The Influence of Sense of Community Belonging on Physical Activity

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Feeling connected to one's community has been associated with increased self-rated health and well-being. Connectivity has also been linked to health behaviours such as smoking and obesity, which have been related to overall health status. Physical activity is related to overall health status as it protects against many chronic diseases. Unfortunately, less than 50% of Canadian adults are meeting the physical activity requirements set out by Canada's Physical Activity Guide to Healthy Living. Thus, this study determines whether sense of connectedness is associated with current participation in leisure-time physical activity and intention to start or increase engagement in physical activity.

Cross-sectional data from the Canadian Community Health Survey (CCHS) cycle 3.1 was used to analyze the association between sense of community belonging and physical activity among Canadians aged 25 to 64. A series of logistic regression models were used to analyze the data.

People reporting a stronger sense of connectedness had greater odds of being physically active with income, education and sex often moderating the relationship. It appeared that the relative odds of being physically active were greatest among people who felt very strongly connected to their communities and in the highest socioeconomic groups. Further, feeling more that very weakly connected to the community increased the odds of intending to start or increase physical activity among inactive females and decreased the odds of intending to increase physical activity among moderately active males.

This study provides preliminary results regarding how important social factors may alter population level physical activity. The results from this study inform our understanding of barriers and facilitators associated with physical activity and how policies and conditions which affect community connectedness may be used to enhance physical activity.

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Without the unconditional love and support from my parents, Don and Diane, I would not be the person I am today. They have taught me to learn from my mistakes and to follow my dreams.

Dedication

It is an honour to my siblings, Nicole and David.

Although life may be difficult at times, always remember to let your heart choose your passion and your ability to succeed will follow.

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Chapter 1: Introduction and Overview

Approximately two-thirds of Canadians report feeling strongly connected to their local community (Shields, 2008). This sense of connection is reflective of a personal sense of belonging and close relationship to the social environment. Recent literature reveals that connectivity is related to well-being and self-reported health (Ross, 2005; Shields, 2008). For instance, those reporting a very strong or somewhat strong sense of community belonging were almost two times more likely to report excellent or very good general health than those reporting a weak sense of belonging (Shields, 2008). The concept of connectivity has also been applied to health behaviours such as suicide (Durkheim, 1952), smoking (McDonald, 2008; Christakis & Fowler, 2008) and obesity (Christakis & Fowler, 2007).These behaviours have been related to overall health status, which suggests that the way connectivity impacts health is through health behaviours.

It is widely accepted that regular physical activity is related to health and well-being. It is a main protective factor against many chronic diseases including circulatory diseases, type II diabetes mellitus and cancers (Warburton, Katzmarzyk, Rhodes & Shephard, 2007). Further, it has been repeatedly shown that physical activity enhances psychological well-being (Asztalos, De Bourdeaudhuij & Cardon, 2009; Warburton et al., 2007) with increasing frequency and intensity of activities resulting in better mental health status (Hamer, Stamatakis & Steptoe, 2009). With this in mind, it is possible that connectedness may influence participation in physical activity which in turn influences health.

According to the 1998 Canada's Physical Activity Guide to Healthy Living (CPAG), adults should aim to "accumulate 60 minutes of daily physical activity, or 30 minutes of moderate or vigorous exercise on at least four days a week" (Warburton et al., 2007, p. S19). Unfortunately, fewer than half of Canadian adults are meet these requirements (Health Canada, 2008). As a result, it is

estimated that physical inactivity is responsible for over 20,000 premature deaths per year in Canada (Katzmarzyk, Gledhill, & Shephard, 2000) and over $5.3 billion in direct and indirect costs in 2001 (Katzmarzyk & Janssen, 2004).

Increasing leisure-time physical activity may be a key factor to reduce the number of premature deaths and health care spending. As connectivity has been found to influence other health behaviours it may similarly influence physical activity. This study aims to determine whether and to what degree sense of community belonging is associated with current participation in leisure-time physical activity observed among Canadians and their intention to start or increase engagement in physical activity.

Chapter 2: Review of the Literature

The construct of connectedness has gained significant attention in the field of psychology. It has been considered an important factor in self-identity, mental health and well-being as it has been associated with loneliness, attachment, companionship, and belongingness (Townsend & McWhirter, 2005). Further, studies have measured how health and wellbeing are influenced by perceived connectedness to people and systems including family, school, work and community (Townsend & McWhirter, 2005). The perception of these relationships has been termed "social connectedness". Stated most clearly by Lee and Robbins (1998), "social connectedness reflects this internal sense of belonging and is defined as the subjective awareness of being in close relationship with the social world" (p. 338). In other words, people who perceive themselves as belonging within their family, school, community, etc may report better health and well-being. In fact, studies from Canada provide evidence that sense of community belonging *does* influence health and well-being.

2.1 Connectedness in Canada

Sense of community belonging is identified as a current health indicator by Statistics Canada (Statistics Canada, 2008). Previous studies determined that sense of community belonging is associated with wellbeing. Results from the 2000-2001 Canadian Community Health Survey (CCHS) revealed that 56% of Canadians aged 18 and older reported a very strong or somewhat strong sense of community belonging, with sense belonging increasing as age and income increased (Ross, 2002). Further, those who reported a strong sense of community belonging had almost double the odds of reporting very good or excellent health compared to those who reported a weak sense of belonging even after controlling for demographic variables such as age, education and income (Ross, 2002).

Using more recent data from the 2005 CCHS, Shields (2008) determined that the number of Canadians who reported a very strong or somewhat strong sense of community belonging had increased within all 10 of the Canadian provinces but decreased within the three territories since 2000/2001. In general, the percent of people who reported at least a somewhat strong sense of belonging rose from 56% to 64% (Shields, 2008). Similar to the study by Ross (2002), these data indicated that people in the lower household income quintiles and younger populations (with the exception of youth aged 12-17) reported lower levels of connectedness (Shields, 2008). Perhaps more importantly, self-perceived general health status was once again positively correlated with sense of community belonging after controlling for variables such as age and income. Shields (2008) found that people who reported a somewhat strong or very strong sense of community belonging had almost twice the odds of reporting very good or excellent self-perceived general health.

Expanding on Ross's (2002) study, Shields (2008) also explored the relationship between sense of community belonging and self-perceived mental health. She found that after adjusting for certain demographic and socioeconomic variables people who reported a very strong sense of community belonging had over twice the odds of reporting very good or excellent self-perceived mental health in comparison to those who reported a very weak sense of community belonging. Thus, there is a distinct association between sense of connectedness and self-perceived general and mental health. Although these studies add to our understanding of the relationship between connectivity and health, the association between sense of community belonging and self-perceived health that is revealed in these articles may not be the true causal path. Rather, there may be other mechanisms that may play a role in mediating this relationship.

2.2 Connectedness and Other Health Behaviours

The influence of social relationships and social structures on health and health behaviours has been researched as early as the 1890's. One of the founding fathers of sociology, Emile Durkheim, proposed that the act of suicide, which is commonly assumed to be a very individualistic act, was rather a result of social isolation (Durkheim, 1952). Conducting his research in France in the late 1800s, Durkheim was interested in how the degree to which a person was socially integrated within religious, domestic, and political societies influenced suicide. He concluded that "suicide varies inversely with the degree of integration of the social groups of which the individual forms a part" (Durkheim, 1952, p209). In other words, people who were more integrated within their social societies had a decreased risk of committing suicide than the socially isolated. This finding perhaps fuelled interest among researchers regarding how social integration, social networks and connectivity are associated with a variety of other health behaviours.

Over a century later, researchers continue to examine the influence of connectedness on health. Advanced technology and data collection methods allowed for one of the largest network studies to be conducted. The Framingham Heart Study is a longitudinal study that started by collecting data from over 5,000 people residing in Framingham, MA in 1948 (original cohort). Currently, this study has grown to include over 15,000 people including the original cohort, the offspring cohort (the original cohort's children and their spouses), and the generation three cohort (the original cohort's grandchildren) (Cacioppo, Fowler & Christakis, 2009). Using data from this study, researchers were able to determine how social networks influence health behaviours. By conducting cluster analysis, the spread of behaviours and emotions within social networks over the period of 50 years was able to be mapped. Cacioppo and colleagues (2009) hypothesized that, since people are embedded in

social networks, their emotions and behaviours would be influenced by those around them. When they analyzed the influence of social networks on emotions such as loneliness and happiness and behaviours such as obesity and smoking, their results supported this hypothesis.

The most recent study that used data from the Framingham Heart Study assessed whether the feeling of loneliness was induced by aspects of one's social network. Cacioppo and colleagues (2009) found that the average number of friends reported by people who experienced more lonely days during the week was lower than people who had less lonely days. In addition, it appeared that the number of lonely days that people reported decreased with each additional friend. Although number of friends appeared to be related to loneliness, it became apparent that the emotions of friends also matter (Cacioppo et al., 2009). For instance, if your friend felt lonely, then the risk of you feeling lonely is increased by approximately 50%. It was also found that people who were lonely tended to report fewer friends during each assessment and had fewer people reporting them as friends. Thus, people who had fewer friends (or more lonely friends) got lonelier which, in turn, made it difficult for them to attract new friends. As stated by Cacioppo and his colleagues (2009) "loneliness is both a cause and consequence of becoming disconnected" (p. 982); however, connecting lonely people to social networks that consist of happy people may prevent isolation.

Fowler and Christakis (2008) found that happiness can also spread through social networks. For instance, among participants, happiness increased by 25% if a nearby friend became happy and by approximately 70% if that nearby friend was a mutual friend (Fowler & Christakis, 2008). Furthermore, happiness increased by approximately 30% if a next door neighbour became happy, but was not influenced by the happiness of a distant friend or distant sibling. This suggests that geographical proximity may play an important role in the spread of happiness. Fowler and Christakis

(2008) also found that happiness spread up to three degrees of separation. In other words, if your friend's, friend's friend became happy, your happiness has the potential to increase by 10%. Interestingly, people in the core of their social networks tended to be happier and people in the periphery of their social networks tended to be less happy; this formed clusters of happy and unhappy people.

Beyond confirming that emotions can be influenced by social networks, Christakis and Fowler conducted additional studies, using the same data from the Framingham Heart Study, which looked at how social networks influenced health behaviours. The following paragraphs summarize the findings from their studies on the influence of social networks on obesity (2007) and smoking (2008).

Christakis and Fowler (2007) found that a person's risk of becoming obese increased by approximately 170% if their mutual friend were to become obese, 40% if their sibling became obese, and 35% if their spouse became obese. Similar to the study on happiness, these trends were apparent for up to three degrees of separation. Although increased social distance between contacts appeared to decrease the probability of becoming obese, increased geographic distance had no effect; this implied that the spread of behaviours or norms associated with obesity are more strongly influenced by social distance than geographic distance (Christakis & Fowler, 2007).

Alternatively, social networks and social norms may assist in promoting healthy behaviours. When Christakis and Fowler (2008) examined the influence of social networks on cigarette smoking they found that if a person identified someone in their social network as a smoker their risk of becoming a smoker increased by over 60%. Increased risk was observed in people who were separated by up to three degrees. More specifically, the risk of a person smoking decreased by over

40% if their mutual friend quit smoking, 25% if their sibling quit smoking, nearly 70% if their spouse quit smoking and 35% if their coworker quit smoking (Christakis & Fowler, 2008). In addition, Christakis and Fowler (2008) noted that in the year 1971 smokers and non-smokers equally occupied the centers of their social circles. However, as time advanced, most people had stopped smoking, and those who still did smoke were likely to be found at the periphery of their social networks. Interestingly, the results revealed the smokers and non-smokers tended to cluster in different social circles and that clusters of smokers became non-smokers simultaneously. Since entire clusters of smokers quit together programs and legislation that promoted smoking cessation may have been present during this time; however, Christakis and Fowler (2008) suggest that this phenomenon occurred because decisions to quit reflected the collective choice of the group rather than decisions made solely by the individual.

Both studies revealed that the risk of becoming obese and the probability of quitting smoking were not influenced by the behaviours of geographically close neighbours; however, they were increased if a geographically distant mutual friend or sibling became obese or quit smoking. This suggests that environmental factors may not have a substantial influence on these behaviours (Christakis & Fowler, 2007). Rather, Christakis and Fowler (2007) propose that the mechanism causing behaviour change may be the shift in norms regarding the specific behaviour. For instance, if a person observed his/her friend gain weight, he/she may perceive this as acceptable and also gain weight. Similarly, with the decrease in the number of smokers over the past 30 years, norms supporting the acceptability of smoking have greatly declined which may further deter current smokers from continuing this behaviour or non-smokers from starting.

Unfortunately, conducting a large longitudinal study that collects such detailed data similar to the Framingham Heart Study may be a difficult and time consuming task for other communities or countries. Further, one of the limitations of the studies conducted by Christakis and Fowler was that they did not take into account the participants' internalization of these relationships and their perceived sense of connectedness.

Intrigued by Christakis and Fowler's (2008) findings on the influence of connectedness in combination with results from Ross (2002) and Shields (2008) regarding sense of community belonging, McDonald (2008) looked at the influence of community belonging on smoking behaviours among Canadians over the age of 15 years. McDonald (2008) found that after adjusting for sex, age and income, the prevalence of smoking was greatest among people who reported a very weak sense of community belonging (30%) and lowest among people who reported a very strong sense of community belonging (19%). A significant interaction with age revealed that the way in which connectedness was associated with smoking was strongest for those between the ages of 12-24. Within this age group, over 20% of people who had reported a very strong sense of community belonging were smokers; however, the prevalence of smoking doubled among those who reported a very weak sense of community belonging. In addition, McDonald (2008) found that a greater proportion of smokers who had a somewhat strong or very strong sense of community belonging quit for at least 24 hours within the last year than those reporting a somewhat weak or very weak sense of belonging. Finally, approximately 70% of Canadians who reported a very strong or somewhat strong sense of community connectedness intended to quit smoking in the next six month. This was significantly higher than people who reported a somewhat weak and very weak sense of connectedness.

These studies lend evidence that people are connected and as a result their health behaviours are influenced by their social networks and sense of connection to their community.

2.3 Health Behaviours Influence Overall Health Status

It is understood that behaviours such as smoking, poor diet and lack of physical activity are often the cause of chronic disease and other negative health outcomes. For instance, smoking causes cardiovascular and respiratory diseases, multiple cancers and negative reproductive effects (US Department of Health and Human Services, 2004). Likewise, lack of physical activity and a poor diet are risk factors for becoming overweight or obese, which in turn increase the risk of developing hypertension, type II diabetes, coronary heart disease and stroke, osteoarthritis, and breast and colon cancers (Luo et al., 2007).

A Canadian study that looked at the predictors of self-reported health assessed whether self-perceived health status was influenced by having one or more chronic conditions including, but not limited to, asthma, high blood pressure, diabetes, heart disease, and/or cancer (Shields & Shooshtari, 2001). The results from this study revealed that women who had one or more chronic conditions and men who had two or more chronic conditions were less likely to report very good or excellent health compared to those who had no chronic conditions. Furthermore, the diagnosis of a new chronic condition decreased the likelihood of reporting very good or excellent health and increased the likelihood of reporting fair or poor health compared to those who were not diagnosed with a new chronic condition (Shields & Shooshtari, 2001).

Based on the results of this study, it is evident that the diagnosis of one or more chronic conditions influences self-perceived general health status. Thus, it can be suggested that rather than directly influencing self-perceived mental and physical health, the way connectedness impacts on

perceptions of health is indirectly through health behaviours (Figure 1). With this in mind, this study will explore whether an association exists between connectivity and leisure-time physical activity, which may ultimately impact health.

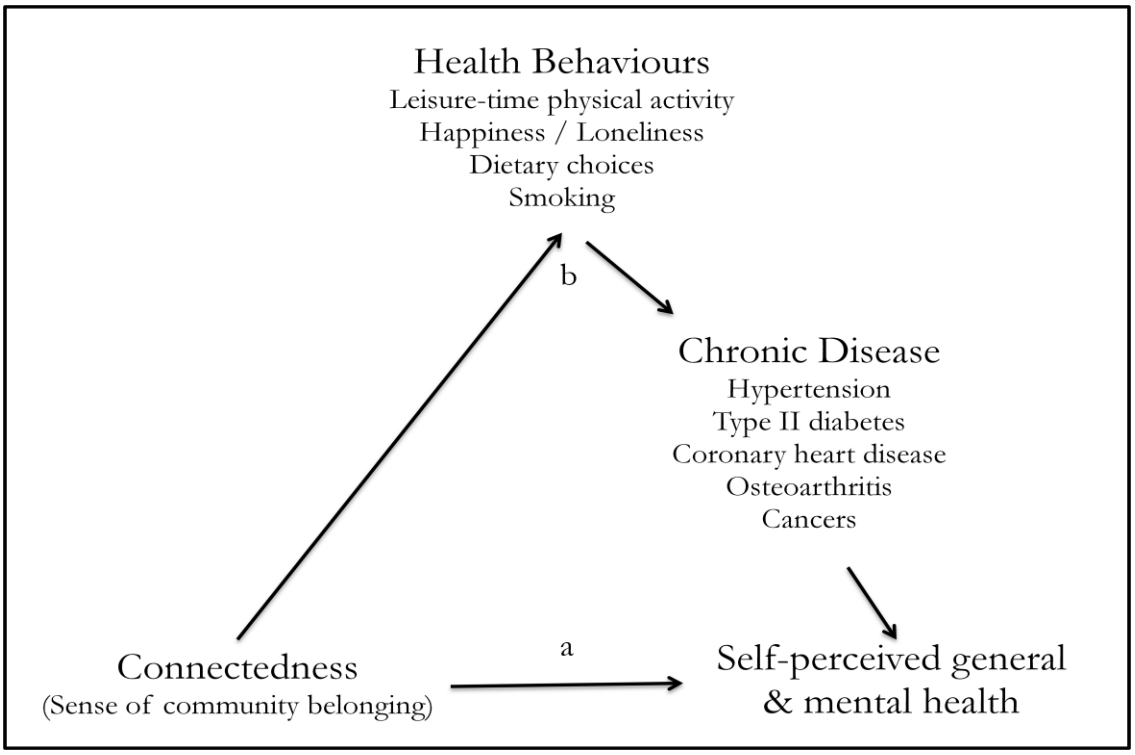

Figure 1: Summary of the various pathways in which sense of connectedness may influence health. (a) Connectedness directly influences self-perceived general and mental health status (Ross, 2002; Shields, 2008); (b) Connectedness indirectly influences self-perceived general and mental health status through health behaviours.

2.4 Leisure-Time Physical Activity

Leisure-time physical activity is an important non-medical health determinant (Statistics Canada, 2008). It is defined as physical activities not performed at work and is measured using daily energy expenditure (DEE). DEE is calculated by multiplying the number of times an activity was performed (over the past three months) by the average duration of the activity and then by the energy cost (kcal/kg of body weight/hr) (Statistics Canada, 2008). Table 1 displays the classifications of people based on their DEE calculations as well as an example of the amount of physical activity required to meet these thresholds. Based on these classifications, over 25% of Canadians over the age of 12 are physically active, 25% are moderately active, and almost 50% are inactive (Statistics Canada, 2007).

Table 1: Physical activity classifications based on the DEE scores and the estimated amount of physical activity required to meet these thresholds.

DEE Score	Classification	Amount of Physical Activity
<1.5 kcal/kg/day	Inactive	Walking <30 minutes
1.5 – 2.9 kcal/kg/day	Moderately active	Walking 30-59 minutes
≥3.0 kcal/kg/day	Physically active	Walking ≥60 minutes

Note: adopted from Katzmarzyk (2006).

2.4.1 Physical activity protects against chronic diseases

Chronic diseases are the leading cause of death in the world (WHO, 2009). In 2004, chronic diseases accounted for approximately 70% of all deaths in Canada, with the main contributors being circulatory diseases, cancers, respiratory diseases and diabetes mellitus (Public Health Agency of Canada, 2009). Further, in 2005 approximately one third of Canadians over the age of 12 reported having at least one chronic condition (Broemeling, Watson, & Prebtani, 2008). This high prevalence

of chronic disease accounted for approximately $112 billion per year in direct and indirect costs from 1998 to 2003 (Patra et al., 2007).

Regular participation in physical activity has the potential to protect against the most common chronic diseases (Warburton et al., 2007). People who are physically inactive have an increased risk of developing breast cancer, colon cancer, hypertension, coronary artery disease, type II diabetes, osteoporosis or succumbing to stroke relative to their physically active counterparts (Table 2) For instance, inactive people have 1.5 times greater risk of developing type II diabetes than active people (Katzmarzyk & Janssen, 2004).

Table 2: Relative risk estimates of developing a common chronic disease among people classified as inactive compared to people classified as active.

Disease	Relative Risk	Confidence Interval
Hypertension	1.30	1.16 – 1.46
Breast cancer	1.31	1.23 – 1.38
Colon cancer	1.41	1.31 – 1.53
Coronary artery disease	1.45	1.38 – 1.54
Type 2 diabetes	1.50	1.37 – 1.63
Osteoporosis	1.59	1.40 – 1.60
Stroke	1.60	1.42 – 1.80

Note: adopted from Katzmarzyk and Janssen, 2004.

These relative risk estimates should be interpreted with caution as different components of physical activity (frequency, intensity, time and type) are better suited for protecting against certain conditions. For instance, 30-60 minutes of aerobic exercise four to seven days a week assists in preventing and treating hypertension, whereas 30-45 minutes of moderate to vigorous physical activity on most days is a recommended intervention to prevent breast and colon cancers

(Warburton et al., 2007). To prevent or treat type 2 diabetes, aerobic and resistance activities are recommended and weight-bearing and impact exercises are suggested to prevent osteoporosis (Warburton et al., 2007).

There is a considerable amount of evidence demonstrating a dose-response relationship between physical activity and many chronic diseases (Warburton et al., 2007). Studies have illustrated that increased participation in physical activity can result in a decreased risk of developing a chronic disease whereas reductions in physical activity caused increased risk (Warburton et al., 2007). With this in mind, it has been suggested that the greatest improvements in population physical activity levels would occur if inactive individuals became at least moderately active, if not vigorously active (Erikssen, 2001; Warburton et al., 2007). More specifically, Katzmarzyk and Janssen (2004) predict 13% to 25% of chronic disease cases could be eliminated if sedentary people became physically active.

2.4.2 Physical activity enhances mental health

Reviews on the effects of physical activity on mental health status in the general population have continuously revealed a positive correlation between participation in physical activity and decreased depression and anxiety, and increased health-related quality of life and wellness (Bize, Johnson & Plotnikoff, 2007; Warburton et al., 2007). Particularly, increases in leisure-time physical activity are associated with enhanced physical health, mental health, and vitality in both men and women (Tessier et al., 2007). Further, the results from a longitudinal study revealed that psychological benefits of increased leisure-time physical activity were greater than physical benefits (Tessier et al., 2007).

Apart from a general association between physical activity and mental well-being, there appears to be a dose-response relationship for specific disorders. For men, engaging in more vigorous bouts of physical activity resulted in greater emotional well-being and was protective against depression, anxiety and other psychiatric disorders; there was no association between the intensity of physical activity and mental health for women (Asztalos et al., 2009). Alternatively, Cerin and colleagues (2009) found a linear positive relationship between psychological health and the frequency, duration and intensity of leisure-time physical activity in men and women with participation in more vigorous activities resulting in the strongest psychological benefit. With such profound health benefits resulting from participation in regular physical activity, determining predictors of leisure-time physical activity can greatly improve the health of Canadian populations.

2.5 Determinants of Participation in Physical Activity

It is probable that the high concentration on the clinical and biomedical fields branches from the intense focus on individual factors influencing health behaviours and disease outcomes observed during the mid 20th century. After the shift from the infectious disease era to the chronic disease era in the late 1940's most research on health behaviours was focused on individual risk factors (Susser & Susser, 1996). Little attention was given to the health of populations as the "black box" paradigm of this time could not clearly explain societal forces that influenced health (Susser & Susser, 1996). Fortunately, the importance of environmental and social determinants on health behaviours is gaining more recognition by researchers. An overview of how individual, environmental and social determinants of participation in physical activity are presented in the following sections.

