throughout one’s years spent at university and set the stage for poor lifetime adherence (Fish & Nies, 1996; Sparling & Snow, 2002). Second, decline in vigorous physical activity among first year university students may have numerous short and long term physical and mental health implications (Bray & Born, 2004; Stallman, 2008). Regular physical activity is associated with weight management, decreased risk of cardiovascular disease, and lower incidence of illness (Warburton et al., 2010). Further, regular vigorous physical activity has been correlated with improvements in HRQOL and psychological well-being (Bize, Johnson, & Plotnikoff, 2007).
5.2 Changes in HRQOL and Psychological Distress

The transition to university is associated with notable declines in quality of life and psychological well-being (Stallman, 2008). First year students report higher levels of stress, anxiety and negative mood related to their non-academic counterparts. Further, these scores are typically greater than that of the general adult population (Stallman, 2010). In the current study, a significant main effect for time indicated that participants experienced a decline in HRQOL and increase in psychological distress from baseline to 12-week follow-up. Univariate analysis indicated that mental health status significantly declined where as physical health status did not. The nonsignificant change in physical health status is likely attributable to the age of participants, as younger individuals typically report fewer physical limitations (Hung, Lubetkin, Fahs, & Shelley, 2009; Wensing, Vingerhoets, & Grol, 2001). Parallel results found in third-year pharmacy students reported lower mental health scores and higher physical health scores than population averages (Marshall et al., 2008). Authors also attributed higher physical composite scores to the age of the population, as the majority of participants were under the age of thirty. However, if trends of physical inactivity persist, physical health issues may become apparent at a later time.

With regards to psychological distress, Stallman (2008) reported elevated levels of distress in over half of the 1168 students sampled, with one fifth reporting levels indicative of moderate to severe psychological disorders. Further, Stallman (2008) reported that two thirds of students did not seek assistance for this distress. In conjunction with the findings of the present study, these results support that declines in HRQOL and psychological distress are evident among first year university students.
Similar to physical activity, it is suspected that changes in HRQOL and psychological distress are a result of the transitional nature of young adults in combination with academic demands.

For new students, arriving at university is often characterized by a separation from one’s family, establishing new living arrangements, and a new way of learning (Lüdtke et al., 2011). This loss of social support, in conjunction with pressures to make friends, creates high levels of stress that can adversely affect HRQOL and psychological well-being (Misra & McKean, 2000). Transitioning students also experience increased responsibility over their personal matters, leaving them subject to financial, time and health related stresses (LaCaille et al., 2011). Academically, the combination of large class sizes and a new lecture-based teaching style results in a less personal learning environment. Students remain largely anonymous to their instructors and lose the educational support networks of high school. Students report that academic stresses persist across the semester and are caused by having a large amount of content to master in a small amount of time (LaCaille et al., 2011). Further, academic stress has been found to fluctuate, with the highest levels of stress occurring during midterm and final exam periods (LaCaille et al., 2011). Despite these numerous stresses, the transition to university is often viewed as a positive experience (Misra & McKean, 2000). However, as these factors accumulate, it is understandable that changes in HRQOL and psychological distress would occur. Although these transitions are an important part of becoming an adult, efforts can be made to ease the transition and alleviate these burdens.

Pedometer-based interventions have been found to increase self-efficacy (Raedeke, Focht, & King, 2010), improve mood, emotion (Baker et al., 2008), and quality of life
(Murphy, Nevill, Neville, Biddle, & Hardman, 2002). As no significant changes in physical activity were found between groups, it stands to reason that no differences in HRQOL or psychological distress were observed either. However, it is important to explore the relationship between these two factors. A systematic review of physical activity and HRQOL in the healthy adult population provided supporting evidence of a positive relationship between levels of physical activity and HRQOL (Bize et al., 2007). That is, higher levels of moderate-to-vigorous physical activity are associated with higher levels of HRQOL. While the present study found evidence of both declines in vigorous physical activity and HRQOL, it is unclear whether this relationship occurs through a causal pathway, mutual influence, or through the influence of an external factor (e.g. self-efficacy) (Bize et al., 2007). Future research should look more carefully at the relationship between physical activity, HRQOL and psychological distress among university students and how these factors interact. Results from the general adult population suggest that interventions promoting physical activity may improve the HRQOL and psychological distress of first year university students. However, provided the multifaceted nature of this population, the aforementioned factors may play a role in mitigating the return. For example, even if an individual increased their physical activity behaviour, psychological distress may remain elevated due to an inability to cope with persistent academic stresses. Depending on the strength of the relationship between physical activity behaviour, HRQOL and psychological distress among university students, implications for future interventions may be drawn. For instance, if these factors are highly correlated, specifically focusing on a single behaviour, such as physical activity, may be adequate to influence HRQOL and psychological distress. However, if
the opposite is true, a more multidimensional approach, focusing on several aspects of an individual’s life, may be required to improve the health of students.
6 Conclusion