2.5.1 Individual and demographic determinants of participation in physical activity

Research on adult physical activity has focused predominately on individual-level variables, such as self-efficacy, motivation and intentions (McNeill, Wyrwich, Brownson, Clark, Kreuter, 2006b). Self-efficacy has been a key component in many health models that intended to change behaviour. For instance, Albert Bandura, father of the Social Cognitive Theory defines perceived self-efficacy as the "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). From a different perspective, people who have high self-efficacy in regards to physical activity believe that they have the ability and means to be physically active and thus may be more likely to integrate regular physical activity into their lifestyle. McNeill and colleagues (2006b) found that among lower- and middle-income adults, self-efficacy had a positive effect on walking and engagement in moderate and vigorous physical activities. In addition, they measured levels of intrinsic (behaviour is performed for pleasure and enjoyment) and extrinsic (behaviour is performed as a means to an end, such as weight loss) motivation and found that intrinsic motivation was positively associated with self-efficacy and extrinsic motivation was negatively associated with self-efficacy (McNeill et al., 2006b). This suggests that people who engage in physical activity for enjoyment have an increased self-efficacy towards being physically active which, in turn, is positively associated with walking or engaging in moderate or vigorous physical activities. On the other hand, people who are motivated to exercise to achieve a goal such as losing weight, have lower self-efficacy which may then lead to lower levels of physical activity. Both self-efficacy and motivation influence the maintenance of a physically active lifestyle over an extended period of time as well as shape the formation of intentions to exercise among inactive people (Bandura, 1995).

Intentions are often used to predict people's behaviour. As a strong focus in Theory of Planned Behaviour and Theory of Reasoned Action, intentions are based on one's attitudes towards the behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991). For instance, if a person has a positive attitude towards the benefits of being physically active, perceives that other people think he should be physically active, and he feels he has control over integrating physical activity into his daily schedule then he would have a greater intention to become physically active. A recent Canadian study assessing the intention-behaviour relationship for leisure-time physical activity found that among a sample of 300 men and women aged 18-55 intention was a significant determinant of being physically active (Amireault, Godin, Vohl & Perusse, 2008). As Ajzen (1991) stated "[i]ntentions are assumed to capture the motivational factors that influence a behaviour; they are indications of how hard people are willing to try, how much of an effort they are planning to exert, in order to perform a behaviour." (p.181). Thus, from a health promotion perspective, by recognizing which people have a stronger intention to perform a specific behaviour, such as exercising, there is the possibility that less resources would be required to get these people to start and maintain healthy behaviours.

There are multiple demographic characteristics that are also associated with participation in physical activity. For instance, it is common for men to be more physically active that women and for participation in physical activity to decrease with age. According to 2008 data, approximately 55% of males were at least moderately active during their leisure time whereas only 45% of females were at least moderately active (Statistics Canada, 2010). Additionally, almost 70% of youth aged 12-19 were physically active during their leisure time; however among those aged 65 and over, only 45% reported being at least moderately active during their leisure time (Statistics Canada, 2010).

Interestingly, marital status also influences participation in physical activity such that unmarried people are more physically active than married people (Sherwood & Jeffery, 2000).

Socioeconomic determinants, such as income and education, also influence participation in physical activity (Sherwood & Jeffery, 2000). It is common for people who have higher income and educational attainment to be more physically active than those with lower income and education after controlling for age (Liu, Wade, Faught & Hay, 2008; Pan et al., 2009; Sherwood & Jeffery, 2000). Ethnicity may also influence participation in physical activity, as studies have revealed that Caucasian adults tend to be more physically active than African American or Hispanic adults (Sherwood & Jeffery, 2000). Likewise, people born outside of Canada are less likely to be physically active than those born within Canada (Liu et al., 2008).

Other negative health behaviours are commonly associated with physical inactivity. For instance, there is an abundance of literature supporting the notion that current smokers are less physically active than non-smokers (Liu et al., 2008; Nagaya, Yoshida, Takahashi & Kawai, 2006). In contrast, there have been mixed results regarding the association between alcohol use and physical activity. Some studies report no association between the two behaviours (Paavola, Vartiainen, & Haukkala, 2004), while other report that an increase in alcohol consumption is associated with increases in physical activity, to a certain extent (Smothers & Bertolucci, 2001). It may be, however, that the clustering of such behaviours is due to environmental and social factors.

2.5.2 Environmental determinants of participation in physical activity

Although there is strong evidence that personal attributes are predictive of participation in physical activity, there is additional evidence proposing that the physical environment in which people are embedded plays a role in promoting or inhibiting physical activity (Pan et al., 2009). Pan

and colleagues (2009) found that environmental factors such as perceived availability of facilities, including the number of multi-purpose recreation trails and facilities, and the number of programs or places designed specifically for sports or physical activity were independently associated with physical activity, especially among people with a university degree. Furthermore, McNeill, Kreuter and Subramanian (2006a) supported the finding that physical activity is directly related to the availability of recreation facilities as well as to perceived neighbourhood qualities related to pleasantness, traffic and crime, which may in part be determined by the social environment.

2.5.3 Social determinants of participation in physical activity

The impact of the social environment on physical activity is gaining more recognition by researchers (Vrazel, Saunders & Wilcox, 2006). Social support, an important aspect of the socio-cultural environment, is repeatedly shown to have a positive association with general physical activity and participation in moderate or vigorous activities among men and women (Wendel-Vos, Droomers, Kremers, Brug & van Lenthe, 2007). For instance, a meta-analysis on physical activity among adult women revealed common themes of women reporting the perception of physical activity not being an appropriate behaviour for adult women, lack of role models in their intermediate and larger social environments, and lack of acceptance and support for being physically active (Vrazel et al., 2006). According to a Swedish study by Lindström, Hanson and Östergren (2001), low leisure-time physical activity is associated with psychosocial variables. They found that females with low perceived instrumental support were less likely to be active during their leisure time compared to females who had high perceived instrumental support. In this case, instrumental support was defined as a person's access to advice, guidance, information, services and material resources.

An alternative view may be that the social networks people are a part of and the social norms inherent in these networks are the mechanisms influencing participation in physical activity similarly to how they have influenced other health behaviours such as smoking and obesity (Christakis & Fowler, 2007; Christakis & Fowler, 2008). According to results from Lindström and colleagues (2001) it is highly possible that psychosocial variables, such as social participation and social anchorage, may explain why some people are more active than others.

Lindström and his colleagues (2001) found that people with low social participation (defined as being part of three or fewer formal or informal social groups) had approximately 2.5 times greater risk of having low leisure-time physical activity than people with high social participation. Similarly, those with low social anchorage (defined as the *extent* to which one is part of the formal and informal groups, e.g. feeling of membership, position of trust, etc.) had approximately 1.5 times greater risk of having low leisure-time physical activity.[1] Although this finding is of interest, the main purpose of the paper by Lindström and his colleagues (2001) was to determine whether demographic and psychosocial variables assisted in explaining the socioeconomic differences in leisure-time physical activity. Similar to the unadjusted model, they found that in the models that adjusted for age, country of origin, and previous/current disease status, the less advantaged socioeconomic groups were at greater risk of having low leisure-time physical activity. However, once social participation was added into the model, the association between socioeconomic status and physical activity vanished (Lindstöm et al., 2001). This interesting finding suggests that the influence socioeconomic status has on physical activity may be slightly overestimated; participation

[1] It should be noted that for this analysis, each variable was entered independently; thus the odds above reflect the unadjusted influence each variable has on leisure-time physical activity.

in leisure-time physical activity may be attributed to active participation in formal and informal groups within society.

A similar, however more recent, study by Lindström, Moghaddassi and Merlo (2003) assessed how demographic variables, socioeconomic status and social participation influenced physical inactivity among people living in different neighbourhoods. They found that, at an individual level, low levels of social participation increased the risk of being physically inactive by approximately 3.5 when no other variables were accounted for. When age, sex, country of origin, and educational level were added into the model, those with low social participation still had over three times the risk of being physically inactive than those with high social participation. Further, social participation, in combination with age, sex, country of origin and educational level, may assist in explaining differences in participation in physical activity among people in different neighbourhoods. It may be that people who have higher social participation feel more connected to their neighbourhoods or communities. If this is true, then the above studies lend further evidence that connectivity is an important determinant of participation in leisure-time physical activity.

Unfortunately these studies are not without limitations. In the earlier study, only people between the ages of 45 to 64 were included; thus, it is unknown whether social participation has the same influence on younger or older age groups. In the latter study, leisure-time physical activity was assessed by one multiple choice question offering four answers (first choice: "completely sedentary leisure time physical activity status" to fourth choice: "hard and regular training at the elite level"). The answers were then collapsed into a dichotomized variable consisting of inactive (first choice) and active (all other choices). There was no reference to the validity or reliability of this measure, whereas collecting data to calculate a DEE may have allowed for a more accurate measure of

physical activity. Both of these studies had relatively large sample sizes; however they only controlled for a few variables. For instance, the latter study had a sample size of almost 3,400 and only controlled for age, sex, country of origin, education level, social participation and mobility. A study with such a generous sample size could have considered other variables associated with physical activity such as marital status, smoking status, etc. Since norms and social networks are constantly changing, data that was collected in 1994 from Sweden may not provide an accurate portrayal of how connectedness influences physical activity in present day Canada.

Taking into consideration the limitations of these two studies which have linked social participation to physical activity, this study aims to build on the literature to determine whether sense of connectedness is equally important in influencing physical activity among Canadians.

Chapter 3: Study Rationale and Research Questions

It is evident that sense of community belonging is related to perceptions of general and mental health status. Further, connectedness has also been related to emotional states and health behaviours including loneliness, happiness, obesity and smoking. These emotions and health behaviours are ultimately linked to perceptions of health and well-being. There is an abundance of literature supporting that participation in regular physical activity is beneficial to physical and mental health, and in most cases increases in physical activity lead to even better health status.

In the past, a majority of research pertaining to physical activity has focused on biomedical and clinical aspects of this behaviour; thus, there is strong support that individual and demographic characteristics are associated with participation in physical activity. A limited amount of research has focused on physical activity at the population level. Studies that have adopted this approach have identified environmental factors, such as availability of recreation facilities and neighbourhood pleasantness, and social factors, such as social support and social participation, as possible determinants of participation in physical activity.

More specifically, only two studies have looked at how connectedness (defined by social participation) influence leisure-time physical activity. Although there appears to be a positive association between connectedness and leisure-time physical activity, the limitations of these studies prevent them from accurately determining how connectedness influences physical activity in a Canadian population. Thus, this study will be the first to unmask the association between connectedness and physical activity among Canadians.

3.1 Purpose

The main objective of this paper is to determine how sense of connectedness influences participation in physical activity among Canadians. The secondary objective is to determine how sense of connectedness influences the intention to start or increase physical activity among inactive and moderately active Canadians.

3.2 Research Questions

The following research questions were developed to guide the research and assist in obtaining the objectives:

1. Are people who have a stronger sense of community belonging more likely to engage in higher amounts of physical activity?
    a. Is this relationship consistent after adjusting for potential confounding and moderating variables?
    b. Assuming that there is a relationship between sense of community belonging and physical activity, how does this relationship vary in respect to age, sex, income and education?
2. Among those who are classified as inactive or moderately active, are people who have a stronger sense of community belonging more likely to intend to start or increase their engagement in physical activity?
    a. Is this relationship consistent after adjusting for potential confounding and moderating variables?

b. Assuming that there is a relationship between sense of community belonging and intention to engage in physical activity, how does this relationship vary in respect to age, sex, income and education?

Chapter 4: Methods

This study is a secondary analysis of cross-sectional data collected from the 2005 Canadian Community Health Survey (CCHS) (Cycle 3.1). The following description contains a summary of the methods used to collect and organize the data from the CCHS. A more detailed description can be found in the public use micro-data file user guide (Statistics Canada, 2006a).

4.1 Context for the Study

The Canadian Community Health Survey (CCHS) is a cross-sectional survey that gathers information related to the health status and health determinants of Canadians. The CCHS collects data every two years, alternating between a large, general population health survey intended to provide reliable results at the health region level (identified as the ".1" survey) and a smaller more focused survey intended to provide provincial level estimates on specific health topics (identified as the ".2" survey). This study uses a subset of data from 2005 CCHS (Cycle 3.1), which is the large, general population health survey, to answer the research questions. Although this is not the most recent CCHS data set, it is the most recent data set available for public use that contains all the variables of interest.

4.2 Canadian Community Health Survey Respondents

Responses for the full 2005 CCHS were collected from Canadians aged 12 years and older who resided in private occupied dwellings located in 122 health regions throughout all provinces and territories. Institutional residents, full-time members of the Canadian Forces, people living on Indian Reserves and on Crown Lands, and residents of certain remote areas were excluded from this sampling frame. A total of 168,464 households were selected to participate in the 2005 CCHS. Of these selected households a response was obtained from 143,076 (84.9%). One individual from each

household (n=143,076) was selected to participate, out of which 132,947 (92.9%) provided valid responses. Thus, the overall response rate for the 2005 CCHS was 78.9%.

4.3 Participants

For the purposes of this study, only people between the ages of 25 and 64 years (n = 80,061) were included. People younger than 25 years were excluded to avoid floor effects; people younger than 25 are likely to be single, have lower educational attainment and an unknown or lower household income. People over the age of 65 were excluded due to different physical activity requirements as outlined by the Canadian Physical Activity Guide (Public Health Agency of Canada, 2003). Unfortunately, since data collection procedures focused on gathering responses from people based on the health regions they resided in rather than their age group response rates for this sample could not be calculated; however it is possible that they would reflect the overall response rate of the entire CCHS.

4.4 Procedures

Data from the CCHS cycle 3.1 were collected between January 1st 2005 and December 31st, 2005. Data were downloaded from the Tri-University Data Resources Nesstar Web-retrieval System. Recoded variables were created for intention to engage in physical activity, age, marital status, income and smoking status. A detailed description and explanation of these new variables can be found in their corresponding subheadings in the measures section.

Like all studies, sampling may not reflect the true characteristics of the general population; thus population weights were created by the survey designers to adjust for any over sampling of health regions, out-of-scope households (e.g. residences that are vacant or under construction) and telephone numbers (e.g. business, institutional, or not-in-service numbers), and household and

person non-response. These weights ensured that for each health region, the proportion of people in each age and sex group were reflective of the general population in that health region. However, since this study only uses a proportion of the CCHS data, scaled weights were created to reflect the sample of 25-64 year olds. Furthermore, for the second research question the measure of intention was only asked to residents of Ontario, Manitoba, and Newfoundland and Labrador; thus a second scaled weight was calculated to answer the questions relating to intention.

Creating these scaled weights was done by finding the average of the population weight for each sample (the first including only 25-64 year olds and the second including only 25-64 year olds who provided a valid response for intention) and then dividing each individual's population weight by the average of the population weight. For instance, the mean of population weight for all people aged 25-64 was 219.914. Thus, if an individual's population weight was 93.55 their sample weight would be 0.547.

$$\text{Sample weight} = \frac{\text{population weight}}{\text{mean of population weight}}$$

$$= \frac{93.55}{219.914}$$

$$= 0.547$$

The first scaled weights were applied to the chi-square analyses which were used to define the sample and the logistic regression models used to answer the first research question. The second scaled weights were used to answer the second research question. By applying the scaled weights to the statistical procedures, inferences can be generalized at the population level.

4.5 Measures

4.5.1 Current participation in leisure-time physical activity

To determine participants' engagement in leisure-time physical activity, that is, activities not related to work, respondents were asked "Have you done any of the following in the past three months, that is from [Date three months ago] to yesterday?" (PAC_Q1). The interviewer then listed 21 different physical activities in which the respondent could answer "yes" indicating that they had

Table 3: List of physical activities used to determine participants' daily energy expenditure (DEE)

Walking for exercise	Exercise class or aerobics
Gardener or yard work	Downhill skiing or snowboarding
Swimming	Bowling
Bicycling	Baseball or softball
Popular or social dance	Tennis
Home exercises	Weight-training
Ice hockey	Fishing
Ice skating	Volleyball
In-line skating or rollerblading	Basketball
Jogging or running	Soccer
Golfing	

participated in that activity or "no" indicating that they had not participated in that activity (Table 3). An "other" category was included for respondents who participated in physical activities that were not listed by the interviewer and a "no physical activity" category was added for those who did not partake in any physical activity.

Respondents who indicated that they had participated in any of the physical activities listed in Table 3 were asked about the number of times in the past three months they engaged in the identified activity (PAC_Q2n). The maximum number accepted for all activities except "walking", "bicycling" and "other activities" was 99. The maximum number accepted for "walking" was 270

and the maximum number accepted for "bicycling" and "other activities" was 200. To determine the duration spent on each activity, participants were asked "About how much time did you spend on each occasion?" (1-15 minutes; 16-30 minutes; 31-60 minutes; more than one hour)(PAC_Q3n). These variables were used by the survey designers to calculate the Daily Energy Expenditure (DEE) for each participant.

Based on the DEE calculations, the survey designers created a physical activity index which categorizes participants into three groups: inactive (DEE < 1.5 kcal/kg/day), moderately active (DEE 1.5 – 2.9 kcal/kg/day), and active (DEE ≥ 3.0 kcal/kg/day). These measures used to assess participation in leisure-time physical activity were modeled after the Minnesota Leisure Time Physical Activity Questionnaire (Taylor, Jacobs, Schucker, Knudsen, Leon & Debacker, 1978) and has previously been used by Liu et al. (2008) and the Canadian Fitness and Lifestyle Research Institute (CFLRI) (2005). Bryan and Katzmarzyk (2009) determined that the method used to calculate the DEE of activities from the "other" category may cause the energy expenditure from light and vigorous activities to be underestimated and the energy expenditure from moderately intense activity to be overestimated. This may have important implications when calculating individual DEE's; however, fortunately, at the population level, this method of calculation does not affect classifications (Bryan & Katzmarzyk, 2009).

4.5.2 Intention to start or increase engagement in physical activity

Intentions are a key component in predicting behaviour in the Theory of Reasoned Action and Theory of Planned Behaviour (Ajzen, 1991). Intentions are often measured by asking direct questions relating to the behaviors in question and getting the respondent to indicate on a seven-point scale how likely they intend to perform the behaviour (Ajzen & Madden, 1986). Similarly

research assessing intentions to be physically active have used Likert scales to directly measure whether individuals have decided to, plan to, or will try to increase their physical activity during their leisure time in the next week to next three months (Amireault et al., 2008; Shen, McCaughtry, & Martin, 2008). Although no similar measure is available from the CCHS, behavioural intentions are important to measure because people with an intention to adopt certain behaviour may require less time and resources to commence and maintain behaviour change.

An optional module in the questionnaire was "changes made to improve health". This component was completed by people residing three out of the 10 Canadian Provinces: Newfoundland and Labrador, Ontario, and Manitoba. A total of 22,801 people aged 25-64 were administered this module of which 22,055 provided valid responses. To determine intention to start or increase physical activity people residing in these provinces were asked "Is there anything you intend to do to improve your physical health in the next year?" (yes; no)(CIH Q7). If participants answered "yes", they were asked "What is that?" (start/increase exercise, sports/physical activity; lose weight; change diet/improve eating habits; quit smoking/reduce amount smoked; drink less alcohol; reduce stress levels; receive medical treatment; take vitamins; other-specify)(CIH_Q8).

Intenders, that is, those who intended to start or increase their physical activity, consisted of all people who answered "yes" to intending to do something to improve their health and selected "intending to start/increase exercise, sports/physical activity" when they were asked "What is that?" Those who answered that there was nothing they intended to do to improve their health and those who answered that there was something they intended to do but it was not to start/increase exercise, sport/physical activity were categorized as non-intenders and were used as the reference group.

4.5.3 Sense of community belonging

Sense of community belonging was measured by asking participants "How would you describe your sense of belonging to your local community? Would you say it is: very strong? somewhat strong? somewhat weak? or very weak?" (GEN Q10). For the purposes of this study, respondents who considered their sense of community belonging to be "very weak" were used as the reference group. Sense of community belonging has been previously by Statistics Canada researchers Ross (2002) and Shields (2008) to determine its association with self-reported general and mental health status. The use of this measure in Statistics Canada research and it's classification as an important health indicator by Statistics Canada (2008) warrants it some validity and reliability.

4.5.4 Potential moderating variables

Moderators are best described as "characteristics of the persons, settings, or circumstances...that can enhance or depress the effect of interventions" (Green & Kreuter, 2005, p.204). In this case, moderating variables would be individual characteristics that may increase or decrease the effect of community belonging on current participation in or intention to engage in physical activity. The potential moderating variables that will be examined in this study are sex**,** age, and measures of socioeconomic status. These variables have been associated with sense of connectedness (Ross 2002; Shields, 2008) and physical activity (Liu et al., 2008; Pan et al., 2009; Sherwood & Jeffery, 2000); however the effect they may have on the relationship between connectedness and physical activity has not previously been assessed.

4.5.4.1 Sex

Sex was recorded by the interviewer before the start of the interview (male; female). Female was used as the reference group.

4.5.4.2 Age

Age was determined by asking participants "What is your age?" (ANC_Q03). Based on their response, participants were categorized into four groups (20-29; 30-39; 40-49 and 50-64). These groups were selected because the nature of social interactions is similar within each group. For instance, those aged 25-29 years are typically finishing school, moving away from home and starting careers and thus their social interactions revolve around these life transitions; 30-39 year olds are solidifying their careers and starting families thus their social connections consist primarily of work and family contacts (Berk, 2008). The number of close friendships and social interactions generally start to decrease after the age of 40 and friendships with family members start to strengthen; finally for people 50-64, possible life events may include retirement and becoming a grandparent, and as a result the number of close friends continues to decline and ties with family become increasingly important (Berk, 2008).

4.5.4.3 Socioeconomic status

Income, education, and employment status were used as proxies for social economic status. It has been shown that education and income are predictors of physical activity as those with lower education and income are less likely to be physically active (Pate et al., 1995; Pan et al., 2009). In addition, people with lower levels of education and income tend to have a lower sense of belonging (Ross, 2002; Shields, 2008).

Income was measured by asking participants to "best estimate [their] household income, before taxes and deductions, of all household members from all sources in the past 12 months" (INC_Q3). Participants who did not know their household income were prompted with questions to obtain a best estimate (INC_Q3A – INC_Q3G). Responses were then grouped by the survey designers into

the following categories: No income or less than $15, 000, $15,000 to $29,999, $30,000 to $49,999, $50,000 to $79,999, and $80,000 plus. After preliminary analysis, models suggested that there was an inaccurate response distribution. As a result, the two lowest income categories (no income or less than $15,000 and $15,000 to $29,999) were collapsed into one category and renamed "less than $30,000" and this category served as the reference group.

Based on questions regarding the educational background of respondents (EDUE_1, EDUE_2, EDUE-3, and EDUE_4), the survey designers created a variable that categorizes the highest level of education attained by respondent into four levels: less than secondary school graduation (reference group); secondary school graduation; some post-secondary education; and post-secondary degree or diploma).

Employment status as was ascertained by asking participants "Have you worked at a job or business at anytime in the past 12 months?" (yes, no). People who replied that they had worked anytime during the past 12 months were the reference group.

4.5.5 Control variables

It is possible that the relationship between sense of community belonging and physical activity exists due to confounding by other variables. Controlling for potential confounding variables is done to provide a clear as possible association between community belonging and physical activity. Ideally, researchers aim to control for as many potential confounding variables as possible, however some variables that would have been interesting to include in this study, such as geographic location, obesity, chronic conditions, and injury, were either unavailable in the data set or may have lead to a story outside of the scope of this thesis. The exclusion of these variables is further commented on in the limitations section located in Chapter 6. The confounding variables that were taken into

consideration for this study were marital status, smoking status, alcohol use, country of birth and race.

4.5.5.1 Marital status

Participants were asked "What is your marital status? Are you married, living common-law, widowed, separated, divorced, or single, never married?" Response options were collapsed into two categories. The first category consisted of married and common-law people; the second category consisted of widowed, separated, and divorced and single people.

4.5.5.2 Smoking status and alcohol use

Unhealthy behaviours that increase peoples' risk for chronic diseases tend to cluster together among certain individuals. For instance, there is evidence that people who smoke are less likely to partake in physical activity than non-smokers or former smokers (Conway & Cronan, 1992). Further, preliminary research by McDonald (2008) reveals a negative association between connectedness and smoking; the prevalence of smoking increases as sense of community belonging decreases. Smoking status was determined by asking "At the present time, do you smoke cigarettes daily, occasionally or not at all?" (daily; occasionally; not at all) (SMQ Q202). Participants who responded that they were daily or occasional smokers will be classified as smokers and participants who responded that they didn't smoke at all will be classified as non-smokers (reference group).

Similar to smoking, alcohol use may also influence participation in physical activity. Alcohol use was determined by asking participants "During the past 12 months, how often did you drink alcoholic beverages?" (Less than once a month; once a month; 2 to 3 times a month; once a week; 2 to 3 times a week; 4 to 6 times a week; everyday)(ALCE_Q2). People who reported that they had not consumed any alcoholic beverage in the past 12 months were asked "Have you ever had a

drink?" (yes; no)(ALC_Q5B). Responses from these questions were used by the survey designers categorize participants into four categories. Regular drinkers were people who drank alcohol once a month or more; occasional drinkers were people who drank alcohol less than once a month, former drinkers were people who reported that they had ever had a drink, but did not have a drink in the past 12 months; and never drinkers were people who have never had a drink. For the purposes of this study, former drinkers and never drinkers were collapsed into one category as they currently have the lowest alcohol consumption (reference group).

4.5.5.3 Country of birth and race

Country of birth was determined by asking participants "In what country were you born?" Nineteen countries were listed as options, as well as an "other" category (SDC_Q1). The survey designers collapsed the categories to create a variable which classified participants by their country of birth (Canada; other). Additionally, racial background was ascertained by first stating "People living in Canada come from many different cultural and racial backgrounds." Then survey administrators asked participants whether they identified with any of twelve different races (White; Chinese; South Asian; Black; Filipino; Latin American; Southeast Asian; Arab; West Asian; Japanese; Korean; Aboriginal; Other) (SDC_Q7). The survey designers collapsed these categories into White and Non-white (Aboriginal or other Visible Minority).

4.6 Analyses

Data were analyzed using statistical analysis software (SAS version 9.1). Frequency procedures were conducted to ensure that there were no large sex, age, educational or income differences between participants who had missing data for physical activity index, intention, and sense of community belonging. Chi-square analyses are used to test for independence between two

categorical variables. For instance, chi-square analyses were used to determine whether there were any associations between level of physical activity and sense of community belonging, sex, age, marital status, education, income, employment status, smoking status, alcohol use, country of birth and race. The results from the chi-square analyses were used to describe the characteristics of the overall sample. Since the section on intentions to start or increase engagement in physical activity was only administered to a subset of the sample, an additional chi-square analysis will be used to determine any associations between intention and physical activity, community belonging, sex, age, marital status, education, income, employment status, smoking status, alcohol use, country of birth and race. The results from this chi-square will be used to describe the characteristics of the subset of the sample who were asked questions related to intention.

Logistic regression models were used to answer the research questions. The goal of logistic regression tests as described by Hosmer and Lemeshow (2000) is "to find the best fitting and most parsimonious, yet biologically reasonable model to describe the relationship between an outcome (dependant or response) variable and a set of independent (predictor or explanatory) variables." (p. 1). Since the dependant variables in this study are categorical, logistic regression is an appropriate method to explain the relationship between the dependant variables (physical activity and intention) and the predictor variables (sense of connectedness, sex, age, income, etc.). A second benefit of the logistic regression is that it provides output regarding the association of predicted probabilities and observed responses. One of the statistics provided in this output is the c statistic, which describes the model's ability to predict the response. The c statistic values range from 0.5 (model randomly predicts response) and 1.0 (model can perfectly distinguish positive and negative responses). It will

be used to highlight each model's ability to predict engagement in physical activity and intention to start or increase physical activity.

4.6.1 Analysis plan for research question 1

Six gender specific univariate logistic regression models were used to answer the first research question: "Are men and women who have a stronger sense of community belonging more likely to engage in higher amounts of physical activity?" For both men and women, the first model examined how sense of community belonging influenced the odds of being active as opposed to inactive, the second model examined how sense of community belonging influenced the odds of being moderately active as opposed to inactive, and the third model examined how sense of community belonging influenced the odds of being active as opposed to moderately active.

For the secondary analysis of research question one (is this relationship consistent for each model after adjusting for potential confounding and moderating variables?) the following variables were added into each model: age, marital status, household income, highest educational attainment, employment status, smoking status, alcohol use, country of birth, and race. Variables that were significant predictors of physical activity with an alpha of less than $p=0.15$ for both sexes were kept in the model when conducting two-and three-way interactions. There was low likelihood, due to the large sample size, that any variables that were not significant at $p=0.15$ would become significant when interactions were included in the model. Thus, these variables were dropped from the models containing interactions.

Further exploration of possible two- and three-way interactions was done. Rather than determining whether each moderating variable interacted with connectedness to predict physical activity separately for each sex, the models included both genders and sex was used as a possible

interaction term. The three-way interactions include (a) sense of community belonging, age and sex; (b) sense of community belonging, income and sex; and (c) sense of community belonging, education and sex. In models that had insignificant three-way interactions, any significant two-way interactions were commented on.

4.6.2 Analysis plan for research question 2

Four gender specific univariate models were used to answer the second research question: "Among those who are classified as inactive and moderately active are people who have a stronger sense of community belonging more likely to intend to start or increase their engagement in physical activity?" For both men and women, the first two models provided odds ratios and confidence intervals for inactive people. The third and fourth models provided the odds rations and confidence intervals for moderately active men and women. Intention was entered in as the dependant variable (intenders (1) vs. non-intenders (0)) and sense of community belonging was entered as an independent variable to determine the unadjusted effect. The regression equation would be the same as in section 4.6.2 except "z" would represent the odds of intending to start or increase physical activity.

For the secondary analysis of research question two (is this relationship consistent after adjusting for potential confounding and moderating variables?) age, marital status, household income, highest educational attainment, employment status, smoking status, alcohol use, country of birth, and race were added into each model.

Chapter 5: Results

Data from 80,061 Canadians between the ages of 25 and 64 were included in the analyzed sample. Approximately 24% of Canadians were classified as physically active, 26% were classified as moderately active and 51% were classified as inactive (Table 4).

A majority of participants felt at least a strong sense of belonging to their local community. Forty-seven percent felt a somewhat strong sense of belonging and approximately 16% felt a very strong sense of belonging. Less than 28% felt a somewhat weak sense of belonging and less than 10% felt a very weak sense of belonging. Sense of connectedness was significantly associated with physical activity (X^2=984.46, df=6, p<.0001). Approximately equal numbers of males and females were included in the sample; however, slightly more men were classified as being physically active (25%) compared to women (22%) and slightly more women were classified as moderately active (27%) and inactive (51%) than men (25% and 50% respectively). This association between sex and physical activity level was significant (X^2=71.01, df=2, p<.0001). Although the significant chi-square value is most likely attributed to the large sample size, it is still important to conduct sex-specific analyses because the way in which physical activity is associated with connectivity may be different for each sex.

Approximately 12% of the sample were between the ages of 25 and 30, a quarter of the sample were between the ages of 30 and 39, 30% were between the ages of 40 and 49, and 33% were between the ages of 50-64. A higher proportion of people in the younger age groups were classified as active and this association was significant (X^2=193.32, df=6, p<.0001). Three-quarters of the sample were either married or in a common law relationship.

Table 4: Descriptive statistics highlighting the characteristics of the sample of 25-64 year olds and the proportion of each group who were classified as inactive, moderately active and active.

	Sample %	% Inactive	% Moderately Active	% Active	Chi^2 p
Outcome Variable					
Physical Activity Index					
Inactive	50.62	-	-	-	
Moderately active	25.81	-	-	-	
Active	23.58	-	-	-	
Predictor Variables					
Sense of community belonging					
Very strong	15.58	44.10	26.48	29.42	
Somewhat strong	47.01	48.20	26.63	25.17	
Somewhat weak	27.60	53.65	25.91	20.45	X^2(6, n=77,872)=984.46
Very weak	9.81	63.04	20.89	16.07	p<.0001
Sex					
Male	49.59	50.03	25.13	24.83	X^2(2, n=78,797)=71.01
Female	50.41	51.19	26.47	22.34	p<.0001
Age					
25-29	11.95	45.26	26.19	28.55	
30-39	24.84	50.83	25.63	23.54	
40-49	30.32	51.28	25.37	23.35	X^2(6, n=78,797)=193.32
50-64	32.89	51.79	26.21	22.00	p<.0001
Marital status					
Married/common-law	74.46	50.95	26.03	23.02	X^2(2, n=78,733)=38.57
Widowed/divorced/separated/single	25.54	49.66	25.17	25.17	p<.0001
House hold income					
Less than $30,000	13.59	59.30	21.30	19.39	
$30,000 - $49,999	18.84	55.91	23.27	20.61	
$50,000 - $79,999	28.90	51.29	26.54	22.18	X^2(6, n=69,781)=1021.40
More than $80,000	38.66	43.43	28.88	27.69	p<.0001
Education					
Less than secondary school diploma	11.72	63.96	19.45	16.59	
Secondary school diploma;	15.52	54.01	25.17	20.83	
Some post-secondary education	6.89	51.38	26.65	21.97	X^2(6, n=76,911)=962.48
Post secondary degree/diploma	65.88	47.20	27.19	25.61	p<.0001

Worked at a job/business over the past year?					
Yes	83.81	50.40	26.03	23.57	X^2(2, n=78,789)=11.47
No	16.19	51.73	24.67	23.60	p=0.0032
Smoking status					
Daily/Occasionally	25.04	56.81	22.64	20.55	X^2(2, n=78,673)=405.51
Not at all	74.96	48.52	26.90	24.58	p<.0001
Alcohol use					
Regular	66.89	46.80	27.52	25.68	
Occasional	16.91	56.86	23.45	19.69	X^2(4, n=77,875)=902.71
Former & Never	16.20	59.30	21.57	19.12	p<.0001
Country of origin					
Canada	80.86	48.79	26.88	24.33	X^2(2, n=73,470)=363.35
Other	19.14	57.71	22.60	19.69	p<.0001
Race					
White	83.25	48.96	26.84	24.19	X^2(2, n=76,974)=393.01
Aboriginal/Visible Minority	16.75	58.50	21.28	20.23	p<.0001

Over a third of participants reported having a household income greater than $80,000 per year (39%), 66% had obtained a post-secondary diploma or degree, and 84% had held a position at a job or business during the past 12 months. One quarter of the sample reported daily or occasional smoking, and approximately two thirds reported drinking alcohol regularly.[2] Approximately 20% of participants were born outside of Canada and 17% identified themselves as Aboriginal or other visible minority.

5.1 Missing Data

It was noted that not every question was answered by each person; thus, it was necessary to look at the missing data to determine whether those who did not provide responses to the measures of key interest (physical activity index, intention and sense of community belonging) differed by sex, age, income, or education. For each dependant and independent variable, frequencies were used to obtain the percent of missing data for sex, age, income and education (Appendix A).

In terms of people who did not provide answers to questions used to calculate physical activity levels and connectedness, there were no large differences between sexes or age groups. Conversely, it was noted those reporting less than high school education and a total household income of less than $30,000 had the most missing values for physical activity and sense of connectedness. This may suggest that participants with less than a high school education and participants who have an annual household income of less than $30,000 may be under represented in this analysis.

Missing values for intention were approximately equally distributed among men and women and for each age group. It appeared that those with a household income of less than $30,000 and those with less than high school graduation had more missing values than the other income and

[2] Regular alcohol use was defined as consuming an alcoholic beverage at least once a month. It does not take into account the amount or type of alcohol consumed.

education categories. In order to decrease the number of missing values for these categories, imputation was contemplated; however, since the response variable is a dichotomous categorical measure, calculating a mean value (which would fall between 0 and 1) and then assigning participants to the appropriate category would be troublesome. Thus, it should be noted that those with an income less than $30,000 and those with less than high school graduation may be underrepresented in this analysis. As missing data were ` minimal in comparison to the sample size it should have little effect on the results and conclusions; however a more detailed explanation regarding the possible implications of missing data can be found in the limitations and strengths section of the discussion (section 6.3).

5.2 The Influence of Connectedness on Engagement in Physical Activity

It has been suggested that one of the best ways to improve mental and physical health at the population level is to get inactive people active. Section 5.2.1 provides results for how sense of connectedness might influence the odds of being active opposed to inactive. Fortunately, health benefits can still be observed if inactive people become even moderately active. Section 5.2.2 provides results for how sense of community belonging may influence the odds of being moderately active opposed to inactive. Finally, people who are moderately active can further improve their health by becoming more active. Thus, section 5.2.3 provides results for how connectedness can potentially influence the odds of being active opposed to moderately active.

5.2.1 Model 1: The odds of being physically active verses inactive

Unadjusted models were run separately for men and women to determine the association between sense of connectedness and the odds of being physically active. Then age, marital status,

household income, education, employment status, smoking status, alcohol use, country of birth and race were added into each model to determine these adjusted odds.

5.2.1.1 Unadjusted and adjusted odds of being active opposed to inactive for men

Unadjusted odds revealed that men who reported a very strong sense of community belonging had the greatest odds of being physically active (OR 2.85, 95% CI 2.56-3.17) (Table 5). The odds of being physically active was also greater for men reporting a somewhat strong (OR 2.16, 95% CI 1.96-2.38) and somewhat weak (OR 1.60, 95% CI 1.44-1.77) sense of connectedness when compared to men who reported a very weak sense of connectedness. The c statistic for this model was 0.558, indicating that sense of connectedness on its own can predict whether men are active or inactive 55.8% of the time.

After adjusting for age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race the dose response relationship between sense of connectedness and physical activity was still apparent. In fact, odds of being active among men increased to 3.16 (95% CI 2.80-3.57) if they reported a very strong sense of community belonging. As expected, the odds of being active for men who reported a somewhat strong (OR 2.08, 95% CI 1.87-2.32) and somewhat weak (OR 1.44, 95% CI 1.29-1.62) sense of connectedness decreased after adding the other variables into the model.

In the adjusted model the other variables which were added were also associated with the odds of being active opposed to inactive. For instance, after taking into account all the other variables in the model, the odds of being active decreased with age; men aged 25-29 are had the greatest odds of

Table 5: Unadjusted and adjusted odds of being active opposed to inactive for men.

	Odds of being active[a] vs. inactive[b]			
	Unadjusted[c]		Adjusted[d]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	2.85	(2.56-3.17)***	3.16	(2.80-3.57)***
Somewhat strong	2.16	(1.96-2.38)***	2.08	(1.87-2.32)***
Somewhat weak	1.60	(1.44-1.77)***	1.44	(1.29-1.62)***
Very weak†	1.00		1.00	
Age				
25-29			1.83	(1.66-2.01)***
30-39			1.23	(1.14-1.33)***
40-49			1.11	(1.03-1.19)**
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.48	(1.38-1.59)***
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			1.10	(0.98-1.23)
$50,000-$79,999			1.30	(1.17-1.46)***
More than $80,000			2.01	(1.81-2.25)***
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.39	(1.24-1.56)***
Some post-secondary education			1.59	(1.39-1.82)***
Post-secondary degree/diploma			1.83	(1.67-2.01)***
Employed during past year				
Yes†			1.00	
No			1.94	(1.75-2.15)***
Smoking status				
Daily or occasional smoker			0.70	(0.65-0.74)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.33	(1.21-1.45)***
Occasional			0.99	(0.88-1.12)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			0.70	(0.64-0.76)***
Race				
White†			1.00	
Aboriginal/other visible minority			0.98	(0.88-1.08)

[a] Active (n=8,011); [b] Inactive (n=15,689)
[c] Model Fit Statistics (Unadjusted): -2 Log L = 36,239.62; c = 0.558
[d] Model Fit Statistics (Adjusted): -2 Log L = 29,274.18; c = 0.646
†Reference group; *p<0.05, **p<0.01, ***p<0.001

being active (OR 1.83, 95% CI 1.66-2.01). Men who were separated, divorced, widowed, or single were more likely to be active (OR 1.48, 95% CI 1.38-1.59) than men who were married or in a common-law relationship.

The odds of being active was greater for men who had an annual household income of $50,000-$79,999 (OR 1.30, 95% CI 1.17-1.46) and more than $80,000 (OR 2.01, 95% CI 1.81-2.25) compared to those who had a household income of less than $30,000. Similarly, physical activity appeared to increase as education increased. For instance, men who had obtained a high school diploma (OR 1.39, 95% CI 1.24-1.56), some post-secondary education (OR 1.59, 95% CI 1.39-1.82) or a post-secondary degree or diploma (OR 1.83, 95% CI 1.67-2.01) were more likely to be active than men who had less than a high school diploma. Additionally, men who had not worked at any time during the past 12 months were more likely to be active (OR 1.94, 95% CI 1.75-2.15) than men who had worked within the past 12 months.

Men who reported daily or occasional smoking were less likely to be active (OR 0.70, 95% CI 0.65-0.74) than non-smokers and men who used alcohol regularly were more likely to be active (OR 1.33, 95% CI 1.21-1.45) than those who were never or former drinkers. Finally, the odds of being active were lower among men who were born in a county other than Canada (OR 0.70, 95% CI 0.64-0.76). According to the c statistic, this model can predict whether men are active or inactive 64.6% of the time.

5.2.1.2 Unadjusted and adjusted odds of being active opposed to inactive for women

Similar to men, women who reported a very strong sense of community belonging were more likely to be active (OR 2.39, 95% CI 2.15-2.66) than those who reported a very weak sense of

community belonging (Table 6). The odds of being active was also greater for women who reported a somewhat strong (OR 1.94, 95% CI 1.77-2.14) and somewhat weak (OR 1.40, 95% CI 1.26-1.54) sense of connectedness compared to those who had a very weak sense of connectedness. The c statistic suggests that level of connectedness is able to predict whether women are active or inactive 56.3% of the time.

After adjusting for age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race the dose response relationship between sense of connectedness and physical activity was still apparent. In fact, odds of being active among women increased to 2.57 (95% CI 2.28-2.91) if they reported a very strong sense of community belonging. As expected, the odds of being physically active among women who reported a somewhat strong (OR 1.89, 95% CI 1.69-2.11) and somewhat weak (OR 1.30, 95% CI 1.215-1.46) sense of connectedness decreased after adding the other variables into the model.

The other variables that were added into the model suggest that women aged 25-29 had the greatest odds of being active (OR 1.51, 95% CI 1.37-1.66) with the odds of being active decreasing with age. Women who are separated, divorced, widowed, or single were more likely to be active (OR 1.25, 95% CI 1.16-1.34) than women who were married or in a common-law relationship.

The odds of being active was greater for women who had an annual household income of $30,000-$49,999 (OR 1.15, 95% CI 1.03-1.27), $50,000-$79,999 (OR 1.23, 95% CI 1.11-1.36), and more than $80,000 (OR 1.53, 95% CI 1.38-1.70) when compared to those who had a household income of less than $30,000. Women who had obtained a high school diploma (OR 1.18, 95% CI 1.04-1.33) or a post-secondary degree or diploma (OR 1.51, 95% CI 1.36-1.68) were more likely to be active than women who had less than a high school diploma. Additionally, women who had not

Table 6: Unadjusted and adjusted odds of being active opposed to inactive for women.

	Odds of being active[a] vs. inactive[b]			
	Unadjusted[c]		Adjusted[d]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	2.39	(2.15-2.66)***	2.57	(2.28-291)***
Somewhat strong	1.94	(1.77-2.14)***	1.89	(1.69-2.11)***
Somewhat weak	1.40	(1.26-1.54)***	1.30	(1.15-1.46)***
Very weak†	1.00		1.00	
Age				
25-29			1.51	(1.37-1.66)***
30-39			1.14	(1.06-1.24)***
40-49			1.15	(1.06-1.24)***
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.25	(1.16-1.34)***
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			1.15	(1.03-1.27)**
$50,000-$79,999			1.23	(1.11-1.36)***
More than $80,000			1.53	(1.38-1.70)***
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.18	(1.04-1.33)*
Some post-secondary education			1.11	(0.96-1.29)
Post-secondary degree/diploma			1.51	(1.36-1.68)***
Employed during past year				
Yes†			1.00	
No			1.29	(1.20-1.39)***
Smoking status				
Daily or occasional smoker			0.77	(0.72-0.83)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.46	(1.34-1.59)***
Occasional			0.98	(0.89-1.08)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			0.86	(0.78-0.94)***
Race				
White†			1.00	
Aboriginal/other visible minority			0.77	(0.69-0.85)***

[a] Active (n=8,173); [b] Inactive (n=17,807)
[c] Model Fit Statistics (Unadjusted): -2 Log L = 35,111.56; c = 0.563
[d] Model Fit Statistics (Adjusted): -2 Log L = 28,095.93; c = 0.635
†Reference group; *p<0.05, **p<0.01, ***p<0.001

worked at any time during the past 12 months were more likely to be active (OR 1.29, 95% CI 1.20-1.39) than those who had worked within the past 12 months.

Women who were daily or occasional smokers were less likely to be active (OR 0.77, 95% CI 0.72-0.83) than non-smokers and those who consumed alcohol regularly were more likely to be active (OR 1.46, 95% CI 1.34-1.59) than those who were never or former drinkers. Finally, the odds of being active were lower among women who were born in a county other than Canada (OR 0.70, 95% CI 0.64-0.76) and women who identified themselves a race other than white (OR, 0.77, 95% CI 0.69-0.85). This model was able to predict the physical activity level among active and inactive women 63.5% of the time.

For both men and women, all potential confounding and moderating variables that were included in the adjusted models were significant predicators of physical activity (Pr<0.0001) thus, they were included in the following models which explored the interactions between connectedness, age and sex; connectedness, income and sex; and connectedness, education and sex.

5.2.1.3 Exploring the interactions among both men and women

Before the association between connectedness and physical activity can be properly interpreted, there was a need to explore interactions. The rise in odds of being physically active among men and women who report a very strong sense of connectedness from the unadjusted to adjusted odds does not rule out that an interaction may be present. It should be noted that the interaction analyses were not separated by sex, rather the models include both sexes and sex was used as a possible interaction variable.

Exploratory analyses revealed no significant three-way interaction between sense of community belonging, age and sex (p=0.07) or two-way interaction between sense of community belonging and

age (p=0.33). This suggests that age does not moderate the relationship between connectedness and physical activity.

There was no significant three-way interaction between connectedness, income and sex (p=0.13); the lack of a significant three-way interaction implies that there are no significant sex differences in how income moderates the relationship between connectedness and physical activity. However, when looking at the two-way interactions, there was a significant interaction between connectedness and income (Table 7).The c statistic suggests that this model is able to predict active and inactive people's participation in physical activity 63.8% of the time. The parameter estimates of this model can be found in Appendix B.

Using people who reported a very weak sense of connectedness and an annual household income of less than $30,000 as the reference group, after controlling for age, sex, marital status, education, employment status, smoking status, alcohol use, country of birth, and race, the relative odds indicated that people who had a very strong sense of community belonging were more likely to be active than those who reported a weaker sense of community belonging (Figure 2). This relationship is especially true for people who had an annual household income of $50,000-$79,999 or more than $80,000; the odds of being physically active dramatically increased among people who had a household income of $80,000 or more if their sense of connectedness was somewhat strong or very strong and among people who had a household income of $50,000-$79,999 if they felt very strongly connected to their community.

Although the odds of being physically active continued to increase as sense of connectedness increased among those who reported an annual household income of less than $30,000 and between

Table 7: Relative odds of being active opposed to inactive, moderated by income and compared to people who reported a very weak sense of connectedness and an income of less than $30,000.

	Relative odds of being active vs. inactive			
	Annual household income			
	< $30,000	$30,000-$49,999	$50,000-$79,999	> $80,000
Sense of connectedness				
Very strong	2.41	2.76	4.26	5.23
Somewhat strong	1.91	2.18	2.27	3.22
Somewhat weak	1.29	1.33	1.71	2.21
Very weak	1.00†	1.12	1.27	1.41

†Reference group

Figure Caption: The association between connectedness and being active opposed to inactive is moderated by income. In Figure 1, the odds of being active opposed to inactive are relative to people who reported a very weak sense of connectedness and a household income of less than $30,000 as indicated by the black diamond.