The purpose of the present study was to test the effects of a pedometer-based intervention on the physical activity behaviour, HRQOL, and psychological distress of first year university students. Results indicated that the intervention produced no significant differences between the intervention and control group from baseline to follow-up. However, a significant main effect for time indicated that all participants experienced an increase in mild physical activity and psychological distress and decrease in vigorous physical activity and mental health status across the duration of the study.

6.1 Strengths, Limitations, and Future Recommendations

The present study provided some insight to the use of pedometer-based interventions among university students. Unlike the majority of current pedometer-based research, the present study had a large sample size that was likely more representative of students varying baseline physical activity levels. While previous pedometer research has been conducted largely among sedentary individuals (Bravata et al., 2007; Tully & Cupples, 2011), the present study did not restrict recruitment based on activity level. When compared to descriptive research conducted in Canadian universities (Irwin, 2007), the portion of students meeting physical activity guidelines is quite comparable. Further, the present research also utilized a strong recruitment strategy. By coordinating with first year instructors, it was possible to address a large and diverse group of students in a timely manner. Full recruitment was completed within the first two weeks of classes using a single recruitment technique and required minimal burden on instructors and researchers. In addition to strong sampling, the physical activity questionnaire used for the present research provided a more dynamic look at changes in physical activity than
steps alone, as it differentiated between mild, moderate, and vigorous activities. While it would be interesting to compare daily steps between the intervention and control group, it is known that even pedometer acquisition is associated with increased steps (Clemes, Matchette, & Wane, 2008). That is, by simply donning a measurement device individuals may increase their walking behaviour. As the control group had no (known) contact with the pedometers, there was less chance of physical activity measurement protocols confounding participants’ behaviour.

Despite the aforementioned strengths, several limitations must be noted. Although the large sample size of the present study was a strength, it must be considered that participants were taken from a single cohort of students drawn from one western Canadian university. Results can be generalized only to the population that the random sample was taken from. Further, assessments were only conducted at two time points and may be affected by external factors. For example, follow-up measures were conducted at the conclusion of the first semester. It has been seen that physical activity of first year university students fluctuates across the school year (LeCheminant et al., 2011), with a downward trend towards the end of each semester. It may be that the natural ebb and flow of student life masked any effect caused by the intervention. Potential follow-up studies should incorporate multiple measurement periods to better understand the intervention’s effects.

Furthermore, although several significant main effects for time were found, it is important to interpret these findings with caution. As it was not the initial intent of the study to observe changes over time of all participants, it would be careless to discredit the effects of the intervention completely. That is to say that, while the intervention itself
produced no statistically significant differences between groups, it may still have resulted in changes that would inflate or deflate the main effect for time.

Finally, as both groups differed in multiple ways, it is unclear as to the effect of the pedometer itself. In an attempt to enhance the interventions effect, the present study incorporated additional components to supplement the use of pedometers (i.e., monthly step logs, step goals, and follow-up emails). Future research should incorporate multiple conditions to assess the different effects these techniques have upon university students’ physical activity. For example, including a pedometer-only group, a pedometer plus step log group, etc., may help to better understand the individual effects these components have on first year students.

Limitations notwithstanding, the present study found supporting evidence that increases in psychological distress and declines in vigorous physical activity and mental health status are apparent in university students, and that these changes begin early in an individual’s academic career. As a greater awareness for the health concerns of young adults is promoted and efforts are made to address these concerns, researchers must pay particular attention to the specific needs of this population. The current intervention took a minimalist approach in maintaining and improving the health of university students. The complex interaction of changing interpersonal relationships, housing arrangements, and increased financial responsibility, in addition to the academic burden of university, likely all affect student’s HRQOL, psychological distress, and physical activity behaviour. More favorable results may be obtained through a more intensive intervention including increased face-to-face contact time (Greaves et al., 2011) and more directed intervention material. For instance, interventions could utilize coping and relapse
prevention strategies (Greaves et al., 2011) targeted specifically at problem time periods for students, in addition to promoting self-regulatory strategies. However, this is not done without limitation and the benefits accrued by the intervention must be weighed against the required resources. Despite the conflicting findings of the present intervention, pedometer-based interventions have been found to not only increase ambulatory physical activity (Tully & Cupples, 2011) but also moderate and vigorous physical activity among sedentary university students (Jackson & Howton, 2008). The contradictory findings of the present intervention shed light on potential modifications for future pedometer-based interventions and point to a need to differentiate between strategies focused on physical activity promotion and physical activity maintenance among university students.

6.2 Practical Implications

The present research supports several practical implications for academic institutions and administration. It is a growing expectation that, as an educational institution, universities have the obligation to not only provide an opportunity for higher learning, but also promote the health and well-being of students (Fullerton, 2011). A growing number of universities are introducing Health and Wellness departments that provide health services in a variety of ways (Fullerton, 2011). Departmental Health and Wellness efforts at the present institution have been on the forefront of campus health research. Considerable efforts have been made to promote student health through community-based action research methods in combination with setting-based health promotion strategies (Budgen et al., 2011). Researchers successfully used community dialogs to identify and address student health issues including access to healthy food and
clean water (Budgen et al., 2011). The overall decline in physical activity and HRQOL as well as the increase in psychological distress found by the present research provides direction for the future. As these issues become apparent within the first semester of post-secondary education, efforts must be made to engage students at the first instance. As many of the aforementioned recommendations for future interventions involve educating students on strategies to modify their behaviour, courses could be developed using the contemporary educational paradigm. Local stakeholders may consider offering curriculum-based health and well-being courses to all first-year students, regardless of discipline, to educate students on healthy living. For example, Hager, George, LeCheminant, Bailey, and Vincent (2012) conducted a 15-week mandatory university wellness course and found that students’ overall physical activity increase by 12%. Researchers found that the single-semester wellness course significantly increase students daily minutes of moderate physical activity as well as their overall fitness level (Hager et al., 2012). Efforts could be made to also emphasize other key health issues among this population, including the prevention of declines HRQOL, and increases in psychological distress.
References


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pedometer studies? British Journal of Sports Medicine, 42(1), 68-70. doi:10.1136/bjsm.2007.038521


Fullerton, D. S. (2011). A collaborative approach to college and university student health


Appendicies

Appendix A : Letters of Initial Contact

Dear Dr.________,

I appreciate your time in reading this email. I am a Masters student in the School of Health and Exercise Sciences, under the supervision of Dr. Cristina Caperchione. In September I will be undertaking my thesis project in fulfillment of my degree. My research study will examine the effects of a physical activity based health promotion intervention on first year students that have recently graduated high school. With your support, we would like to invite your ______(e.g. SOCI 111) class to participate in this study.

To participate in this study students must be a full-time undergraduate student at UBC Okanagan, 17 years of age or older, graduated high school within the past year, able to speak and read English, and capable of performing ambulatory (walking) physical activity. Students should not participate if their doctor has advised against mild forms of physical activity such as walking.

This is an excellent opportunity to promote the health and well-being of the students under your supervision. Should you choose to allow your class to participate your responsibilities would be minimal. I would ask that you allow me to enter your lecture on a single occasion to introduce the intervention (early September). The introductory session will last approximately 15 minutes at which point I will provide an overview of the study and invite eligible students to contact a researcher or come to the PHAB lab during prearranged drop-in hours.

Further information including participant eligibility and study protocol can be found in the attached proposal. If you have any further questions please feel free to contact me by email or phone or my supervisor, Dr. Cristina Caperchione by email at: cristina.caperchione@ubc.ca or by phone at ext. 79679.

Please respond indicating your interest in this study, at which point I will arrange a time to come and speak to your class.

Thank you for your time and consideration,

Paul Sharp, BHK, CSEP CPT
Graduate Student
Health and Exercise Sciences
University of British Columbia
Kelowna, BC
E: pgsharp@shaw.ca
P: (250) 859-5968
Appendix B: Questionnaire

B.1 Demographic Information

Using the blanks provided, please complete the following personal information.