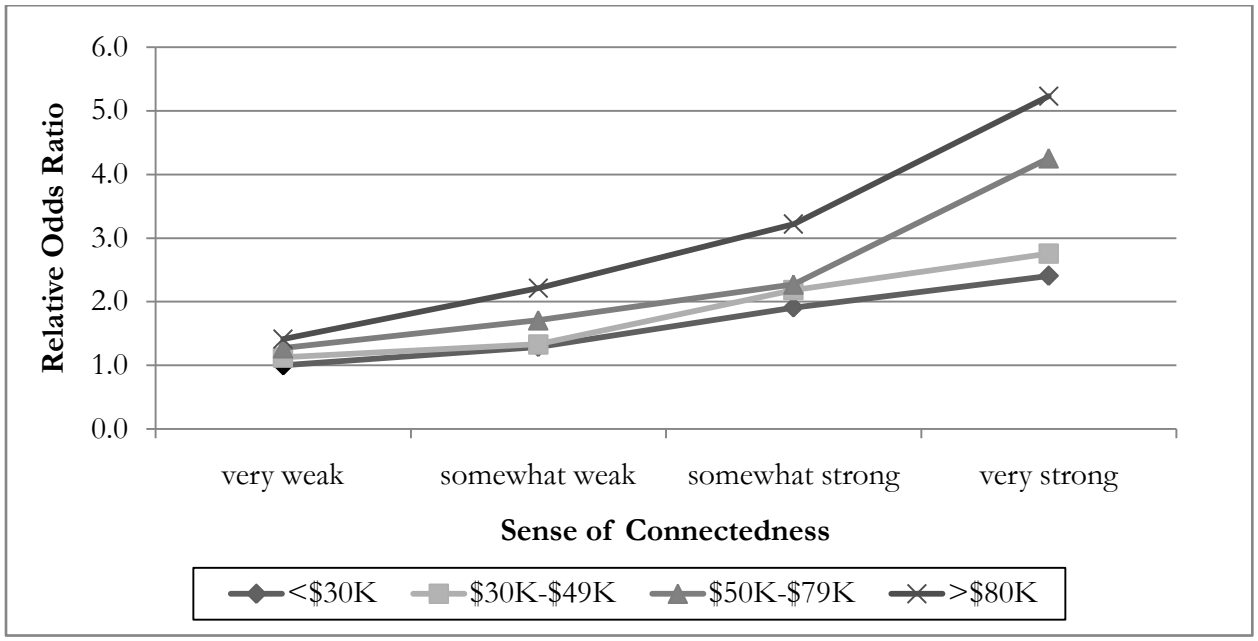

Figure 2: The odds of being active opposed to inactive moderated by income.

$30,000 and $49,999 it was not as dramatic as the increases observed among the higher two income categories. More specifically, relative to people who had a household income of less than $30,000 and a very weak sense of connectedness, people who had an income of less than $30,000 were approximately 2.5 times as likely to be active if they had a very strong sense of connectedness. On the other hand people who had an annual income of more than $80,000 were over five times more likely to be active if they felt very strongly connected to their community even though people in the same income category who reported a very weak sense of connectedness were only slightly more likely to be active than the reference group.

For people reporting a somewhat strong or very strong sense of connectedness, parallel lines were apparent between the two highest income groups and between the two lowest income groups. This may suggest that there is a minimum amount of income required for a very strong sense of connectedness to have a more meaningful effect on physical activity.

There was a significant three-way interaction between sense of community belonging, education and sex (Table 8). Similar the interaction with income, this model was able to predict the physical activity level of active and inactive people 63.8% of the time. Parameter estimates of this interaction model can be found in Appendix C. Figure 3 reveals the odds of being active opposed to inactive relative to women who reported a very weak sense of community belonging and less than a high school diploma. After adjusting for potential confounding variables the relative odd ratios revealed that men who felt very strongly connected to their community had the greatest odds of being active (by nearly five times) given that they had obtained a post-secondary school degree or diploma when compared to females in the lowest educational category who had a very weak sense of

Table 8: Relative odds of being active opposed to inactive, moderated by education and sex and compared to women who reported a very weak sense of connectedness and less than a high school graduation.

	Relative odds of being active vs. inactive for men‡			
	Educational attainment			
	Less than high school graduation	High school diploma	Some post-secondary education	Post-secondary degree/diploma
Sense of connectedness				
Very strong	1.84	3.66	2.83	4.73
Somewhat strong	1.67	2.27	3.08	2.86
Somewhat weak	1.11	1.33	1.30	2.17
Very weak	1.20	1.11	2.00	1.24
	Relative odds of being active vs. inactive for women			
Sense of connectedness				
Very strong	1.80	2.37	3.23	3.69
Somewhat strong	1.69	2.05	1.89	2.57
Somewhat weak	1.42	1.47	1.11	1.71
Very weak	1.00†	1.19	0.85	1.28

‡ Relative to women who have a very weak sense of connectedness and less than high school graduation.
† Reference group

connectedness. Relative to females who had less than a high school diploma and a very weak sense of connectedness, men who reported a very strong sense of connectedness were approximately two times more likely to be active if they had less than a high school diploma, nearly three times more likely if they had some post-secondary education, nearly four times more likely if they had only a high school diploma and almost five times more likely if they had a post-secondary degree or diploma.

Figure Caption: The association between sense of connectedness and being active opposed to inactive is moderated by sex and education. In Figure 2, the odds of being physically active opposed to inactive are relative to females who reported a very weak sense of connectedness and less than a high school diploma as indicated by the black diamond.

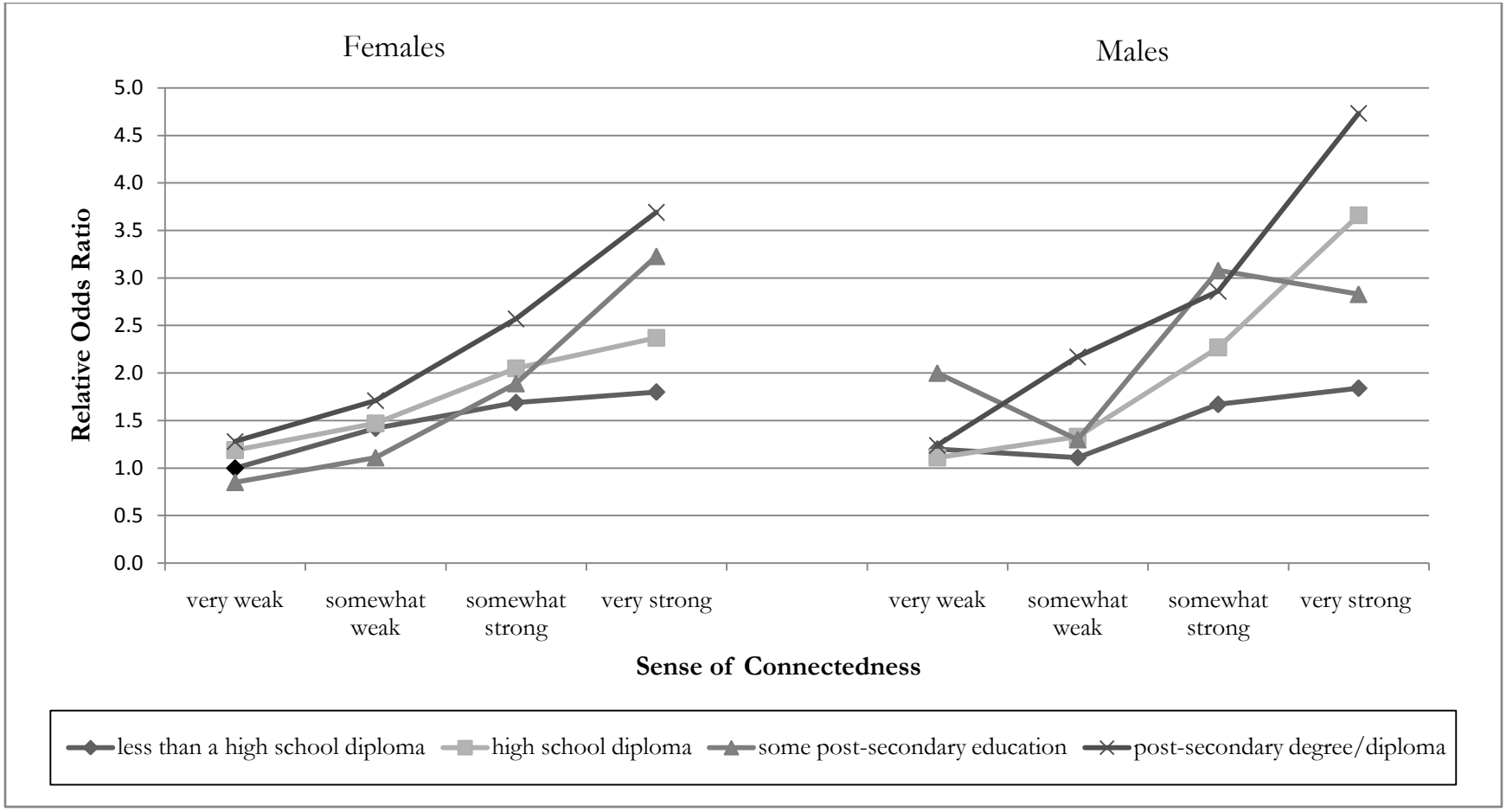

Figure 3: The odds of being active opposed to inactive moderated by educational attainment and sex.

For almost all education groups it was evident that as sense of connectedness increased as did the odds of being active, with the exception of men who had some post-secondary education. Among men who had some post-secondary education, it appeared that those who had a very weak sense of connectedness had greater odds of being active than those who had a somewhat weak sense of community belonging. Further, those who had a somewhat strong sense of connectedness had greater odds of being active than those who had a very strong sense of connectedness relative to the reference group.

Women who had completed some post-secondary education were *less* likely to be active than women who reported less than a high school diploma or women who had obtained a high school diploma if they reported their sense of connectedness to be very weak or somewhat weak. Alternatively, having a very strong sense of connectedness increased the odds of being active more so for women who had some post-secondary education than for women who had a high school diploma or less than a high school diploma. Similar to men, the odds of being active was greatest among women who reported a very strong sense of belonging given that they had obtained a post-secondary degree or diploma.

5.2.2 Model 2: The odds of being moderately active opposed to inactive

Unadjusted models were run separately for men and women to determine the association between sense of connectedness and the odds of being moderately active opposed to inactive. Subsequently, age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race were added into each model to determine the adjusted odds.

5.2.2.1 Unadjusted and adjusted odds of being moderately active opposed to inactive for men

Unadjusted odds revealed that men who had a very strong sense of community belonging had the greatest odds of being moderately active (OR 1.90, 95% CI 1.71-2.10) (Table 9). The odds of being moderately active was also greater for men who reported a somewhat strong (OR 1.66, 95% CI 1.51-1.80) and somewhat weak (OR 1.46, 95% CI 1.33-1.60) sense of connectedness compared to men who had a very weak sense of connectedness. Sense of connectedness, on its own, was able to predict level of physical activity among moderately active and inactive males 53.1% of the time.

After adjusting for age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race the dose response relationship between sense of connectedness and physical activity was still apparent. In fact, odds of being moderately active among men increased slightly to 1.92 (95% CI 1.71-2.16) if they reported a very strong sense of community belonging. The odds of being moderately active for men who reported a somewhat strong (OR 1.55, 95% CI 1.41-1.72) and somewhat weak (OR 1.35, 95% CI 1.22-1.50) decreased after adding the other variables into the model.

The other variables that were added into the model were also significantly associated with the odds of being moderately active opposed to inactive. For instance, men aged 25-29 had significantly greater odds of being moderately active (OR 1.33, 95% CI 1.21-1.47) than men aged 50-65. Men who reported their marital status as separated, divorced, widowed, or single were more likely to be moderately active (OR 1.22, 95% CI 1.14-1.31) than men who were married or in a common-law relationship.

Table 9: Unadjusted and adjusted odds of being moderately active opposed to inactive for men.

	Odds of being moderately active[a] vs. inactive[b]			
	Unadjusted[c]		Adjusted[d]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	1.90	(1.71-2.10)***	1.92	(1.71-2.16)***
Somewhat strong	1.66	(1.51-1.81)***	1.55	(1.41-1.72)***
Somewhat weak	1.46	(1.33-1.60)***	1.35	(1.22-1.50)***
Very weak†	1.00		1.00	
Age				
25-29			1.33	(1.21-1.47)***
30-39			1.00	(0.93-1.08)
40-49			1.03	(0.96-1.10)
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.22	(1.14-1.31)***
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			0.97	(0.86-1.08)
$50,000-$79,999			1.34	(1.20-1.49)***
More than $80,000			1.74	(1.56-1.93)***
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.34	(1.20-1.50)***
Some post-secondary education			1.56	(1.37-1.78)***
Post-secondary degree/diploma			1.62	(1.48-1.77)***
Employed during past year				
Yes†			1.00	
No			1.38	(1.20-1.50)***
Smoking status				
Daily or occasional smoker			0.73	(0.69-0.78)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.37	(1.25-1.50)***
Occasional			1.05	(0.93-1.18)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			0.81	(0.74-0.88)***
Race				
White†			1.00	
Aboriginal/other visible minority			0.87	(0.79-0.97)**

[a] Moderately active (n=8,034); [b] Inactive (n=15,689)
[c] Model Fit Statistics (Unadjusted): -2 Log L = 36,724.19; c = 0.531
[d] Model Fit Statistics (Adjusted): -2 Log L = 30,535.39; c = 0.606
†Reference group; *p<0.05, **p<0.01, ***p<0.001

The odds of being moderately active was greater for men who had an annual household income of $50,000-$79,999 (OR 1.34, 95% CI 1.20-1.49) and more than $80,000 (OR 1.74, 95% CI 1.56-1.93) when compared to men who had a household income of less than $30,000. Similarly, physical activity appeared to increase as education increased. For instance, men who had obtained a high school diploma (OR 1.34, 95% CI 1.20-1.50), some post-secondary education (OR 1.56, 95% CI 1.37-1.78) or a post-secondary degree or diploma (OR 1.62, 95% CI 1.48-1.77) were more likely to be moderately active than men who had less than a high school diploma. Additionally, men who had not worked at any time during the past 12 months were more likely to be moderately active (OR 1.38, 95% CI 1.20-2.50) than men who had worked within the past 12 months.

Men who identified as daily or occasional smokers were less likely to be moderately active (OR 0.73, 95% CI 0.69-0.78) than non-smokers and those who used alcohol regularly were more likely to be moderately active (OR 1.37, 95% CI 1.25-1.50) than those who were never or former drinkers. Finally, the odds of being at least moderately active were lower among men who were born in a county other than Canada (OR 0.81, 95% CI 0.74-0.88) and men who identified as an Aboriginal or other visible minority (OR 0.87, 95% CI 0.79-0.97). This model was able to predict physical activity levels among moderately active and inactive men 60.6% of the time.

5.2.2.2 Unadjusted and adjusted odds of being moderately active opposed to inactive for women

Similar to men, women who reported a very strong sense of community belonging were more likely to be moderately active (OR 1.73, 95% CI 1.57-1.92) than those who reported a very weak sense of community belonging (Table 10). The odds of being moderately active were also greater for women who reported a somewhat strong (OR 1.67, 95% CI 1.54-1.82) and somewhat weak (OR

Table 10: Unadjusted and adjusted odds of being moderately active opposed to inactive for women.

	Odds of being moderately active[a] vs. inactive[b]			
	Unadjusted[c]		Adjusted[d]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	1.73	(1.57-1.92)***	1.69	(1.51-1.89)***
Somewhat strong	1.67	(1.54-1.82)***	1.52	(1.38-1.67)***
Somewhat weak	1.46	(1.33-1.59)***	1.27	(1.21-1.41)***
Very weak†	1.00		1.00	
Age				
25-29			1.11	(1.01-1.21)*
30-39			1.03	(0.96-1.11)
40-49			0.94	(0.88-1.01)
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.12	(1.05-1.20)***
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			1.30	(1.18-1.43)***
$50,000-$79,999			1.35	(1.23-1.49)***
More than $80,000			1.53	(1.39-1.68)***
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.33	(1.19-1.49)***
Some post-secondary education			1.25	(1.09-1.43)**
Post-secondary degree/diploma			1.45	(1.31-1.60)***
Employed during past year				
Yes†			1.00	
No			1.17	(1.09-1.25)***
Smoking status				
Daily or occasional smoker			0.77	(0.72-0.83)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.38	(1.28-1.49)***
Occasional			1.04	(0.95-1.14)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			0.84	(0.78-0.92)***
Race				
White†			1.00	
Aboriginal/other visible minority			0.72	(0.65-0.79)***

[a] Moderately active (n=9,807); [b] Inactive (n=17,807)
[c] Model Fit Statistics (Unadjusted): -2 Log L = 39,045.09; c = 0.538
[d] Model Fit Statistics (Adjusted): -2 Log L = 32,018.06; c = 0.604
†Reference group; *p<0.05, **p<0.01, ***p<0.001

1.46, 95% CI 1.33-1.59) sense of connectedness compared to women who had a very weak sense of connectedness. On its own, connectedness was able to predict level of physical activity among moderately active and inactive women 53.8% of the time.

The dose response relationship between sense of connectedness and physical activity was still apparent after adjusting for age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race. The odds of being moderately active among women who had a very strong sense of connectedness was still the greatest (OR 1.69, 95% CI 1.51-1.89), followed by women who reported a somewhat strong (OR 1.89, 95% CI 1.69-2.11) and somewhat weak (OR 1.30, 95% CI 1.215-1.46) sense of connectedness when compared to women who had a very weak sense of connectedness.

When looking at the other variables that were added into the model, women aged 25-29 had slightly higher odds of being moderately active (OR 1.11, 95% CI 1.01-1.21) compared to women aged 50-64. Similarly, women who were separated, divorced, widowed, or single had slightly higher odds of being moderately active (OR 1.12, 95% CI 1.05-1.20) compared to women who were married or in a common-law relationship.

The odds of being moderately active was greater for women who had an annual household income of $30,000-$49,999 (OR 1.30, 95% CI 1.18-1.43), $50,000-$79,999 (OR 1.35, 95% CI 1.23-1.49), and more than $80,000 (OR 1.53, 95% CI 1.39-1.68) when compared to women who had a household income of less than $30,000. Women who had obtained a high school diploma (OR 1.33, 95% CI 1.19-1.49), some post-secondary education (OR 1.25, 95% CI 1.09-1.43), or a post-secondary degree or diploma (OR 1.45, 95% CI 1.31-1.60) were more likely to be physically active than women who had less than a high school diploma. Additionally, women who had not worked at

any time during the past 12 months were more likely to be physically active (OR 1.17, 95% CI 1.09-1.25) than women who had worked within the past 12 months.

Women who were daily or occasional smokers were less likely to be moderately active (OR 0.77, 95% CI 0.72-0.83) than non-smokers and those who consumed alcohol regularly were more likely to be moderately active (OR 1.38, 95% CI 1.28-1.49) than those who were never or former drinkers. Finally, the odds of being moderately active were lower among women who were born in a county other than Canada (OR 0.84, 95% CI 0.78-0.92) and women who identified as an Aboriginal or other visible minority (OR, 0.72, 95% CI 0.65-0.79). This model, which included all potential moderating and predictor variables, was able to predict physical activity level among moderately active and inactive females 60.4% of the time.

For both men and women, all potential confounding and moderating variables that were included in the adjusted models were significant predicators of physical activity ($Pr<0.0001$) thus, they were included in the following models exploring the interactions between connectedness, age and sex; connectedness, income and sex; and connectedness, education and sex.

5.2.2.3 Exploring the interactions among both men and women

Similar to the interactions explored in section 5.2.1.3, the interactions explored in this section included both men and women together and used sex as an interaction variable. Exploratory analyses revealed no significant three-way interaction between sense of community belonging, age and sex ($p=0.80$) or two-way interaction between sense of community belonging and age ($p=0.91$). This suggests that age does not moderate the relationship between connectedness and being moderately active.

There was, however, a significant three-way interaction between sense of community belonging, income and sex (Table 11). This interaction model was able to predict the physical activity level of moderately active and inactive people 60.4% of the time. The parameter estimates and standard errors can be found in Appendix D. Figure 4 reveals the relative odds ratios of being moderately active compared to women who had a very weak sense of community belonging and an annual income of less than $30,000. After controlling for potential confounding variables that were in the adjusted model, the relative odds indicated that men who had a very strong sense of community belonging had the greatest odds of being moderately active (by nearly four times) given that they had an annual income of more than $80,000. The greatest increase in odds of being moderately active for men was observed among those with a household income of more than $80,000 who felt very strongly connected to their communities. Relative to women who had a very weak sense of connectedness and a household income of less than $30,000, men who had an annual income of $30,000 to $49,999 had the lowest odds of being physical active if they had a very weak, somewhat weak or somewhat strong sense of connectedness than any other income groups with the same sense of connectedness. The odds of being moderately active for women who reported a very strong sense of connectedness was approximately 3.25 times greater for those with a household income greater than$80,000 compared to the reference group. Women in the lowest income category (less than $30,000) were approximately 1.5 times more likely to be moderately active than the reference group if they had a very strong sense of connectedness. For women who had an income of more than $50,000 it appeared that the odds of being moderately active continued to increase as sense of connectedness got stronger; however for women who had a household income of $30,000 to $49,999 this dose response relationship leveled off between those reporting a somewhat strong and very strong sense of connectedness. Women in the lowest income group reflected a similar trend yet

the odds of being moderately active decreased between those with a somewhat strong and very strong sense of connectedness.

Table 11: Relative odds of being moderately active opposed to inactive, moderated by income and sex and compared to women who reported a very weak sense of connectedness and a household income of less than $30,000.

	Relative odds of being moderately active vs. inactive for men‡			
	Annual household income			
	< $30,000	$30,000-$49,999	$50,000-$79,999	> $80,000
Sense of connectedness				
Very strong	1.76	2.08	2.33	3.70
Somewhat strong	1.77	1.66	2.12	2.65
Somewhat weak	1.43	1.26	1.98	2.36
Very weak	1.08	0.81	1.39	1.98
	Relative odds of being moderately active vs. inactive for women			
Sense of connectedness				
Very strong	1.43	2.19	2.80	3.28
Somewhat strong	1.88	2.22	2.25	2.62
Somewhat weak	1.44	1.88	2.01	2.11
Very weak	1.00†	1.65	1.47	1.70

‡ Relative to women who have a very weak sense of connectedness and an annual household income of less than $30,000

† Reference group

Figure Caption: The association between connectedness and being moderately active opposed to inactive is moderated by income and sex. In Figure 3, the odds of being moderately active opposed to inactive are relative to females who reported a very weak sense of connectedness and a household income of less than $30,000 as indicated by the black diamond.