Name: __________________________

Phone Number: __________________________

Email (Print Clearly): __________________________

1. Gender

____ Male
____ Female

2. Date of Birth

Day _______ Month _______ Year _______

3. Which of the following ethnicities would you most associate yourself with?

____ Caucasian
____ Chinese
____ Japanese
____ Aboriginal
____ African American
____ South Asian
____ Hispanic
____ Other: Please Specify: _______________________

4. Height

_______ Feet _______ Inches OR _______ Meters

5. Weight

_______ Lbs OR _______ Kgs
6. What is your current employment status?

_____ Unemployed
_____ Part-time employment
_____ Full-time employment

7. What faculty would you most associate yourself with?

_____ Arts and Sciences (Biology, Chemistry, Physics, Sociology, History)
_____ Applied Sciences (Engineering)
_____ Faculty of Education
_____ Management
_____ Creative and Critical Studies (Fine Arts, Languages, Cultural Studies)
_____ Health and Social Development (Nursing, Social Work, Human Kinetics)
_____ Other
    Please Specify: __________________________

8. What is your current housing situation?

_____ Off-campus with parents/guardians
_____ Off campus alone or with roommate(s)
_____ On campus residency

9. In the last 7 days, about how many hours a day, on average, did you spend: on a computer, watching TV/movies, playing video/computer games, or doing other sitting activities such as studying, or sitting in class?

_____ Less than one hour per day
_____ 1-2 hours per day
_____ 3-4 hours per day
_____ 5-6 hours per day
_____ 7-8 hours per day
_____ More than 8 hours per day

10. Considering a 7-Day period (a week) during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

_____ Often
_____ Sometimes
_____ Never
**B.2 Adapted Godin Leisure-Time Exercise Questionnaire**

Considering a **7-Day period** (a week), how many times on average do you do the following kinds of physical activity for 30 minutes or more (all at once or in 10- or 15-minute blocks) during your free time? (write on each line the appropriate number)

For example, if a person walks her dog twice a day for 15 minutes each time on Mondays, Wednesdays, and Fridays, she would indicate moderate activity on 3 days a week and a total of six (6) 10-15 min blocks and zero (0) 30-minute continuous blocks. If, however, she walks her dog once a day for 30 minutes each time on Mondays, Wednesdays, and Fridays, she would indicate moderate activity on 3 days a week and a total of three (3) 30-minute blocks and zero (0) 10-15 minute blocks. If she walks her dog twice on Mondays for 15 minutes each time, and for 30 continuous minutes on Wednesdays and Fridays, she would indicate 3 days a week and a total of two (2) 10-15 minute blocks and two (2) 30-minute continuous blocks.

<table>
<thead>
<tr>
<th>Days a week</th>
<th>Approx. # of 10-15 min blocks on these days</th>
<th>Approx. # of 30-minute continuous blocks on these days</th>
</tr>
</thead>
</table>

**STRENUOUS EXERCISE**
(HEART BEATS RAPIDLY AND BREATHE HEAVILY FOR TIME YOU ARE ACTIVE)
(i.e., running, jogging, football, soccer, squash, basketball, cross country skiing, judo, vigorous swimming, vigorous long distance bicycling)

---

**MODERATE EXERCISE**
(NOT EXHAUSTING)
*Similar to how you feel when you are walking as if you were going somewhere*
(i.e., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing, biking to and from classes, active work)

---

**MILD EXERCISE**
(MINIMAL EFFORT)
(i.e., yoga, archery, fishing, bowling, horseshoes, golf, snowmobiling, easy walking)
B.3 SF-12 Health Survey

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

1. In general, would you say your health is:

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Very good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

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

2. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

3. Climbing **several** flights of stairs

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

4. **Accomplished less** than you would like

5. Were limited in the **kind** of work or other activities

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

6. **Accomplished less** than you would like

7. Didn't do work or other activities as **carefully** as usual
8. During the *past 4 weeks*, how much did pain interfere with your normal work (including both work outside the home and housework)?

<table>
<thead>
<tr>
<th>Not at all</th>
<th>A little bit</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
</table>

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

How much of the time during the *past 4 weeks*...