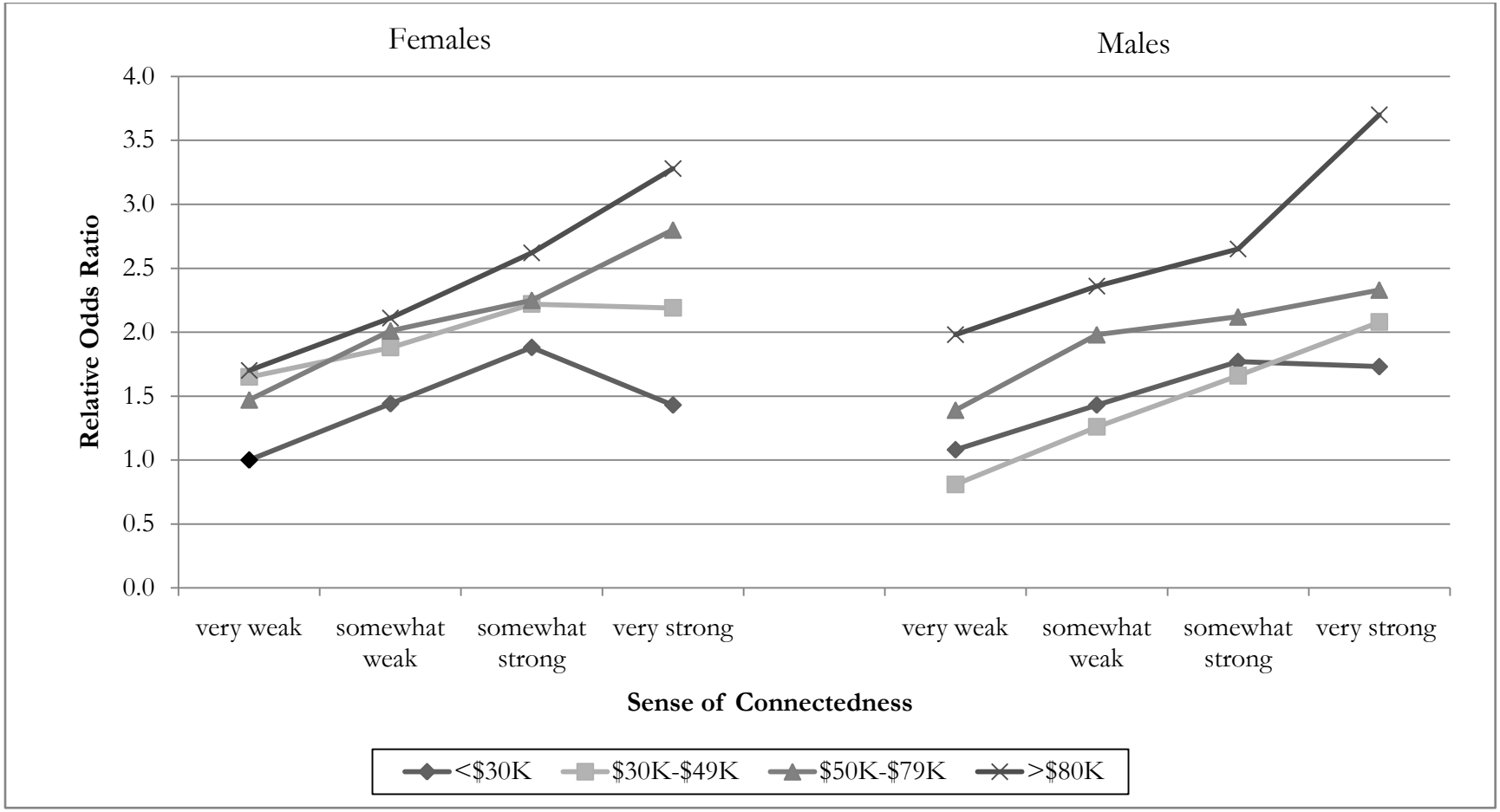

Figure 4: The odds of being moderately active opposed to inactive moderated by income and sex.

When exploring interactions with education, there was no significant three-way interaction between sense of community belonging, education and sex (p=0.36); however, the two-way interaction between sense of community belonging and education was significant suggesting the relationship is similar for men and women (Table 12). Similar to the previous interaction model, this model was able to predict physical activity levels of moderately active and inactive people 60.4% of the time. Full parameter estimates and standard errors can be found in Appendix E.

For all levels of educational achievement as sense of connectedness increased as did the odds of being moderately active with the exception of people who had some post-secondary education (Figure 5). It appeared that those who had some post-secondary education experienced a slight decrease in the odds of being moderately active if their sense of connectedness increased from very weak and somewhat weak before the odds increased similar to the other education categories. Although those who obtained a post-secondary degree or diploma had similar odds of being moderately active as those had had only a high school diploma when they both had a very weak sense of connectedness, their odds when reporting a very strong sense of connectedness exceeds the rest of the categories. In other words, people who had obtained a post secondary degree or diploma had approximately 3.75 the odds of being moderately active compared to the reference group. On the other hand, people who had not completed high school were only 1.75 times more likely to be moderately active if they had a very strong sense of connectedness compared to the reference group.

Table 12: Relative odds of being moderately active opposed to inactive moderated by educational attainment and compared to people who reported a very weak sense of connectedness and less than high school diploma.

	Relative odds of being physically active vs. inactive			
	Annual household income			
	Less than high school graduation	High school diploma	Some post-secondary education	Post-secondary degree/diploma
Sense of connectedness				
Very strong	1.66	2.35	2.45	2.78
Somewhat strong	1.51	2.13	2.14	2.31
Somewhat weak	1.35	1.56	1.67	2.04
Very weak	1.00†	1.49	1.79	1.42

† Reference group

Figure Caption: The association between connectedness and being moderately active opposed to inactive is moderated by educational attainment. In Figure 4, the odds of being moderately active opposed to inactive are relative to people who reported a very weak sense of connectedness and less than a high school diploma as indicated by the black diamond.

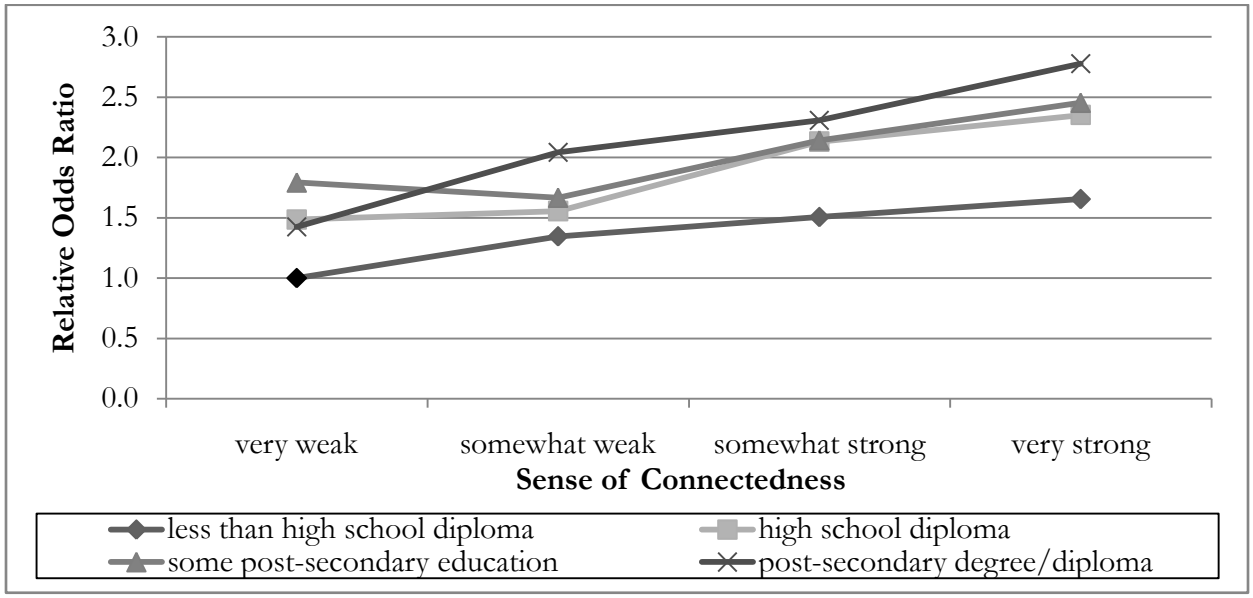

Figure 5: The odds of being moderately active opposed to inactive moderated by highest educational attainment.

5.2.3 Model 3: Odds of being active opposed to moderately active

Unadjusted models were run separately for men and women to determine the association between sense of connectedness and the odds of being active opposed to moderately active. Subsequently, age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race were added into each model to determine the adjusted odds.

5.2.3.1 Unadjusted and adjusted odds of being active opposed to moderately active for men

Unadjusted odds revealed that men who had a very strong sense of community belonging had the greatest odds of being active (OR 1.50, 95% CI 1.33-1.70) (Table 13). The odds of being active was also greater for men who reported a somewhat strong (OR 1.30, 95% CI 1.21-1.46) sense of connectedness compared to men who reported a very weak sense of connectedness. Level of connectedness is predictive of physical activity level among active and moderately active males 52.7% of the time.

After adjusting for age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race the dose response relationship between sense of connectedness and physical activity was still apparent. In fact, odds of being active among men increased slightly to 1.64 (95% CI 1.42-1.88) if they reported a very strong sense of community belonging and to 1.34 (95% CI 1.19-1.53) if they reported a somewhat strong sense of community belonging.

Some of the other variables that were added into the model were also associated with the odds of being active opposed to moderately active. For instance, men aged 25-29 had the greatest odds of being active (OR 1.38, 95% CI 1.24-1.54) followed by men aged 30-39 (OR 1.23, 95% CI 1.13-1.34)

Table 13: Unadjusted and adjusted odds of being active opposed to moderately active for men.

	Odds of being active[a] vs. moderately active[b]			
	Unadjusted[c]		Adjusted[d]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	1.50	(1.33-1.70)***	1.64	(1.42-1.88)***
Somewhat strong	1.39	(1.21-1.46)**	1.35	(1.19-1.53)***
Somewhat weak	1.09	(0.97-1.23)***	1.09	(0.97-1.22)
Very weak†	1.00		1.00	
Age				
25-29			1.38	(1.24-1.54)***
30-39			1.23	(1.13-1.34)***
40-49			1.07	(0.99-1.16)
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.22	(1.13-1.32)***
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			1.15	(1.00-1.31)*
$50,000-$79,999			0.99	(0.87-1.13)
More than $80,000			1.18	(1.04-1.28)*
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.03	(0.90-1.18)
Some post-secondary education			1.03	(0.88-1.21)
Post-secondary degree/diploma			1.14	(1.01-1.28)*
Employed during past year				
Yes†			1.00	
No			1.45	(1.29-1.62)***
Smoking status				
Daily or occasional smoker			0.94	(0.87-1.02)
Former or never smoker†			1.00	
Alcohol use				
Regular			0.95	(0.86-1.06)
Occasional			0.94	(0.82-1.08)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			0.87	(0.79-0.96)**
Race				
White†			1.00	
Aboriginal/other visible minority			1.08	(0.96-1.20)

[a] Active (n=8,011); [b] Moderately active (n=8,034)
[c] Model Fit Statistics (Unadjusted): -2 Log L = 26,706.08; c = 0.527
[d] Model Fit Statistics (Adjusted): -2 Log L = 22,732.07; c = 0.557
†Reference group; *p<0.05, **p<0.01, ***p<0.001

when compared to men aged 50-65. Once again, men who were separated, divorced, widowed, or single were more likely to be active (OR 1.22, 95% CI 1.13-1.32) than men who were married or in a common-law relationship.

The odds of being active was greater for men who had an annual household income of more than $80,000 (OR 1.18, 95% CI 1.04-1.28) when compared to men who had a household income of less than $30,000. Similarly, physical activity appeared to be greater in men who had obtained a post-secondary degree or diploma (OR 1.14, 95% CI 1.01-1.28). Additionally, men who had not worked at any time during the past 12 months were more likely to be active (OR 1.45, 95% CI 1.29-1.62) than men who had worked within the past 12 months.

Smoking, alcohol use, and race were not significant predictors of being active opposed to moderately active for men; however men born outside of Canada were less likely to be active (OR 0.87, 95% CI 0.79-0.96) than men born within Canada. Taking all the variables in the model into account, it is able to predict level of physical activity among active and moderately active males 55.7% of the time.

5.2.3.2 Unadjusted and adjusted odds of being active opposed to moderately active for women

Similar to women in the previous two models, those who reported a very strong sense of community belonging were more likely to be active (OR 1.38, 95% CI 1.22-1.56) than those who reported a very weak sense of community belonging (Table 14). The odds of being active were also greater for women who reported a somewhat strong (OR 1.16, 95% CI 1.04-1.30) sense of connectedness compared to women who have a very weak sense of connectedness. This model had

Table 14: Unadjusted and adjusted odds of being active opposed to moderately active for women.

	Odds of being active[a] vs. moderately active[b]			
	Unadjusted[c]		Adjusted[d]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	1.38	(1.22-1.56)***	1.52	(1.32-1.75)***
Somewhat strong	1.16	(1.04-1.30)**	1.25	(1.10-1.41)***
Somewhat weak	0.96	(0.85-1.08)	1.01	(0.88-1.15)
Very weak†	1.00		1.00	
Age				
25-29			1.39	(1.25-1.55)***
30-39			1.11	(1.02-1.21)*
40-49			1.22	(1.12-1.32)***
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.12	(1.03-1.21)**
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			0.88	(0.78-0.99)*
$50,000-$79,999			0.90	(0.81-1.01)
More than $80,000			1.01	(0.93-1.20)
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			0.89	(0.77-1.02)
Some post-secondary education			0.88	(0.74-1.04)
Post-secondary degree/diploma			1.05	(0.93-1.20)
Employed during past year				
Yes†			1.00	
No			1.12	(1.03-1.22)**
Smoking status				
Daily or occasional smoker			1.00	(0.92-1.08)
Former or never smoker†			1.00	
Alcohol use				
Regular			1.06	(0.96-1.16)
Occasional			0.92	(0.83-1.03)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			1.04	(0.94-1.15)
Race				
White†			1.00	
Aboriginal/other visible minority			1.05	(0.93-1.18)

[a] Active (n=8,173); [b] Moderately active (n=9,807)
[c] Model Fit Statistics (Unadjusted): -2 Log L = 26,424.69; c = 0.525
[d] Model Fit Statistics (Adjusted): -2 Log L = 21,951.35; c = 0.548
†Reference group; *p<0.05, **p<0.01, ***p<0.001

the lowest c statistic (0.525) indicating that connectedness, on its own, poorly predicted level of physical activity among active and moderately active females.

After adjusting for age, marital status, household income, education, employment status, smoking status, alcohol use, country of birth and race, the odds of being active among women who have a very strong sense of connectedness was still the greatest (OR 1.52, 95% CI 1.32-1.75), followed by women who reported a somewhat strong (OR 1.25, 95% CI 1.10-2.41) sense of connectedness when compared to women who have a very weak sense of connectedness.

When looking at the other variables that were added into the model, women aged 25-29 had the highest odds of being active (OR 1.39, 95% CI 1.25-1.55) compared to women aged 50-64. Similarly, women aged 30-39 (OR 1.11, 95% CI 1.02-1.21) and 40-49 (OR 1.22, 95% CI 1.12-1.32) were more active than those aged 50-64. Women who were separated, divorced, widowed, or single had slightly higher odds of being active (OR 1.12, 95% CI 1.03-1.21) compared to women who were married or in a common-law relationship.

The odds of being active was lower for women who had an annual income of $30,000-$49,999 (OR 0.88, 95% CI 0.78-0.99) than women who had an annual income of less than $29,000. Women who had not worked at any time during the past 12 months were more likely to be active (OR 1.12, 95% CI 1.03-1.22) than women who had worked within the past 12 months.

Education, smoking status, alcohol use, country of birth and race did not significantly influence the odds of being active opposed to moderately active. This model was able to predict level of physical activity among active and moderately active women 54.8% of the time.

The univariate analysis revealed that all variables, with the exception of smoking status (p=0.28), had a chi-square p value of less than 0.15 suggesting that once entered into the model they may be significant associated with being moderately active. Thus, all variables (with the exception of smoking status) were kept in the model when the multi-variable analyses were conducted.

5.2.3.3 Exploring the interactions

Exploration of possible interactions once again revealed no significant three-way interaction between sense of community belonging, age and sex (p=0.16) and there was no significant two-way interaction between sense of community belonging and age (p=0.17).

There was no significant three-way interaction between sense of community belonging, income and sex (p=0.16); however there was a significant two-way interaction between sense of community belonging and income (Table 15) (Figure 6). This model was able to predict the response of being either active or moderately active 55.7% of the time. The parameter estimates and standard errors for this interaction model can be found in Appendix F.

The reference group consisted of people who had an annual income of less than $30,000 and felt a very weak connection to their community. Those with an income of more than $80,000 and a very weak sense of connectedness had the lowest observed odds (approximately 0.80) of being active. However, there did appear to be a dose response relationship for these people in the highest income category such that as sense of community belonging increased as did the odds of being active to the extent that those with a very strong sense of connectedness were 1.5 times more likely to be active than the reference group.

Table 15: Relative odds of being active opposed to moderately active, moderated by income and compared to people who reported a very weak sense of connectedness and household income of less than $30,000.

	Relative odds of being active vs. moderately active			
	Annual household income			
	< $30,000	$30,000-$49,999	$50,000-$79,999	> $80,000
Sense of connectedness				
Very strong	1.59	1.33	1.26	1.53
Somewhat strong	1.07	1.17	1.07	1.26
Somewhat weak	0.93	0.86	0.88	1.00
Very weak	1.00†	0.95	0.92	0.78

†Reference group

Figure Caption: The association between sense of connectedness and being active opposed to moderately active is moderated by income. In Figure 5, the odds of being active opposed to moderately active are relative to people who reported a very weak sense of connectedness and a household income of less than $30,000 as indicated by the black diamond.

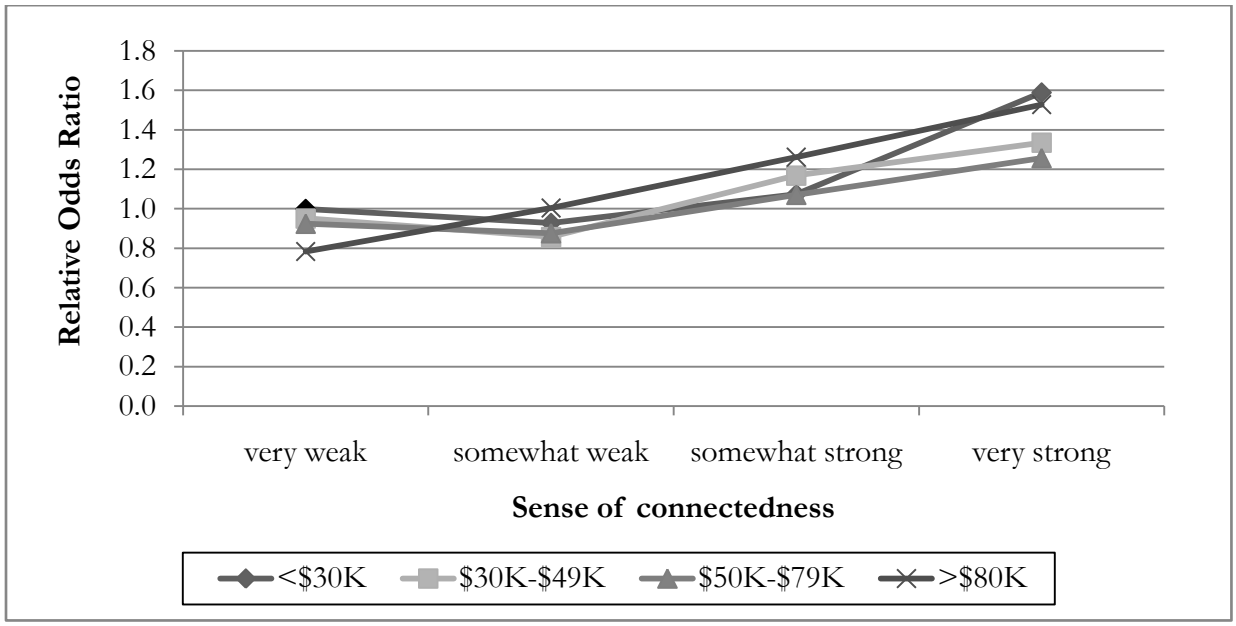

Figure 6: The odds of being active opposed to moderately active, moderated by income.

Relative to people who reported a very weak sense of connectedness and a household income of less than $30,000, people with an income of less than $80,000 displayed a slight decrease in the odds of being active if they had a somewhat weak sense of belonging; however, the odds of being active increased when sense of connectedness was somewhat strong and further increased if sense of connectedness was very strong. Unexpectedly, those with an annual household income of less than $30,000 had the greatest odds (almost 1.6) of being active if they felt very strongly connected to their community.

There was a significant three-way interaction between sense of community belonging, education and sex (Table 16). This interaction model was able to predict level of physical active for active and moderately active males and females 55.6% of the time. The parameter estimates and standard errors of this interaction model can be found in Appendix G. Figure 7 illustrates the odds ratios of being active opposed to moderately active relative to women who had not obtained a high school diploma and had a very weak sense of connectedness. Men with less than a high school diploma had the greatest odds of being active when their sense of connectedness was either very weak or somewhat strong (relative odds of approximately 1.4). Similarly, men with some post-secondary education had the greatest odds of being physically active when they had a somewhat strong sense of connectedness (relative odds of approximately 1.5). On the other hand, a dose response relationship appeared between sense of connectedness and relative odds of being active for men who had obtained a high school diploma or post-secondary degree or diploma. For both categories the odds of being physically active was approximately 1.7 times greater than the reference group.

Table 16: Relative odds of being active opposed to moderately active, moderating for education and sex and compared to women who reported a very weak sense of connectedness and who have less than a high school diploma

	Relative odds of being active vs. moderately active for men‡			
	Educational attainment			
	Less than high school graduation	High school diploma	Some post-secondary education	Post-secondary degree/diploma
Sense of connectedness				
Very strong	1.17	1.74	1.25	1.73
Somewhat strong	1.34	1.22	1.44	1.37
Somewhat weak	0.91	0.99	0.87	1.13
Very weak	1.33	0.95	0.92	0.96
	Relative odds of being active vs. moderately active for women			
Sense of connectedness				
Very strong	1.12	1.01	1.33	1.49
Somewhat strong	1.01	0.96	1.00	1.18
Somewhat weak	1.07	0.96	0.67	0.90
Very weak	1.00†	0.74	0.63	0.93

‡ Relative to women who have a very weak sense of connectedness and less than high school graduation.
† Reference group

Figure Caption: The association between sense of connectedness and being active opposed to moderately active is moderated by sex and educational attainment. In Figure 6, the odds of being active opposed to moderately active are relative to females who reported a very weak sense of connectedness and less than a high school diploma as indicated by the black diamond.

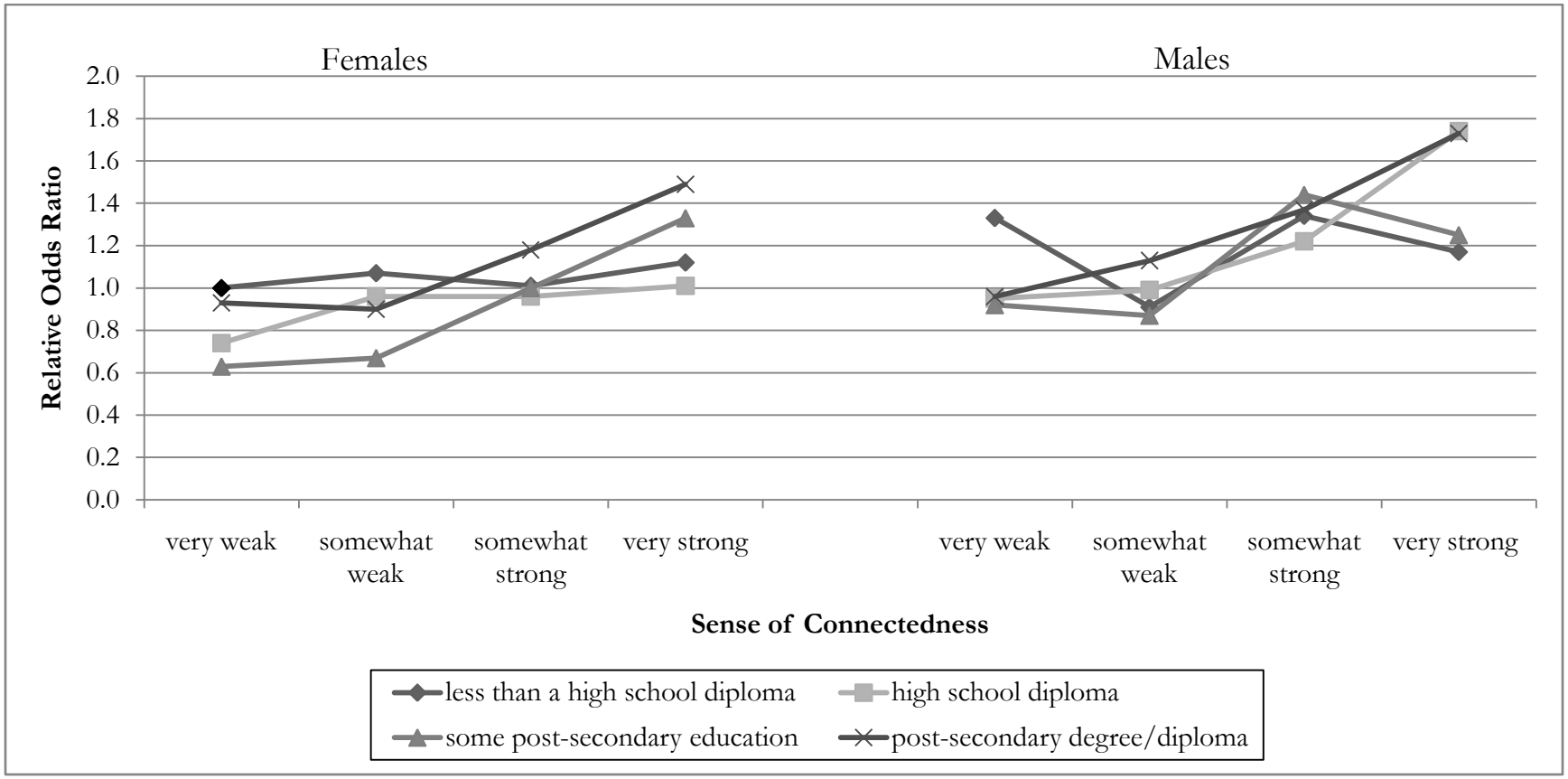

Figure 7: The odds of being active opposed to moderately active moderated by educational attainment and sex.

In contrast to men, sense of connectedness did not have as large an influence on being active for women. A small dose response relationship between sense of connectedness and relative odds of being active was still noticeable among most educational categories; however, those who reported achieving a high school diploma or greater had decreased odds of being active if they felt a very weak or somewhat weak connection to their communities when compared to the reference group. The lowest observed odds of being active opposed to moderately active were among women who had achieved some post-secondary education and felt a very weak connection to their community (relative odds of approximately 0.6). Alternatively, among women, those who had obtained a post-secondary degree or diploma and felt very strongly connected to their community were approximately 1.5 times more likely to be active than the reference group.

5.2.4 Summary of findings for Research Question 1

In general, as sense of connectedness increased as did the odds of being more active for both males and females before and after adjusting for other potential explanatory variables. Table 17 provides a summary of how sense of connectedness and other predictors are associated with physical activity for men and Table 18 provides a summary of how sense of connectedness and other predictors are associated with physical activity for women. Greater levels of physical activity were usually associated with being between the ages of 25-29; being single, widowed, divorced or separated; having a higher household income and educational attainment; being unemployed; and consuming alcohol regularly. People who were daily or occasional smokers, born outside of Canada or Aboriginal or visible minority were less likely to be active.

Table 17: Odd ratios of being active opposed to inactive (Model 1), moderately active opposed in inactive (Model 2), and active opposed to moderately active (Model 3) for men.

	Model 1[a]	Model 2[b]	Model 3[c]
	OR	OR	OR
Sense of community belonging			
Very strong	3.2	1.9	1.6
Somewhat strong	2.1	1.6	1.4
Somewhat weak	1.4	1.4	NS[d]
Very weak[†]	1.0	1.0	1.0
Age			
25-29	1.8	1.3	1.4
30-39	1.2	NS	1.2
40-49	1.1	NS	NS
50-64[†]	1.0	1.0	1.0
Marital status			
Married/common law[†]	1.0	1.0	1.0
Single/widowed/divorced/separated	1.5	1.2	1.2
Household Income			
Less than $30,000[†]	1.0	1.0	1.0
$30,000-$49,999	NS	NS	1.1
$50,000-$79,999	1.3	1.3	NS
More than $80,000	2.0	1.7	1.2
Education			
Less than secondary school graduation[†]	1.0	1.0	1.0
Secondary school graduation, no post-secondary education	1.4	1.3	NS
Some post-secondary education	1.6	1.6	NS
Post-secondary degree/diploma	1.8	1.6	1.1
Employed during past year			
Yes[†]	1.0	1.0	1.0
No	1.9	1.4	1.4
Smoking status			
Daily or occasional smoker	0.7	0.7	NS
Former or never smoker[†]	1.0	1.0	1.0
Alcohol use			
Regular	1.3	1.4	NS
Occasional	NS	NS	NS
Former/never[†]	1.0	1.0	1.0
Country of birth			
Canada[†]	1.0	1.0	1.0
Outside of Canada	0.7	0.8	0.9
Race			
White[†]	1.0	1.0	1.0
Aboriginal/other visible minority	NS	0.9	NS

[a] Model 1: Odds of being active (n=8,011) vs. inactive (n=15,689)
[b] Model 2: Odds of being moderately active (n=8,034) vs. inactive (n=15,689)
[c] Model 3: Odds of being active (n=8,011) vs. moderately active (n=8,034)
[d] NS = Not Significant;
*p<0.05, **p<0.01, ***p<0.001;
[†]Reference group

Table 18: Odd ratios of being active opposed to inactive (Model 1), moderately active opposed in inactive (Model 2), and active opposed to moderately active (Model 3) for women.

	Model 1[a]	Model 2[b]	Model 3[c]
	OR	OR	OR
Sense of community belonging			
Very strong	2.6	1.7	1.5
Somewhat strong	1.9	1.5	1.2
Somewhat weak	1.3	1.3	NS[d]
Very weak[†]	1.0	1.0	1.0
Age			
25-29	1.5	1.1	1.4
30-39	1.1	NS	1.1
40-49	1.1	NS	1.2
50-64[†]	1.0	1.0	1.0
Marital status			
Married/common law[†]	1.0	1.0	1.0
Single/widowed/divorced/separated	1.2	1.1	1.1
Household Income			
Less than $30,000[†]	1.0	1.0	1.0
$30,000-$49,999	1.1	1.3	0.9
$50,000-$79,999	1.2	1.4	NS
More than $80,000	1.5	1.5	NS
Education			
Less than secondary school graduation[†]	1.0	1.0	1.0
Secondary school graduation, no post-secondary education	1.2	1.3	NS
Some post-secondary education	NS	1.2	NS
Post-secondary degree/diploma	1.5	1.4	NS
Employed during past year			
Yes[†]	1.0	1.0	1.0
No	1.3	1.2	1.1
Smoking status			
Daily or occasional smoker	0.8	0.8	NS
Former or never smoker[†]	1.0	1.0	1.0
Alcohol use			
Regular	1.5	1.4	NS
Occasional	NS	NS	NS
Former/never[†]	1.0	1.0	1.0
Country of birth			
Canada[†]	1.0	1.0	1.0
Outside of Canada	0.9	0.8	NS
Race			
White[†]	1.0	1.0	1.0
Aboriginal/other visible minority	0.8	0.7	NS

[a] Model 1: Odds of being active (n=8,173) vs. inactive (n=17,807)
[b] Model 2: Odds of being moderately active (n=9,807) vs. inactive (n=17,807)
[c] Model 3: Odds of being active (n=8,173) vs. moderately active (n=9,807)
[d] NS = Not Significant
*p<0.05, **p<0.01, ***p<0.001
[†]Reference group

5.3 The Influence of Connectedness on Intention to Start or Increase Physical Activity

Intending to change certain behaviours often increases the likelihood that a person *will* change their behaviours. Section 5.3.1 provides the results for how sense of connectedness may influence the likelihood of inactive people intending to start physically activity or exercise. Section 5.3.2 provides the results for how sense of connectedness may influence the intention of moderately active people to increase their physically activity. However, before getting into the results it should be restated that the optional module of the survey measuring changes made to improve health was only administered to people residing in Ontario, Manitoba, and Newfoundland and Labrador, thus people in this subset of my data may possess different characteristics than the sample characteristic mentioned in Table 4. Please see Table 19 for the weighted descriptive characteristics of this subset of the sample data.

A total of 22055 people provided valid answers for the questions addressing intentions to improve health. Of these people, approximately half reported that they intend to start or increase exercise. The majority was classified as inactive (54%) and about a quarter were classified as moderately active. People who were classified as active had the least number of people reporting that they intended to start or increase physical activity (46%) and approximately half of the people classified as inactive or moderately active intending to start or increase physical activity (51% and 50% respectively). The association between physical activity level and intention to start or increase physical activity was significant (X^2=26.57, df=2, p<.0001). Feeling a somewhat strong sense of connectedness was reported by the highest number of people (49%) followed by somewhat weak (27%), very strong (15%) and very weak (8%) sense of connectedness. Intending the start or increase physical activity was reported most by people who felt a somewhat weak sense of

Table 19: Descriptive statistics highlighting the characteristics of the sample of 25-64 year olds and the proportion of each group who intend or do not intend to start or increase physical activity. ‡

	Total (%)	Intenders (%)	Non-intenders (%)	Chi^2 p
Outcome Variables				
Intention				
Intenders	49.28	-	-	
Non-intenders	50.72	-	-	
Physical Activity Index				
Active	21.23	45.95	54.05	
Moderately Active	25.26	50.40	49.60	X^2(2, n=22,055)=26.57
Inactive	53.51	50.08	49.92	p<.0001
Predictor Variables				
Sense of community belonging				
Very strong	14.99	47.97	52.03	
Somewhat strong	49.16	49.92	50.08	
Somewhat weak	27.40	50.44	49.56	X^2(3, n=21,915)=22.83
Very weak	8.45	44.69	55.31	p<.0001
Sex				
Male	49.07	46.53	53.47	X^2(1, n=22,055)=64.66
Female	50.93	51.94	48.06	p<.0001
Age				
25-29	11.99	51.92	48.08	
30-39	27.14	51.28	48.72	
40-49	30.95	48.58	51.42	X^2(3, n=22,055)=30.31
50-64	29.93	47.15	52.85	p<.0001
Marital status				
Married/common-law	75.31	49.84	50.16	X^2(1, n=22,038)=8.34
Widowed/divorced/separated/single	24.69	47.58	52.42	p=0.0039
Household income				
Less than $30,000	10.24	44.28	55.72	
$30,000 - $49,999	16.16	45.39	54.61	
$50,000 - $79,999	27.54	50.78	49.22	X^2(3, n=20,073)=65.85
More than $80,000	46.06	51.72	48.28	p<.0001
Education				
Less than secondary school diploma	9.35	37.86	62.14	
Secondary school diploma;	15.73	42.98	57.02	
Some post-secondary education	6.93	42.29	57.71	X^2(3, n=21,648)=271.12
Post secondary degree/diploma	67.99	53.10	46.90	p<.0001
Worked at a job/business over the past year				
Yes	87.21	49.66	50.34	X^2(1, n=22,052)=8.56
No	12.79	46.71	53.29	p=0.0034
Smoking status				
Daily/Occasionally	27.78	36.35	63.65	X^2(1, n=22,011)=563.80
Not at all	72.22	54.22	45.78	p<.0001
Alcohol use				
Regular	67.01	50.06	49.94	
Occasional	17.56	48.02	51.98	X^2(2, n=21,787)=13.15
Former & Never	15.14	46.96	53.04	p=0.0014

Country of origin				
Canada	76.66	48.16	51.84	X^2(1, n=20,505)=35.67
Other	23.34	53.09	46.91	p<.0001
Race				
White	80.59	48.29	51.71	X^2(1, n=21,637)=40.12
Aboriginal/Visible Minority	10.41	53.76	46.27	p<.0001

‡ The module regarding changes made to improve health was only administered to Ontario, Manitoba and Newfoundland and Labrador.

connectedness and the association between connectedness and intention was significant (X^2=22.83, df=3, p<.0001).

Similar to the full sample, males and females were equally represented in this subset of data; however intending to start or increase physical activity was reported more by females than males and the association between intention and sex was also significant (X^2=64.66, df=1, p<.0001). Approximately 12% of this subset was aged 25-29, 27% were aged 30-39, 31% were aged 40-49, and 30% were aged 50-64. Further, 75% were married or in a common-law relationship.

In terms of socioeconomic status 46% had an annual household income of $80,000 or more, 28% had a household income of $50,000 to $79,999, 16% had a household income of $30,000 to $49,999, and 10% had a household income of less than $30,000. Having obtained a post-secondary diploma was reported by a majority of participants (68%). The remaining people had obtained some post-secondary education (7%), a secondary school diploma (16%), less than a post-secondary diploma (9%). Over three quarters of the people (87%) reported working at a job or business during the past 12 months.

Over a quarter of the people who answered questions related to improvements made to health were daily or occasional smokers and a majority consumed alcohol regularly (67%). Approximately 77% were born within Canada and 81% classified their race as white.

5.3.1 Does sense of connectedness influence the odds of intending to start or increase physical activity among inactive men?

Unadjusted odds revealed a weak influence of sense of community belonging on intention to start or increase physical activity for inactive people (Table 20). For men, the odds of intending to be physically active were greatest for those with a very strong sense of connectedness (OR 1.30, 95% CI 1.05-1.62); however, intention was still greater for those with a somewhat strong (OR 1.26, 95% CI 1.05-1.52) and somewhat weak (OR 1.27, 95% CI 1.05-1.54) sense of connectedness compared to those with a very weak sense of connectedness. Level of community connectedness was predictive of intentions to start or increase physical activity among inactive males 51.0% of the time.

After controlling for age, sex, marital status, education, income, employment status, smoking status, alcohol use, country of birth and race, the influence of connectedness on the odds of intending to start or increase physical activity was no longer significant for men.

When looking at the other variables in the model, men between the ages of 25 and 29 years were more likely to intend to start or increase physical activity (OR 1.59, 95% CI 1.26-2.00) when compared to people between the ages of 50-64. The odds for the other age groups did not differ significantly from the reference group. Men with a household income of $50,000-$79,000 or more than $80,000 had greater odds of intending to start or increase physical activity (OR 1.30, 95% CI 1.01-1.67; OR 1.46, 95% CI 1.14-1.88, respectively) than men with a household income of less than $30,000. Similarly, men who had obtained a post-secondary degree or diploma were more likely to intend to start or increase physical activity (OR 1.44, 95% CI 1.18-1.75) than men who had less than a high school diploma.

Table 20: Unadjusted and adjusted odds of intending to start or increase physical activity among inactive men.

	Odds of intending to start or increase physical activity[a]			
	Unadjusted[b]		Adjusted[c]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	1.30	(1.05-1.62)*	1.26	(0.98-1.62)
Somewhat strong	1.26	(1.05-1.52)*	1.20	(0.97-1.48)
Somewhat weak	1.27	(1.05-1.54)*	1.07	(0.86-1.33)
Very weak†	1.00		1.00	
Age				
25-29			1.59	(1.26-2.00)***
30-39			0.97	(0.82-1.14)
40-49			1.03	(0.88-1.20)
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			0.95	(0.80-1.12)
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			1.01	(0.77-1.31)
$50,000-$79,999			1.30	(1.01-1.67)*
More than $80,000			1.46	(1.14-1.88)**
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.02	(0.80-1.28)
Some post-secondary education			0.77	(0.57-1.04)
Post-secondary degree/diploma			1.44	(1.18-1.75)***
Employed during past year				
Yes†			1.00	
No			1.14	(0.88-1.48)
Smoking status				
Daily or occasional smoker			0.43	(0.38-0.50)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.05	(0.87-1.27)
Occasional			0.77	(0.60-0.97)*
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			1.14	(0.96-1.35)
Race				
White†			1.00	
Aboriginal/other visible minority			1.47	(1.21-1.79)***

[a] Intenders (n=2,124); Non-intenders (n=2,919)
[b] Model Fit Statistics (Unadjusted): -2 Log L = 7,556.66; c = 0.510
[c] Model Fit Statistics (Adjusted): -2 Log L = 6,129.45; c = 0.644
†Reference group; *p<0.05, **p<0.01, ***p<0.001

The odds of intending to start or increase physical activity was lower among daily and occasional smokers (OR 0.43, 95% CI 0.38-0.50) and occasional alcohol users (OR 0.77, 95% CI 0.60-0.97). Finally, men who were classified as a visible minority were more likely to intend to start or increase physical activity (OR 1.47, 95% CI 1.22-1.78) than those who identified as white. Although sense of connectedness was not longer a significant predictor of intentions to start or increase physical activity among inactive men after other variables were controlled for, the other variables in the model were able to predict men's intentions start or increase to physical activity 64.4% of the time.

5.3.2 Does sense of connectedness influence the odds of intending to start or increase physical activity among inactive women?

Among women, those who reported a somewhat strong (OR 1.36, 95% CI 1.14-1.62) and somewhat weak (OR 1.36, 95% CI 1.13-1.64) sense of connectedness had the greatest odds of intending to start or increase physical activity (Table 21). Women who felt very strongly connected to their community had slightly lower odds (OR 1.32, 95% CI 1.07-1.63) yet this was still higher than women who had a very weak sense of connectedness. Sense of connectedness was predictive of intentions to start or increase physical activity among inactive women 52.4% of the time.

The odds of intending to start or increase physical activity remained fairly consistent after adjusting for age, sex, marital status, education, income, employment status, smoking status, alcohol use, country of birth and race. Those who had a very strong (OR 1.35, 95% CI 1.06-1.72) and somewhat strong (OR 1.35, 95% CI 1.11-1.65) sense of connectedness had the greatest odds of intending to start or increase physical activity. Women who had a somewhat weak sense of

Table 21: Unadjusted and adjusted odds intending to start or increase physical activity among inactive women.

	Odds of intending to start being physically active[a]			
	Unadjusted[b]		Adjusted[c]	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	1.32	(1.07-1.63)*	1.35	(1.06-1.72)*
Somewhat strong	1.36	(1.14-1.62)***	1.35	(1.11-1.65)**
Somewhat weak	1.36	(1.13-1.64)**	1.33	(1.08-1.65)**
Very weak†	1.00		1.00	
Age				
25-29			1.47	(1.20-1.81)***
30-39			1.31	(1.13-1.53)***
40-49			1.16	(1.00-1.34)*
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.04	(0.91-1.20)
Household Income				
Less than $30,000†				
$30,000-$49,999			0.97	(0.80-1.19)
$50,000-$79,999			1.25	(1.03-1.53)*
More than $80,000			1.07	(0.87-1.31)
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.08	(0.86-1.35)
Some post-secondary education			1.02	(0.77-1.35)
Post-secondary degree/diploma			1.43	(1.16-1.75)***
Employed during past year				
Yes†			1.00	
No			1.07	(0.91-1.26)
Smoking status				
Daily or occasional smoker			0.50	(0.43-0.57)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.29	(1.10-1.51)**
Occasional			1.01	(0.85-1.21)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			1.21	(1.03-1.43)*
Race				
White†			1.00	
Aboriginal/other visible minority			0.77	(0.64-0.93)**

[a] Intenders (n=3,253); Non-intenders (n=3,140)
[b] Model Fit Statistics (Unadjusted): -2 Log L = 8,607.45; c = 0.524
[c] Model Fit Statistics (Adjusted): -2 Log L = 6,977.33; c = 0.623
†Reference group; *p<0.05, **p<0.01, ***p<0.001

connectedness still had greater odds of intending to start or increase physical activity (OR 1.33, 95% CI 1.08-1.65) when compared to women who had a very weak sense of connectedness.

Some of the other variables that were added into the model were also associated with the odds of inactive women intending to start physical activity. For instance, the odds of intending to start or increase engagement in physical activity increased as age decreased. Women aged 25-29 (OR 1.47, 95% CI 1.20-1.81) and 30-39 (OR 1.31, 95% CI 1.13-1.53) were more likely to intend to start or increase their physical activity than those aged 50-64. For women, only those who had a household income of $50,000-$79,999 were more likely to intend to start or increase physical activity (OR 1.25, 95% CI 1.04-1.51) when compared to women with a household income of less than $30,000. Additionally, women who have obtained a degree or diploma from a post-secondary institution had increased the odds of intending to start or increase physical activity (OR 1.43, 95% CI 1.16-1.75).

Being a daily or occasional smoker greatly decreased the odds of intending to start physical activity among women (OR 0.50, 95% CI 0.44-0.56); however, drinking alcohol regularly increased the odds of intending to start or increase physical activity (OR 1.29, 95% CI 1.10-1.51) Finally, the odds of intending to start or increase physical activity was greater for women who were born outside of Canada (OR1.21, 95% CI 1.04-1.42) and lower for women who identified as Aboriginal or another visible minority (OR 0.77, 95% CI 0.64-0.93). The addition of the other potential explanatory variables into the model increased its ability to predict intentions to start or increase physical activity among inactive women to 62.3%.

Due to the lack of significant results among both sexes, no further analyses were conducted looking at whether sex, age, income and education were possible mediators explaining the

relationship between sense of connectedness and intention to start or increase physical activity among inactive people.

5.3.3 Does sense of connectedness influence the odds of intending to increase physical activity among moderately active men?

Unadjusted odds reveal that sense of connectedness does not influence the odds of intending to increase physical activity for moderately men. The c statistic of 0.506 confirms that this model's ability to predict moderately active men's intentions to increase physical activity would be the same as randomly predicting this response. However, after adjusting for age, marital status, income, education, employment status, smoking status, alcohol use, country of birth, and race it the ability of the model to predict the intention of moderately active men to start or increase physical activity is correct 60.8% of the time. It appeared that men were actually less likely to intend to increase physical activity if they felt a very strong (OR 0.61, 95% CI 0.41-0.89) or somewhat weak (OR 0.66, 95% CI 0.46-0.91) sense of connection to their community than if they felt a very weak sense of connection (Table 22).

The other variables in the model suggested that men aged 30-39 were more likely to intend to increase their physical activity (OR 1.34, 95% CI 1.07-1.68) than men aged 50-64. Men who had an annual household income of $50,000-$79,999 were 1.55 (95% CI 1.05-2.28) times more likely to intend to increase their physical activity than those with an annual household income of less than $30,000. Further, men with some post-secondary education had greater odds of intending to increase their physical activity (OR 1.94, 95% CI 1.25-3.01) than those who had less than a secondary school diploma.

Table 22: Unadjusted and adjusted odds of intending to increase physical activity among moderately active men.

	Odds of intending to increase physical activity			
	Unadjusted		Adjusted	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	0.75	(0.54-1.05)	0.61	(0.41-0.89)*
Somewhat strong	0.87	(0.65-1.17)	0.73	(0.65-1.02)
Somewhat weak	0.91	(0.67-1.24)	0.66	(0.46-0.91)*
Very weak†	1.00		1.00	
Age				
25-29			1.29	(0.96-1.74)
30-39			1.34	(1.07-1.68)*
40-49			1.24	(1.00-1.55)
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			1.16	(0.94-1.44)
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			1.20	(0.78-1.84)
$50,000-$79,999			1.55	(1.05-2.28)*
More than $80,000			1.36	(0.92-2.01)
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			0.93	(0.63-1.36)
Some post-secondary education			1.94	(1.25-3.01)**
Post-secondary degree/diploma			1.29	(0.92-1.80)
Employed during past year				
Yes†			1.00	
No			1.06	(0.74-1.51)
Smoking status				
Daily or occasional smoker			0.51	(0.42-0.62)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.21	(0.89-1.65)
Occasional			1.50	(1.01-2.22)**
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			0.81	(0.64-1.02)
Race				
White†			1.00	
Aboriginal/other visible minority			1.56	(1.19-2.04)**

[a] Intenders (n=1,188); Non-intenders (n=1,318)
[b] Model Fit Statistics (Unadjusted): -2 Log L = 3,778.34; c = 0.506
[c] Model Fit Statistics (Adjusted): -2 Log L = 3,249.20; c = 0.608
†Reference group; *p<0.05, **p<0.01, ***p<0.001

Being a daily or occasional smoker decreased the odds of intending to increase physical activity (OR 0.51, 95% CI 0.42-0.62) among men compared to those who were non-smokers and consuming alcohol occasionally increased the odds of intending to enhance physical activity (OR 1.50, 95% CI 1.01-2.22) when compared to those who were former or never drinkers. Finally, men who identified themselves as Aboriginal or another visible minority were 1.56 (95% CI 1.19-2.04) times more likely to intend to increase physical activity than those who identified themselves as white.