9. Have you felt calm and peaceful?

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>A Good Bit of the Time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
</table>

10. Did you have a lot of energy?

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>A Good Bit of the Time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
</table>

11. Have you felt downhearted and blue?

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>A Good Bit of the Time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
</table>
B.4 General Health Questionnaire

Please read this carefully:

We should like to know if you have had any medical complaints, and how your health has been in general, over the past few weeks. Please answer ALL the questions simply by underlining the answer which you think most nearly applies to you. Remember that we want to know about present and recent complaints, not those you had in the past. It is important that you try to answer ALL the questions.

Thank you very much for your co-operation.

<table>
<thead>
<tr>
<th>HAVE YOU RECENTLY:</th>
<th>Better than usual</th>
<th>Same as usual</th>
<th>Less than usual</th>
<th>Much less than usual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - been able to concentrate on whatever you’re doing?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 - lost much sleep over worry?</td>
<td>Not at all</td>
<td>No more than usual</td>
<td>Rather more than usual</td>
<td>Much more than usual</td>
</tr>
<tr>
<td>3 - felt that you are playing a useful part in things?</td>
<td>More so than usual</td>
<td>Same as usual</td>
<td>Less useful than usual</td>
<td>Much less useful</td>
</tr>
<tr>
<td>4 - felt capable of making decisions about things?</td>
<td>More so than usual</td>
<td>Same as usual</td>
<td>Less so than usual</td>
<td>Much less capable</td>
</tr>
<tr>
<td>5 - felt constantly under strain?</td>
<td>Not at all</td>
<td>No more than usual</td>
<td>Rather more than usual</td>
<td>Much more than usual</td>
</tr>
<tr>
<td>6 - felt you couldn’t overcome your difficulties?</td>
<td>Not at all</td>
<td>No more than usual</td>
<td>Rather more than usual</td>
<td>Much more than usual</td>
</tr>
<tr>
<td>7 - been able to enjoy your normal day-to-day activities?</td>
<td>More so than usual</td>
<td>Same as usual</td>
<td>Less so than usual</td>
<td>Much less than usual</td>
</tr>
<tr>
<td>8 - been able to face up to your problems?</td>
<td>More so than usual</td>
<td>Same as usual</td>
<td>Less able than usual</td>
<td>Much less able</td>
</tr>
<tr>
<td>9 - been feeling unhappy and depressed?</td>
<td>Not at all</td>
<td>No more than usual</td>
<td>Rather more than usual</td>
<td>Much more than usual</td>
</tr>
<tr>
<td>10 - been losing confidence in yourself?</td>
<td>Not at all</td>
<td>No more than usual</td>
<td>Rather more than usual</td>
<td>Much more than usual</td>
</tr>
<tr>
<td>11 - been thinking of yourself as a worthless person?</td>
<td>Not at all</td>
<td>No more than usual</td>
<td>Rather more than usual</td>
<td>Much more than usual</td>
</tr>
<tr>
<td>12 - been feeling reasonably happy, all things considered?</td>
<td>More so than usual</td>
<td>About same as usual</td>
<td>Less so than usual</td>
<td>Much less than usual</td>
</tr>
</tbody>
</table>

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Appendix C: Written Informed Consent

Information Form

Project Team
Dr. Cristina Caperchione (cristina.caperchione@ubc.ca)
Paul Sharp (pgsharp@shaw.ca)
School of Health and Exercise Sciences, UBC Okanagan

Dear Participant,

Thank you for your initial interest in assisting us with this research project. This project is in fulfilment of co-investigator, Paul Sharp’s Masters thesis under the supervision of Dr. Caperchione. We are interested in observing the physical activity rates, health-related quality of life, and psychological distress of students in their first year of university. The purpose of this letter is to provide you with the information you need to make an informed decision about participating in this research investigation.

To participate in this study you must be a full-time undergraduate student at UBC Okanagan, 17 years of age or older, graduated high school within the past year, able to speak and read English, and capable of performing ambulatory (walking) physical activity. You should not participate if your doctor has advised against mild forms of physical activity such as walking.

Should you choose to participate in this research project you will be placed into either a control group or an experimental group. Individuals in both groups will be asked to complete questionnaires regarding physical activity, general health, and psychological well being on two separate occasions (September and November). These questionnaires will take approximately 15-20 minutes to complete.