5.3.4 Does sense of connectedness influence the odds of intending to increase physical activity among moderately active women?

The unadjusted odds reveal that women who feel a somewhat weak connection to their community are more likely to intend to increase their physical activity (OR 1.60, 95% CI 1.19-2.16) than those who felt a very weak sense of connection to their local community (Table 23). Sense of connectedness was only able to predict intentions to increase physical activity among moderately active women 51.7% of the time. After adjusting for age, marital status, income, education, employment status, smoking status, alcohol use, country of birth, and race sense of connection was no longer significant associated with intention to increase physical activity among moderately active women, however the ability of the other variables in the model to predict intentions to increase physical activity among moderately active women was increased to 58.7% of the time.

The other variables in the model suggest that women aged 25-29 are 1.43 (95% CI 1.06-1.92) times more likely to intend to increase physical activity than those aged 50-64. Additionally, intention to increase physical activity was greater among women who had obtained a high school diploma (OR 1.59, 95% CI 1.07-2.36) or a post-secondary degree/diploma (OR 2.06, 95% CI 1.43-2.97)

Table 23: Unadjusted and adjusted odds of intending to increase physical activity among moderately active women.

	Odds of intending to start being physically active			
	Unadjusted		Adjusted	
	OR	95% CI	OR	95%CI
Sense of community belonging				
Very strong	1.24	(0.90-1.72)	1.14	(0.79-1.66)
Somewhat strong	1.20	(0.91-1.39)	1.07	(0.78-1.48)
Somewhat weak	1.60	(1.19-2.16)**	1.33	(0.94-1.88)
Very weak†	1.00		1.00	
Age				
25-29			1.43	(1.06-1.92)*
30-39			1.20	(0.96-1.49)
40-49			1.05	(0.84-130)
50-64†			1.00	
Marital status				
Married/common law†			1.00	
Single/widowed/divorced/separated			0.89	(0.72-1.09)
Household Income				
Less than $30,000†			1.00	
$30,000-$49,999			0.84	(0.60-1.19)
$50,000-$79,999			1.04	(0.75-1.45)
More than $80,000			0.99	(0.71-1.38)
Education				
Less than secondary school graduation†			1.00	
Secondary school graduation, no post-secondary education			1.59	(1.07-2.36)*
Some post-secondary education			1.34	(0.82-2.18)
Post-secondary degree/diploma			2.06	(1.43-2.97)***
Employed during past year				
Yes†			1.00	
No			1.01	(0.80-1.29)
Smoking status				
Daily or occasional smoker			0.56	(0.46-0.68)***
Former or never smoker†			1.00	
Alcohol use				
Regular			1.05	(0.81-1.37)
Occasional			1.01	(0.75-1.35)
Former/never†			1.00	
Country of birth				
Canada†			1.00	
Outside of Canada			0.92	(0.72-1.18)
Race				
White†			1.00	
Aboriginal/other visible minority			1.24	(0.91-1.70)

[a] Intenders (n=1,505); Non-intenders (n=1,638)
[b] Model Fit Statistics (Unadjusted): -2 Log L = 3,888.92; c = 0.517
[c] Model Fit Statistics (Adjusted): -2 Log L = 3,222.17; c = 0.587
†Reference group; *p<0.05, **p<0.01, ***p<0.001

than those who had less than a high school diploma. Similar to men, women who were daily or occasional smokers were less likely to intend to increase physical activity (OR 0.56, 95% CI 0.46-0.68) than those who were non-smokers.

Due to the lack of significant results among both sexes, no further analyses were conducted looking at whether sex, age, income and education were possible mediators explaining the relationship between sense of connectedness and intention to start or increase physical activity among moderately active people.

5.3.5 Summary of findings for Research Question 2

It appears that a greater sense of connectedness increases the odds of intending to start being physically active among inactive women however, decreases the odds of intending to increase physical activity among moderately active males. There were no significant associations between connectedness and intentions among moderately active females or inactive males after adjusting for other potential explanatory variables. Being younger and having higher income and educational attainment generally increased the intention of people to start or increase physical activity and being a daily or occasional smoker always decreased the odds of intending to start or increase physical activity. Thus, although there is a clear positive association between sense of connectedness and current participation in leisure-time physical activity, the association between sense of connectedness and intentions to start or increase engagement in physical activity is less clear.

Chapter 6: Discussion

The primary aim of this research was to determine how sense of connectedness may be associated with participation in leisure-time physical activity among Canadians. The secondary aim was to determine how sense of connectedness may be associated with intentions to start or increase engagement in physical activity.

6.1 Connectedness and Participation in Physical Activity

In line with the first research question "Are people who have a strong sense of connectedness more likely to engage in higher amounts of physical activity?" the results suggest that there is a positive association between sense of connectedness and participation in physical activity. After adjusting for potential moderating and confounding variables such as age, sex, marital status, income, education, employment status, smoking status, alcohol use, country of birth and race the data revealed a dose response relationship between connectedness and physical activity. In other words, as sense of connectedness increased, the odds of participating in physical activity also increased. More specifically, connectedness appeared to have the largest influence on the likelihood of being active opposed to inactive. For instance, men who reported a very strong sense of connectedness were over three times more likely to be active than men who reported a very weak sense of connectedness. Similarly, women who had a very strong sense of connectedness were approximately 2.5 times more likely to be active than those who had a very weak sense of connectedness.

Having a stronger sense of connectedness also resulted in a greater likelihood of being moderately active compared to inactive. The adjusted models revealed that men are almost two times more likely to be moderately active if they had a very strong sense of connectedness than if

they had a very weak sense of connectedness. Likewise, women were approximately 1.7 times more likely to be physically active if they had a very strong sense of connectedness than a very weak sense of connectedness. Finally, people who reported a very strong connection to their communities were also more likely to be active opposed to moderately active, but to a lesser extent than the other two models. Men who reported a very strong sense of connectedness were 1.6 times more likely to be active and women who reported a very strong sense of connectedness were 1.5 times more likely to be active than their same-sex counterparts who felt a very weak sense of connectedness.

These results support the earlier findings by Lindström and colleagues (2001; 2003) who found that people who participated in a lower number of formal and informal societal groups were more likely to be physically inactive than those who partook in a greater number of groups. However, building on the study by Lindström and colleagues (2003) this study assessed the influence of sex, age, income and education on the magnitude of the association between connectedness and participation in physical activity.

Women tend to "define themselves more in terms of intimacy and empathy" (Lee & Robbins, 1998, p339) and value connectedness more than men (Townsend & McWhirter, 2005). Further, among married people, the wife's ability to connect her husband to social groups is one suggested reason for a longer life expectancy among married men when compared to unmarried men (Christakis & Fowler, 2009). In this study, however, men and women reported relatively equal levels of community belonging, although connectivity seemed to have a greater influence on engagement in physical activity among men than women. This is interesting as a recent study regarding predictors of physical activity among adolescents revealed that for girls, approval from friends was positively correlated with physical activity, where as this association did not exist for boys (Trinh, Rhodes &

Ryan, 2008). In other words, girls were more likely to be physically active if their friends approved of their participation in physical activity and less likely to be physically active if their friends did not approve of this behaviour. It appears that this compliance with the perceived normative beliefs of peers continues into adulthood as there is evidence that among women, physical activity is often perceived as an inappropriate and unaccepted behaviour (Vrazel et al., 2006). Thus, it may be that norms encouraging physical activity are more prevalent, encouraged, and accepted among networks of men than networks of women.

Interestingly, age did not significantly moderate the relationship between connectedness and physical activity as it had the relationship between connectedness and smoking as seen by McDonald (2008). This suggests that way in which sense of connectedness is associated with participation in physical activity may be the same for all age groups included in this study. Although age was not found to moderate the relationship between connectedness and physical activity, exploratory analyses revealed that sex, income and education did influence the effect to which sense of connectedness was associated with physical activity.

For almost every income and educational category, as sense of connectedness increased as did the odds of being physically active. However, the extent to which connectedness influenced physical activity is not the same for all people. Connectedness tended to have the greatest impact on participation in physical activity among the highest income and education groups. For example, people in the lowest income category (less than $30,000) were approximately 2.5 times more likely to be physically active opposed to inactive if they had a very strong sense of connectedness than people in the same income category who felt a very weak connection to their community. On the other

hand, people in the highest income bracket ($80,000+) were over 3.7[3] times more likely to be physically active opposed to inactive if they felt very strongly connected to their community compared to people in the same income category who felt a very weak connection to their community. The other two models revealed a similar trend; however the influence of income was less extreme than the first model.

Higher levels of physical activity were continuously observed among people in the highest income bracket and who had a very strong sense of connectedness. The relationship between income and health is evident. People who have greater income have better selection of housing quality, type and location, food, clothing, transportation, and increased opportunity for cultural, recreational and physical activities and childcare (Lynch & Kaplan, 2000). It is also understood that people who have a greater household income feel more connected (Ross, 2002; Shields, 2008) and that people who are more connected are more likely to be physically active. Thus, it may be that increased access to resources, as observed among the wealthy, enhances the ability for people to comply with norms that promote physical activity and that norms supporting a physically active lifestyle were enforced to a greater extent among the most connected.

For instance, it may be that people who report being most connected to their communities had greater exposure to norms promoting participation in physical activity; however, without access to resources such as trails, fitness facilities, childcare, etc. which are commonly less accessible for people who have a lower income, then ability of these people to comply to the norm of being physically active would be difficult. In line with this logic, recent results from the Physical Activity

[3] The value was obtained by dividing the odds of being physically active when income is greater than $80,000 and sense of connectedness is very strong (5.23) by the odds of being physically when income is greater than $80,000 and sense of connectedness is very weak (1.41). Values can be obtained from Appendix B.

and Sport Monitor revealed that social norms for walking appear to be highest among people who have the lowest household income; however, these people often have less perceived control over fitting physical activity into their lifestyle (CFLRI, 2005). On the other hand, people with a higher annual income may have access to the resources that allow them to be physically active, however if they feel less connected to their community then they would have less exposure to norms promoting physical activity, ultimately reducing the likelihood of being physically active.

The influence educational attainment had on the association between connectedness and physical activity is comparable to the influence of income. People who had a very strong sense of connectedness tended to be the most physically active if they also had a post-secondary degree or diploma. Additionally, people who had less than a high school diploma often reported the lowest levels of physical activity among all levels of connectedness. It is known that educational attainment often predicts career opportunities, working conditions, income, housing, and neighbourhood (Lynch & Kaplan, 2000). It may be that people who have lower education have more physically demanding occupations, poorer working conditions and housing, and live in more disadvantaged neighbourhoods which may decreases their desire and ability to be physically active during their leisure-time. On the other hand, people who have higher levels of education may have greater skills in gathering facts, learning concepts and accessing information which may contribute to their knowledge regarding the health benefits of being physically active. If these propositions are true, then it would be expected that people in the highest educational categories would be more physically active than people in the lower educational categories regardless of level of connectedness. However, as seen in Figures 2, 4, and 6, people with higher levels of education are not necessarily the most physically active when their sense of connectedness is very weak.

An alternative explanation may be that people in certain income and educational groups cluster together and thus reinforce the norms supporting physical activity within that group. Christakis and Fowler (2008) found that among people who were most connected, those with a higher educational background were more likely to imitate the smoking habits of their friends. This may hold true for physical activity; people who are most connected and in the highest income and educational categories may emulate the physical activity patterns of their friends, thus strengthening the norm to be physically active and ultimately displaying higher levels of physical activity among these groups.

6.2 Connectedness and Intentions to Start or Increase Physical Activity

Approximately 50% of people aged 25-64 residing in Manitoba, Ontario and Newfoundland and Labrador stated that they intend to start or increase exercise, sport or physical activity to improve their health in the next year. Intentions to start or increase physical activity were greater among women than men. Findings from the Canadian Fitness and Lifestyle Research Institute (CFLRI) (2003) revealed that among Canadians who had strong intentions to be physically active, more women intended to be physically active to lose weight, whereas more men intended to be physically active because they perceived it as fun, exciting and enjoyable or part of their work, chores, or school. From this finding, it is clear that women intend to start or increase exercise to improve some aspect of their health where as men's intentions are more based on enjoyment. This may be one explanation why intentions to start or increase physical activity are greater among women than men.

Corresponding to the second research question "Among those who are classified as inactive and moderately active, are people who have a stronger sense of community belonging more likely to intend to start or increase their engagement in physical activity?" the results revealed that among

inactive people, connectedness was only significantly associated with intention to start physical activity among women after adjusting for age, marital status, income, education, employment status, smoking status, alcohol use, country of birth and race. Inactive women who had a very strong or somewhat strong sense of connectedness had increased odds of being physically active than those reporting a very weak sense of connectedness. Among moderately active women, connectedness was no longer associated with intentions to increase physical activity. Inactive women who reported a strong connection to their communities may have been exposed to norms promoting physical activity.

Interestingly, among moderately active men, having a very strong or somewhat weak sense of connectedness actually decreased the odds of intending to increase physical activity. Thus, as sense of connectedness appeared to be negatively associated with intentions to be physically active among moderately active men and not associated with intentions among moderately active women, it may be suggested that being at least moderately active may be the norm within Canadian social networks. However, a study by Rhodes and Courneya (2003) suggest that normative beliefs and subjective norms may not play a substantial role in explaining intentions to exercise.

According to the Theory of Planned Behaviour (TPB), attitudes towards the behaviour and perceived behavioural control also contribute to the development of intentions (Ajzen, 1991). Overall attitude towards a certain behaviour can be shaped by one's instrumental attitude (e.g. that the behaviour is beneficial or harmful) and affective attitude (e.g. that the behaviour is enjoyable or not enjoyable) (Rhodes & Courneya, 2003). A recent study by the CFLRI (2005) revealed that at least 75% of Canadians have strong instrumental beliefs that participation in regular physical activity leads to health benefits (e.g. prevents heart disease, reduces stress, assists in maintaining physical

ability in older age) and over 75% find physical activity to be pleasant, comfortable, fun, and convenient. With a high proportion of Canadians displaying positive attitudes towards physical activity, inactive women who are more connected to their communities may be more observant of the positive attitudes of their peers and adapt these attitudes as their own, thus increasing their intentions to start or increase engagement in physical activity. Unfortunately it was beyond the scope of this study to measure and control for constructs of the TBC and assess if/how they may have contributed to the findings.

6.3 Limitations and Strengths

This study was not without its limitations. First, there are weaknesses inherent in self-report questionnaires including social desirability and recall biases. The accuracy of some responses may be threatened as some questions referred to activities or behaviours that occurred during the past three months to past year, though it is unlikely that these biases would significantly alter the results.

Since not all people answered every question this study may not be completely representative of the Canadian population. Males, people in the oldest age group, and people in the lowest income and education groups had more missing data than other groups; thus, these people may be underrepresented in the sample. Since income and education were important moderators explaining the association between sense of connectedness and physical activity, having missing data for these measures may influence the results. For instance, current literature suggest that people in lower education and income categories tend to feel a weaker sense of connection to their communities (Shields, 2005) and they tended to have lower levels of physical activity (Luo et al., 2008; Pan et al., 2009; Sherwood & Jeffery, 2000). If missing data were available for these people and they reported a lower sense of connectedness and physical activity, as suggested by the literature, then there is a

possibility that the magnitude by which income and education influence the association between connectedness and physical activity would be heightened. In other words, people who have a greater income or education and feel more strongly connected to their communities would have even greater odds of being physically active relative to people in the lower income categories who feel a very weak sense of connection. Fortunately, the percent of missing data in comparison to the large sample size should have a minimal effect on the final conclusions.

Second, there is no research regarding the validity or reliability of certain measures such as sense of community belonging and intention. Participants may interpret sense of belonging to their local community differently. For instance, "local community" is not clearly defined and thus could be interpreted as geographically (neighbourhoods), socially (networks, institutions or organizations) or a combination of both. Additionally, the measure of intention that was used in this study has not been previously used or tested in the literature. This may explain why the odds of intending to start or increase physical activity were not largely influenced by sense of connectedness.

Third, since the data were cross-sectional, any associations observed between variables cannot be inferred as causal. Thus, it cannot be concluded that sense of community belonging *causes* one to engage in physical activity for the reverse may be true. It may be that engagement in physical activity increases one's sense of belonging. Other possible explanations include that sense of connectedness and physical activity reinforce each other or that there is another possible psychosocial cause that was not taken into consideration in this research.

Finally, there were some variables that would have been beneficial to control for such as geographic location, obesity and chronic conditions. Data regarding geo-codes could not be obtained from the public-use data set, thus, variables measuring geographic location were not

included in this analysis. It has been documented that people living in rural areas feel more connected to their communities than people living in urban areas (Shields, 2005), but people living in urban areas tend to be more physically active than people in rural areas (Sweet, Macdonald, Reeder, Chen & Angel, 1997). Thus, the inclusion of geographical location may slightly lower the magnitude to which sense of connectedness is associated with physical activity; however, it would not have a large impact on the final conclusions.

Obesity status and chronic conditions were not accounted for in this analysis due to the reciprocal nature of these ailments. For instance, it is well know that lack of physical activity leads to obesity and many chronic diseases (Warburton et al., 2007); however, the actual or perceived functional limitations associated with obesity or chronic diseases may decrease the ability or desire of people who have these ailments to be physically active. For instance, an Australian study revealed that people who are overweight or obese and perceive themselves as being so are less likely to be physically active than people of similar weight status who perceive themselves as normal weight when both are compared to people with a healthy body mass index (Atlantis, Barns & Ball, 2008). There is no literature regarding how the presence of one or more chronic diseases is associated with connectedness. Research by Christakis and Fowler (2007) suggest that people who are overweight or obese are just as connected to social networks as people who are of normal weight. Thus, although being overweight or having a chronic disease may reduce physical activity, there is little evidence that including obesity status or chronic disease status as potential explanatory variables would have a large impact on the results or conclusions.

Fortunately this study was able to control for age, marital status, employment status, smoking status, alcohol use, country of birth and race. Similar to other studies regarding socio-demographic

characteristics on participation in physical activity, younger age groups were more likely to be active than older age groups (Bryan & Katzmarzyk, 2009; Pan et al., 2009; Warburton et al., 2007), single, widowed, separated and divorced people were more likely to be active than people who were married or in a common-law relationship (Salmon, Owen, Bauman, Schmitz & Booth, 2000; Sherwood & Jeffery, 2000) and daily or occasional smokers were less likely to be active than non-smokers or former smokers (Conway & Cornan, 1992; Nagaya et al., 2006; Salmon et al., 2000). Being a regular drinker was associated with increases in physical activity which is similar to findings by Smothers and Berolucci (2001); however, occasional alcohol consumption was did not explain differences in physical activity levels. Further, this study revealed that people born outside of Canada and people who identify as Aboriginal or another visible minority are less likely to be active than those born in Canada and people identifying as white. These results are consistent with other studies reporting on physical activity among immigrants (Liu et al., 2008; Sherwood & Jeffery, 2000; Tremblay, Bryan, Perez, Ardern & Katzmarzyk, 2006) and visible minorities (Sherwood & Jeffery; 2000).

Apart from controlling for multiple variables, an additional strength of this study was the ability of the CCHS cycle 3.1 administrators to collect responses from over 132,000 participants residing in households throughout Canada. This study had a distinctly large sample size which meant that many variables were able to be controlled for and interactions were could be explored. Further, the use of scaled weights ensured that it was representative of Canadians aged 25-64 years old. Since data were collected over a consecutive 12 month period differences in seasonal estimates were able to be controlled.

Many methods were used to minimize non-response including providing introductory letters, initiating face-to-face or telephone contact, discussing importance of survey with people who refused to participate, and accommodating different languages. Data collection procedures such as interviewer training and monitoring, private interviews and the use of computer assisted interviewing assisted in minimizing biases.

From 2000 to 2005, only 18% of physical activity research was population health related where as a majority of physical activity research focused on clinical and biomedical aspects (Herman et al., 2007). To date, there is no known study that has looked at the influence of sense of community belonging on physical activity. Thus, this study serves as a base for future research and possible program and policy strategies.

6.4 Implications for Program and Policy Development and Evaluation

Despite the limitations mentioned earlier, this study can be used to inform program planners, policy analysts and health promotion specialists about the potential influence sense of connectedness can have on health behaviours. It is clear that there needs to be more research to establish the causal relationship between sense of connectedness and physical activity; however there is still the possibility that a greater sense of connectedness increases participation in physical activity. If this proves to be true then programs and policies that aim to increase sense of connectedness should have the potential to promote physical activity. As sense of connectedness has been associated with other health behaviours such as smoking and obesity, focusing attention on programs and policies that enhance community connectedness may promote multiple healthy behaviours simultaneously, thus minimizing the cost and resources required to implement behaviour-specific policies and programs.

Moreover, these policies should be targeted to people in the lower education and income categories. Although, the impact of increasing physical activity may not be as large as if targeting the highest socioeconomic groups, by targeting the more deprived people the gap in physical activity between the highest and lowest socioeconomic categories may be reduced. These findings also lead to an important notion that programs aimed at increasing knowledge may not be as effective as ones aimed at improving connectedness. As observed in figures 2, 4 and 6, the odds of being physically active among those reporting a very weak sense of connectedness is similar regardless of educational status. It is only when sense of connectedness increased that differences in the odds of being physically active were apparent between the different education groups. Long-term benefits of programs targeting sense of connectedness may include a reduction in the high prevalence of chronic disease and obesity among the lower socioeconomic groups and ultimately a reduction in the health disparities that are evident in Canada.

Although creating programs and policies that benefit connectedness is important, it may also be worthwhile to review current social, economic and political programs and policies and how they influence connectedness. Although programs and policies are intended to protect and enhance the health of Canadians, the implementation of these programs and policies may have iatrogenic effects by reducing people's sense of connectedness and thus increasing health disparities. For instance, the 1997 Ontario Works Act requires people who apply for financial and employment assistance to undergo a screening test for substance addiction (ServiceOntario e-laws, 2010). The purpose of this regulation was to ensure that people received treatment to abstain from drugs so they can get off welfare and back into the labour force (Macdonald et al., 2001). However, the prevalence of substance use among people applying for welfare is comparable to substance use among people not

on welfare (CAMH, 2000). Thus, the enforcement of drug testing among welfare candidates increases the stigma linking drug addiction to economic need (CAMH, 2000). Due to this stigma, people in need of economic assistance may be deterred from applying which may lead to increases in poverty and crime and further isolate the most disadvantaged from their communities (CAMH, 2000). The social isolation experienced by the most deprived populations may have extreme consequences on their health and health behaviours. To aid in designing programs and policies that address sense of connectedness it may be helpful to look to the literature regarding a related concept: social capital.[4]

Originating in the fields of sociology and political science, social capital is used to explain how people within a community work together to achieve a common goal and overcome problems inherit in collective action (Lochner, Kawachi, Kennedy, 1999). Defined, social capital is "features of social organization – such as networks, secondary associations, high levels of interpersonal trust, and norms of mutual aid and reciprocity – which act as resources for individuals and facilitate collective action" (Lochner, Kawachi & Kennedy, 1999, p. 260). Each of these features of social organization assists in explaining the health and health behaviours among people within certain communities.

For instance, Kawachi and Berkman (2000) suggest two ways in which social capital influences health behaviours. First, they suggest that neighbourhoods with high social capital may more rapidly diffuse information related to health due to increased connections to multiple networks and resources. Second, neighbourhoods or communities with higher social capital may increase the likelihood that healthy norms surrounding behaviours, such as physical activity, are adopted by residents (Kawachi & Berkman, 2000). The interactions between individuals in these networks assist

[4] It should be noted that the relationship between connectedness and social capital is unknown and thus, the following explanations are merely propositions.

in defining and reinforcing the values and norms of that network (Berkman, Glass, Brissette & Seeman, 2000). However, face-to-face contact or deliberate attempts to change one's behaviour are not the only means of social influence. Mere proximity of two people within a network can influence behaviour (Marsden & Friedkin, 1994). For instance "under conditions of ambiguity people obtain normative guidance by comparing their attitudes with those of a reference group of similar others. Attitudes are confirmed and reinforced when they are shared with the comparison group but altered when they are discrepant." (Marsden & Friedkin, 1994, p.5). From this perspective, social networks can greatly influence one's attitudes about and intention to participate in certain health behaviours. For instance, if an inactive person was welcomed into a new social group where the majority of people in the group were active, he may assess his current attitudes towards physical activity and possibly alter his attitudes and behaviours to reflect those of the group. Thus, designing programs and policies that focus on increasing opportunities for people to form social networks may increase sense of connectedness and physical activity.