Participants assigned to the experimental group will further be asked to wear a personal step counter, known as a pedometer, and report their daily steps in the log provided. Step logs will be collected monthly at your convenience and pedometers will be collected at the end of the study (November). Should your pedometer become damaged or lost during the course of the study, you may email a member of the research team to acquire another without penalty or prejudice.

Your involvement in the study is completely voluntary. Should you decide to withdraw from the study for any reason, at any time, you may do so without penalty or prejudice.
The risks associated with the proposed research are minimal. Mild forms of physical activity, such as walking, are typically very safe but may be associated with muscle strains and pains, cramping, or blisters on the feet. There is no foreseeable risk to your physical well-being for participants in the control group. Should you experience any issues during the course of the study, it is recommended that you visit Campus Health and Wellness. (Drop-in: UNC 337, Mon – Fri 10am – 3pm or call: 250-807-9270).

The benefits of increasing daily physical activity are well known. Short-term benefits of physical activity may include stress release, improved mood, and improved sleep. Further benefits occur when physical activity is done across a lifetime and include reduced risk of cardiovascular disease, diabetes and other common health concerns. Your results may help shape future health promotion programs and potentially better the health of other students. As thanks for your participation in this study, you will be entered to win an iPod Nano™ (approximate value $150 Cdn.).

All your responses will be treated as confidential. At no time, during the course of this present research, or at any time following the completion of this research, will any of your responses be made available in any form that would allow for your personal identification.

The data that are collected from this study may be used in academic publications and presentations; however, your identity will be protected at all times. All data that are collected during the study will be kept in a secure location within a UBC facility for a minimum of five years and will only be made accessible to the research team.

If you have any concerns about your rights as a research subject and/or your experiences while participating in this study, contact the Research Subject Information Line in the University of British Columbia’s Office of Research Services by email at RSIL@ors.ubc.ca or by phone 250-807-8832.

Any enquiries or concerns that you may have about this research can be directed to Dr. Cristina Caperchione at UBC Okanagan. She may be contacted by telephone at 250-807-9679, by email at cristina.caperchione@ubc.ca, or by mail care of the Faculty of Health and Social Development, 3333 University Way, Kelowna BC V1V 1V7.

Thank you for your valued contribution to this research project.

Kind Regards,

Dr. Cristina Caperchione
Participant Consent Form

I, _____________________________ consent to the following conditions regarding my participation in the above research project:

• I have received a copy of the information consent form.
• I consent to participate in this study as it has been outlined to me.
• I consent to the research investigators storing the data collected during this study in a secure location, only accessible by the investigators, for a minimum of 5 years in accordance with UBC policy.
• I consent to the use of this data for academic and research purposes, such as academic publications and presentations.

I have read the above information. The nature, the demands, risks and benefits of the project have been explained to me. I knowingly assume the risks involved, and understand that I may withdraw my consent and discontinue participation at any time without penalty or loss of benefit to myself. In signing this consent form I am not waiving my legal claims, rights or remedies.

NAME:__________________________     DATE: _____________________

SIGNATURE: _____________________________
Appendix D: Monthly Step Logs

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
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<th>Sat</th>
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</table>

**Pedometer Number: ______________** Due by Monday Oct 1\textsuperscript{st}

Questions or other issues contact Paul [Redacted] ASC 264

<table>
<thead>
<tr>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>9</th>
<th>10</th>
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<th>30</th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Daily Steps:</td>
<td>Tip of the month:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tip of the month:**

Try to increase your steps by 500 per week to a goal of 10,000 steps each day!

Don’t get discouraged if some days have more steps than others.

10 minutes of Moderate-intensity activity = 1,000 steps
10 minutes of High-intensity activity = 2,000 steps
Pedometer Number: ______________ Due by Thursday Nov 1\textsuperscript{st}

Questions or other issues contact Paul

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| 28 Daily Steps: | 29 Daily Steps: | 30 Daily Steps: | 31 Daily Steps: | Tip of the month: | Already at 10,000 steps per day? 
More physical activity provides greater health benefits! |

10 minutes of Moderate-intensity activity = 1,000 steps
10 minutes of High-intensity activity = 2,000 steps
Pedometer Number: ______________ Due by Monday Dec 3rd

Questions or other issues contact Paul, __________________ ASC 264

~ November 2012 ~

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Don’t forget to schedule an appointment to complete the follow-up questionnaires for your chance to win an iPod Nano!!!

Great work!

Thank you for participating!
Appendix E: Email Contact

E.1 Introductory Email

Hi ___(name)___,

Thank you for agreeing to participate in the study and wear a pedometer throughout your first term. I wanted to take this opportunity to connect with you and make sure you had all the information needed to participate. I'll try to keep it short!

Pedometers should be worn on the the right hip, in line with the knee. Try to wear the pedometer as many days as possible but don't worry if you miss a few here and there. Take the pedometer off when you sleep, shower, go in water, or perform any of the following activities: sports, swimming, biking, or weight lifting.

If you are performing activities that the pedometer won't read properly (listed above) be sure to add the extra steps to your daily count:
- 10 minutes of Moderate-intensity (lightly sweating, breathing heavy) = 1,000 steps
- 10 minutes of Vigorous-intensity (sweating heavily, out of breath) = 2,000 steps

To maximize the health benefits of walking, try to aim for 10,000 steps each day. Don't worry if you aren't quite there yet, we've got 3 months to work on it! If you try to increase your steps by 500 steps per week, you will be there in no time.

At the end of each month I will connect with you to make sure everything is going well. I'd also like to collect the monthly step log at this time. Logs can be dropped off anytime in the Arts and Sciences building, room 264 (ASC 264).

Try your best to keep the pedometers in good working condition by always attaching the safety clip. If you have any questions, happen to lose the pedometer, or it stops working, please contact me by phone or email and we will get you set up with a new one.

Paul Sharp
Graduate Student
Health and Exercise Sciences
University of British Columbia
Arts and Sciences, Room 264
E.2 End of Month 1 Email

Hi Everyone,

This is just a reminder that I'd like to collect your September step log calendar on October 1st! Please drop it off in the box outside my office (ASC 264) at your earliest convenience. Also, we have had a number of pedometers lost so please pick up a safety clip if you haven't already received one.

Most people know about the long term health benefits of walking but did you know that it can also improve your mood, reduce stress, improve your immune system, and actually help you remember MORE!

By monitoring your daily steps over the next two months, you may be able to notice trends in the amount of activity you do. Try being aware of days where your activity is low and come up with strategies to incorporate physical activity into your daily routine. For example, if you are traveling by bus, try getting off a few stops earlier and walking the extra distance.

Did you know that we also have walking trails around campus? While the weather is still nice check out some of the trails around the university:

http://www.ubc.ca/okanagan/students/health-wellness/UBCO_Trails.html.

Finally, keep working towards the goal of 10,000 steps per day!

Paul Sharp

Graduate Student
Health and Exercise Sciences
University of British Columbia
Arts and Sciences, Room 264
Hello everyone,

It's almost time to drop off your October Steps Log! Please drop it off in the box outside my office (ASC 264) on November 1st. It was great to see so many September logs returned. It looks like lots of you are progressing towards or have already achieved 10,000 steps per day!

As the weather cools off and exams pick up the amount of physical activity we do tends to drop off. Keep an eye on your daily steps and try to find ways to accumulate steps during this final month (November). It's a good idea to take short, 10 minute, study breaks and go for a walk. Researchers have found that this can actually increase the amount you remember when compared to the same amount of time just spent studying.

It is also free for students to use the indoor walking track located in the gymnasium!

At the end of November I will send out one final email to arrange a time to do the final assessment.

Thank you for your continued participation,

Paul Sharp
Graduate Student
Health and Exercise Sciences
University of British Columbia
Arts and Sciences, Room 264
E.4 End of Study Email

REMINDER: End of Pedometer Study!

Hi Everyone,

Thank you for your continued participation in my research study. We are coming to the end of the study but there is one last very essential task that needs to be completed: the follow-up assessment to see how your health has changed. Regardless of how often you wore the pedometer, completing the questionnaire is critical to the study. I have a surprise for everyone that completes the final survey and you will be entered in a draw to win an iPod Nano!

To complete the assessment, please stop by my office (ASC 264) between now and December 5th from 9am-5pm. Intervention participants can also drop off their pedometer (I need them back!) and November step log at this time.

I understand how busy the end of semester can be and I really appreciate you taking 10-minutes out of your study time to support my research. Please let me know if you have any questions.

Regards,

Paul Sharp

Graduate Student
Health and Exercise Sciences
University of British Columbia
Arts and Sciences, Room 264