The formation of social networks may be accomplished by creating opportunity for participation in community organizations. Social engagement enhances people's sense of value, belonging, and attachment to their community by providing them with the opportunity to define and reinforce important social roles such as parental, occupational, and community roles (Berkman & Glass, 2000). It may be that participation in associations increases people's integration within their communities which, in turn, influences health. Results from the Alameda County Study revealed that the percent of people who had three or more risk behaviours (smoking, alcohol use, physical inactivity, obesity and poor dietary patterns) decreased as social integration increased (Berkman & Glass, 2000). Thus, creating opportunities for people to join political or volunteer associations may

increase their integration within the community and foster social roles which promote community belonging, attachment and healthy behaviours.

In addition to increasing social participation as a means to increasing connectivity, program and policy officers should direct attention to community trust and norms of reciprocity as this may be an alternative avenue for increasing social capital and opportunities for physical activity. Lower levels of trust have been associated with higher rates of violent crime, property crime, and many major causes of mortality (Kawachi & Berkman, 2000). Programs such as Neighbourhood Watch have contributed to lower rates of crime in some areas (Australian Institute of Criminology, 2005). In addition to having the potential to lower crime rates, other benefits of this program include structured meeting that build and strengthen neighbourhood dynamics, a general willingness of most neighbours to attend meetings, and opportunities to collaborate with police, businesses, government organizations, and other community members (Australian Institute of Criminology, 2005). Programs such as these allow neighbours to meet each other and build trust and norms of reciprocity with other people residing in their area. Ultimately, initiating and motivating community members to continue these programs may assist in enhancing social capacity and sense of connectedness, while creating a physical environment in which people feel safe to be physically active in.

In summary, it may be suggested that targeting indicators of social capital, such as the presence of social networks, participation in community associations and social integration, and high levels of perceived trust and reciprocity, may increase sense of connectedness. Sequentially, if sense of connectedness is found to cause increases in physical activity, then increasing people's sense of belonging to their local community could promote healthy behaviours which may reduce the burden of chronic diseases and mental health disorders within the Canadian population.

6.5 Implications for Researchers

It has been know for the past 15 years that social capital influences health; however, the pathways between social capital and health are less clear. Although networks, social engagement and level of trust have been some proposed avenues linking the two, researchers may want direct their attention to whether, and to what extent, sense of connectedness is an alternative explanation for the relationship between social capital and health. However, before commencing this possibly confusing task, preliminary research regarding the interpretation of the measure used to determine sense of connectedness should be conducted. For instance, determining how people interpret their "local community" should be assessed. With increasing globalization and technological advancement, "local community" may be interpreted geographically (neighbourhoods, cities), socially (networks, organizations, institutions) or even electronically (on-line communities). Additionally, it would be beneficial to assess the validity and reliability of this measure.

Given that "local community" may be interpreted in a geographical sense, future studies may want to take geographic location into consideration. By determining which communities have the highest levels of connectedness and then establishing which elements of the social, physical and economic environments these communities possess may offer additional insights as to what mechanisms increase connectedness, and thus multiple health behaviours.

As this study used self-report questionnaires to gain information regarding sense of connectedness and health behaviours, there may be biases due to recall or social desirability. Objectively measuring participation in physical activity may provide a more accurate representation of the physical activity patterns among Canadians and how that may be influenced by connectedness. As mentioned earlier, due to the cross-sectional nature of this study, it cannot be

inferred that an increase in sense of connectedness causes an increase in physical activity. Longitudinal analyses measuring people's sense of connectedness and physical activity over a period of months or years may be a useful start to clarify the direction of causality. As sense of connection may be difficult to experimentally alter, an alternative research design could address the other alternative that physical activity causes connectedness. This could be achieved by assessing the sense of connectedness among inactive people, assigning them either a control group (no change in activity level), to a moderately active fitness schedule or to an active fitness schedule, and then assessing their sense of connectedness after a month, or for multiple months. This may assist in proving (or disproving) that connectedness leads to physical activity.

Discovering the type of physical activities people participate in (i.e. group vs. individual activities) and its association with connectedness may also lend some evidence into the direction of the relationship. For instance, people who report higher levels of physical activity and lower levels of connectedness may be partaking in individual physical activities such as running or swimming. On the other hand, people who partake in group activities such as soccer or volleyball may feel more connected to that group and thus more connected to their community in general. Untangling this web of causality is important area for future research to focus.

Although connectedness was not significantly associated with intention for both men and women, it may be worthwhile using more valid and reliable measures of intention as previously used by Azjen and Madden (1986) to assess the relationship between connectedness and intentions to start or increase physical activity among inactive and moderately active people. Previous studies that have measured intention have generally asked about intentions to change behaviour within the next week to next three months (Amireault et al., 2008; Shen, McCaughtry, & Martin, 2008). The measure

used to assess intention for this study inquired about intentions to start or increase physical activity within the next year. Although it is anticipated (but not looked at in this study) that intentions would lead to behaviour, having a large window of time to change behaviours may decrease the likelihood a person's intention to exercise will be predictive of actual behavior change. However, if a true association between connectedness and intention is present, then policies enhancing sense of connectedness can have the potential to increase intention and perhaps make it easier for policy and health promoters to change the behaviour of populations.

Finally, future research may want to consider how connectedness influences physical activity among other age groups. This study was limited to people between the ages of 25 and 64; it would be interesting to determine whether connectedness is similarly associated with participation in physical activity among youth, young adults, or the elderly. This information may assist in creating age appropriate policies using connectedness to promote physical activity.

Chapter 7: Concluding Thoughts

Chronic disease and morbidity have been correlated with self-perceived general health and recent studies have revealed that people reporting higher levels of connectedness are more likely to report very good or excellent self-perceived general and mental health. Connectedness has previously been associated with other health behaviours such as smoking and obesity which ultimately lead to chronic diseases and morbidities. Up until now, it was unknown whether physical activity may be another health behaviour that is influenced by connectedness. As seen in from the results in this study, it appeared that people who feel more connected to their communities were also more likely to be physically active.

Additionally, this study revealed that connectedness did not influence physical activity in the same way for everyone. Socioeconomic factors such as household income and educational attainment played a large role in the relationship between connectedness and physical activity. Since participation in regular physical activity has numerous physical and mental health benefits, increasing ones sense of connectedness may ultimately reduce the burden of chronic disease and mental health disorders within the Canadian population. Although more research is required to gain a greater understanding of the relationship between connectedness and physical activity, this study contributes to our knowledge and advances our understanding of sense of community belonging as a social determinant of health.

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Appendix A

Table 24: Missing data for physical activity index, intention and sense of community belonging.

	Percent of participants in each category reporting missing data†		
	Physical Activity Index (%)	Intention (%)‡	Sense of Community Belonging (%)
Sex			
Male	1.44	3.42	2.3
Female	0.94	2.47	1.6
Age			
25-29	1.09	2.18	1.5
30-39	1.09	2.22	1.6
40-49	1.21	2.92	1.9
50-64	1.23	3.66	2.2
Income			
Less than $30,000	2.31	5.54	4.8
$30,000-$49,999	0.99	2.94	1.8
$50,000-$79,999	0.71	2.13	1.3
More than $80,000	0.60	1.48	1.1
Education			
Less than high school graduation	2.41	7.31	4.1
High school graduation; no post-secondary	0.96	3.35	1.8
Some post-secondary education	0.68	2.68	1.4
Post-secondary degree or diploma.	0.52	1.77	1.3

† All chi square values were significant to $p<.0001$.

‡ Since the measure of intention was included in an optional module of the survey selected only by Newfoundland and Labrador, Ontario and Manitoba, participants who had missing values were computed based on the results from only the people living in these provinces. It does not include the people from provinces that did not select this module.

Appendix B

Table 25: Parameter estimates, standard errors and significance values for the two-way interaction between sense of connectedness and income for Model 1[a] (active people vs. inactive people).

Parameters	Estimates (b)	Standard Error	P value
Intercept	-2.4199	0.0951	<.0001
Sense of community belonging			
Very strong	0.8782	0.1058	<.0001
Somewhat strong	0.6469	0.0934	<.0001
Somewhat weak	0.2545	0.1004	<0.0113
Very weak†	-	-	-
Age			
25-29	0.4923	0.0347	<.0001
30-39	0.1588	0.0280	<.0001
40-49	0.1091	0.0265	<.0001
50-64†	-	-	-
Sex			
Male	0.1392	0.0208	<.0001
Female†	-	-	-
Marital status			
Married/common law†	-	-	-
Single/widowed/divorced/separated	0.3205	0.0251	<.0001
Household Income			
Less than $30,000†	-	-	-
$30,000-$49,999	0.1170	0.1142	0.3054
$50,000-$79,999	0.2394	0.1074	0.0259
More than $80,000	0.3456	0.1071	
Education			
Less than secondary school graduation†	-	-	-
Secondary school graduation, no post-secondary education	0.2587	0.0426	<.0001
Some post-secondary education	0.3040	0.0511	<.0001
Post-secondary degree/diploma	0.5192	0.0365	<.0001
Employed during past year			
Yes†	-	-	-
No	0.4072	0.0311	<.0001
Smoking status			
Daily or occasional smoker	-0.3110	0.0243	<.0001
Former or never smoker†	-	-	-
Alcohol use			
Regular	0.3311	0.0316	<.0001
Occasional	-0.0232	0.0382	0.5435
Former/never†	-	-	-
Country of birth			
Canada†	-	-	-
Outside of Canada	-0.2641	0.0322	<.0001
Race			
White†	-	-	-
Aboriginal/other visible minority	-0.1467	0.0366	<0.0001

INTERACTIONS:			
Sense of belonging * income			
Very strong * >$80K	0.4303	0.1205	0.0010
Very strong * $50K-$79K	0.0331	0.1335	0.8040
Very strong * $30K-$49K	0.0187	0.1441	0.8969
Somewhat strong * >$80K	0.1769	0.1164	0.1284
Somewhat strong * $50K-$79K	-0.0653	0.1181	0.5804
Somewhat strong * $30K-$49K	0.0175	0.1266	0.8902
Somewhat weak * >$80K	0.1942	0.1239	0.1171
Somewhat weak * $50K-$79K	0.0425	0.1263	0.7365
Somewhat weak * $30K-$49K	-0.0877	0.1361	0.5191

[a] Model 1: Active (n=16,184); Inactive (n=33,496)
† Reference Group
Model Fit Statistics: -2 Log L = 57,462.37; c = 0.638

Appendix C

Table 26: Parameter estimates, standard errors and significance values for the three-way interaction between sense of connectedness, education and sex for Model 1[a] (active people vs. inactive people).

Parameters	Estimates (b)	Standard Error	P value
Intercept	-2.2321	0.1408	<.0001
Sense of community belonging			
Very strong	0.5891	0.1760	0.0008
Somewhat strong	0.5255	0.1525	0.0006
Somewhat weak	0.3474	0.1673	0.0380
Very weak†	-	-	-
Age			
25-29	0.5000	0.0348	<.0001
30-39	0.1633	0.0280	<.0001
40-49	0.1150	0.0265	<.0001
50-64†	-	-	-
Sex			
Male	0.1790	0.1858	0.3354
Female†	-	-	-
Marital status			
Married/common law†	-	-	-
Single/widowed/divorced/separated	0.3247	0.0251	<.0001
Household Income			
Less than $30,000†	-	-	-
$30,000-$49,999	0.1149	0.0379	0.0032
$50,000-$79,999	0.2294	0.0375	<.0001
More than $80,000	0.5634	0.0389	<.0001
Education			
Less than secondary school graduation†	-	-	-
Secondary school graduation, no post-secondary education	0.1735	0.1185	0.3574
Some post-secondary education	-0.1630	0.2579	0.5274
Post-secondary degree/diploma	0.2491	0.1498	0.0963
Employed during past year			
Yes†	-	-	-
No	0.4016	0.0312	<.0001
Smoking status			
Daily or occasional smoker	-0.3354	0.0244	<.0001
Former or never smoker†	-	-	-
Alcohol use			
Regular	0.3354	0.0317	<.0001
Occasional	-0.0221	0.0382	0.5625
Former/never†	-	-	-
Country of birth			
Canada†	-	-	-
Outside of Canada	-0.2667	0.0322	<.0001
Race			
White†	-	-	-
Aboriginal/other visible minority	-0.1477	0.0366	<.0001

INTERACTIONS			
Sense of belonging * sex			
Very strong * male	-0.1577	0.2384	0.5083
Somewhat strong * male	-0.1944	0.2088	0.3518
Somewhat weak * male	-0.4262	0.2305	0.0644
Sense of belonging * education			
Very strong * post secondary degree/diploma	0.4684	0.1923	0.0149
Very strong * some post secondary education	0.7449	0.3089	0.0159
Very strong * high school diploma	0.1011	0.2399	0.6733
Somewhat strong * post secondary degree/diploma	0.1678	0.1673	0.3160
Somewhat strong * some post secondary education	0.2717	0.2794	0.3308
Somewhat strong * high school diploma	0.0166	0.2084	0.9365
Somewhat weak * post secondary degree/diploma	-0.0603	0.1825	0.7412
Somewhat weak * some post secondary education	-0.0785	0.3031	0.7957
Somewhat weak * high school degree/diploma	-0.1331	0.2260	0.5560
Education * Sex			
Post secondary degree/diploma * male	-0.2119	0.2069	0.3058
Some post secondary education * male	0.6773	0.3342	0.0427
High school diploma * male	-0.2506	0.2649	0.3442
Sense of connectedness * education * sex			
Very strong * post secondary degree/diploma * male	0.4380	0.2622	0.0949
Very strong * some post secondary education * male	-0.8285	0.4113	0.0439
Very strong * high school diploma * male	0.6640	0.3310	0.0449
Somewhat strong * post secondary degree/diploma * male	0.3349	0.2306	0.1463
Somewhat strong * some post secondary education * male	-0.1720	0.3543	0.6368
Somewhat strong * high school diploma * male	0.3706	0.2912	0.2032
Somewhat weak * post secondary degree/diploma * male	0.6967	0.2523	0.0057
Somewhat weak * some post secondary education * male	-0.2711	0.3965	0.4942
Somewhat weak * high school degree/diploma * male	0.3946	0.3174	0.2137

[a] Model 1: Active (n=16,184); Inactive (n=33,496)

† Reference Group

Model Fit Statistics: -2 Log L = 57,390.38; c = 0.638

Appendix D

Table 27: Parameter estimates, standard errors and significance values for the three-way interaction between sense of connectedness, income and sex for Model 2[a] (moderately active people vs. inactive people).

Parameters	Estimates	Standard Error	P value
Intercept	-1.9176	0.1123	<.0001
Sense of community belonging			
Very strong	0.3577	0.1399	0.0105
Somewhat strong	0.6395	0.1166	<.0001
Somewhat weak	0.3627	0.1248	0.0037
Very weak†	-	-	-
Age			
25-29	0.1879	0.0339	<.0001
30-39	0.0127	0.0263	0.6296
40-49	-0.0161	0.0248	0.5165
50-64†	-	-	-
Sex			
Male	0.0786	0.1549	0.6118
Female†	-	-	-
Marital status			
Married/common law†	-	-	-
Single/widowed/divorced/separated	0.1586	0.0243	<.0001
Household Income			
Less than $30,000†	-	-	-
$30,000-$49,999	0.5032	0.1388	0.0003
$50,000-$79,999	0.3847	0.1352	0.0044
More than $80,000	0.5313	0.1330	<.0001
Education			
Less than secondary school graduation†	-	-	-
Secondary school graduation, no post-secondary education	0.2955	0.0393	<.0001
Some post-secondary education	0.3353	0.0474	<.0001
Post-secondary degree/diploma	0.4293	0.0340	<.0001
Employed during past year			
Yes†	-	-	-
No	0.2105	0.0299	<.0001
Smoking status			
Daily or occasional smoker	-0.2854	0.0230	<.0001
Former or never smoker†	-	-	-
Alcohol use			
Regular	0.3221	0.0301	<.0001
Occasional	0.0508	0.0357	0.1551
Former/never†	-	-	-
Country of birth			
Canada†	-	-	-
Outside of Canada	-0.1936	0.0306	<.0001
Race			
White†	-	-	-
Aboriginal/other visible minority	-0.2350	0.0356	<.0001

INTERACTIONS			
Sense of belonging * sex			
Very strong * male	0.1147	0.2135	0.5912
Somewhat strong * male	-0.1389	0.1772	0.4332
Somewhat weak * male	-0.0830	0.1873	0.5676
Sense of belonging * income			
Very strong * >$80K	0.2996	0.1723	0.0821
Very strong * $50K-$79K	0.2868	0.1756	0.1024
Very strong * $30K-$49K	-0.0777	0.1863	0.6767
Somewhat strong * >$80K	-0.1963	0.1454	0.1770
Somewhat strong * $50K-$79K	-0.2044	0.1486	0.1690
Somewhat strong * $30K-$49K	-0.3347	0.1548	0.0306
Somewhat weak * >$80K	-0.1459	0.1543	0.3443
Somewhat weak * $50K-$79K	-0.0475	0.1586	0.7644
Somewhat weak * $30K-$49K	-0.2363	0.1644	0.1507
Income * Sex			
>$80K * male	0.0749	0.1909	0.6947
$50K - $79K * male	-0.1342	0.1958	0.4932
$30K - $49K * male	-0.7891	0.2135	0.0002
Sense of connectedness * income * sex			
Very strong * >$80K *male	-0.1475	0.2541	0.5516
Very strong * $50K-$79K * male	-0.2417	0.2612	0.3550
Very strong * $30K-$49K * male	0.5450	0.2849	0.0558
Somewhat strong * >$80K * male	-0.00261	0.2138	0.9903
Somewhat strong * $50K-$79K * male	0.1354	0.2198	0.5380
Somewhat strong * $30K-$49K * male	0.5564	0.2398	0.0204
Somewhat weak * >$80K * male	0.0405	0.2252	0.8574
Somewhat weak * $50K-$79K * male	0.1195	0.2318	0.6061
Somewhat weak * $30K-$49K * male	0.3933	0.2529	0.1199

[a] Model 1: Moderately active (n=17,841); Inactive (n=33,496)
† Reference Group
Model Fit Statistics: -2 Log L = 62,548.10; c = 0.604

Appendix E

Table 28: Parameter estimates, standard errors and significance values for the two-way interaction between sense of connectedness and education for Model 2[a] (moderately active people vs. inactive people).

Parameters	Estimates	Standard Error	P value
Intercept	-1.7995	0.0972	<.0001
Sense of community belonging			
Very strong	0.5043	0.1128	<.0001
Somewhat strong	0.4098	0.0994	<.0001
Somewhat weak	0.2974	0.1070	0.0055
Very weak†	-	-	-
Age			
25-29	0.1820	0.0338	<.0001
30-39	0.0090	0.0263	0.7321
40-49	-0.0208	0.0248	0.4015
50-64†	-	-	-
Sex			
Male	-0.0484	0.0198	0.0146
Female†	-	-	-
Marital status			
Married/common law†	-	-	-
Single/widowed/divorced/separated	0.1633	0.0242	<.0001
Household Income			
Less than $30,000†	-	-	-
$30,000-$49,999	0.1308	0.0369	0.0004
$50,000-$79,999	0.2968	0.0355	<.0001
More than $80,000	0.4893	0.0361	<.0001
Education			
Less than secondary school graduation†	-	-	-
Secondary school graduation, no post-secondary education	0.3957	0.1190	0.0009
Some post-secondary education	0.5831	0.1427	<.0001
Post-secondary degree/diploma	0.3539	0.0980	0.0003
Employed during past year			
Yes†	-	-	-
No	0.2134	0.0299	<.0001
Smoking status			
Daily or occasional smoker	-0.2860	0.0230	<.0001
Former or never smoker†	-	-	-
Alcohol use			
Regular	0.3167	0.0301	<.0001
Occasional	0.0454	0.0357	0.2028
Former/never†	-	-	-
Country of birth			
Canada†	-	-	-
Outside of Canada	-0.1926	0.0305	<.0001
Race			
White†	-	-	-
Aboriginal/other visible minority	-0.2380	0.0356	<.0001

INTERACTIONS			
Sense of belonging * education			
Very strong * post secondary degree/diploma	0.1633	0.1238	0.1873
Very strong * some post secondary education	-0.1894	0.1833	0.3015
Very strong * high school diploma	-0.0447	0.1519	0.7683
Somewhat strong * post secondary degree/diploma	0.0726	0.1086	0.5037
Somewhat strong * some post secondary education	-0.2310	0.1582	0.1444
Somewhat strong * high school diploma	-0.0491	0.1316	0.7090
Somewhat weak * post secondary degree/diploma	0.0626	0.1164	0.5906
Somewhat weak * some post secondary education	-0.3705	0.1686	0.0280
Somewhat weak * high school degree/diploma	-0.2512	0.1416	0.7060

[a] Model 1: Moderately active (n=17,841); Inactive (n=33,496)
† Reference Group
Model Fit Statistics: -2 Log L = 62,631.76; c = 0.604

Appendix F

Table 29: Parameter estimates, standard errors and significance values for the two-way interaction between sense of connectedness and income for Model 3[a] (active people vs. moderately active people).

Parameters	Estimates (b)	Standard Error	P value
Intercept	-0.5597	0.1134	<.0001
Sense of community belonging			
Very strong	0.4631	0.1307	0.0004
Somewhat strong	0.0707	0.1137	0.5341
Somewhat weak	-0.0784	0.1219	0.5397
Very weak†	-	-	-
Age			
25-29	0.3176	0.0384	<.0001
30-39	0.1477	0.0311	<.0001
40-49	0.1229	0.0295	<.0001
50-64†	-	-	-
Sex			
Male	0.1773	0.0230	<.0001
Female†	-	-	-
Marital status			
Married/common law†	-	-	-
Single/widowed/divorced/separated	0.1611	0.0279	<.0001
Household Income			
Less than $30,000†	-	-	-
$30,000-$49,999	-0.0496	0.1389	0.7210
$50,000-$79,999	-0.0782	0.1295	0.5460
More than $80,000	-0.2430	0.1274	0.0565
Education			
Less than secondary school graduation†	-	-	-
Secondary school graduation, no post-secondary education	-0.0332	0.0498	0.5047
Some post-secondary education	-0.0390	0.0588	0.5071
Post-secondary degree/diploma	0.1026	0.0432	0.0175
Employed during past year			
Yes†	-	-	-
No	0.1982	0.0345	<.0001
Alcohol use			
Regular	0.00697	0.0362	0.8473
Occasional	-0.0856	0.0441	0.0520
Former/never†	-	-	-
Country of birth			
Canada†	-	-	-
Outside of Canada	-0.0509	0.0350	0.1464
Race			
White†	-	-	-
Aboriginal/other visible minority	0.0609	0.0407	0.1342

INTERACTIONS:			
Sense of belonging * income			
Very strong * >$80K	0.2039	0.1548	0.1878
Very strong * $50K-$79K	-0.1556	0.1605	0.3323
Very strong * $30K-$49K	-0.1248	0.1744	0.4741
Somewhat strong * >$80K	0.4055	0.1372	0.0031
Somewhat strong * $50K-$79K	0.0766	0.1412	0.5873
Somewhat strong * $30K-$49K	0.1346	0.1525	0.3774
Somewhat weak * >$80K	0.3221	0.1460	0.0274
Somewhat weak * $50K-$79K	0.0214	0.1505	0.8871
Somewhat weak * $30K-$49K	-0.0293	0.1633	0.8577

[a] Model 1: Active (n=16,187); Moderately active (n=17,841)
† Reference Group
Model Fit Statistics: -2 Log L = 44,722.25; c = 0.557

Appendix G

Table 30: Parameter estimates, standard errors and significance values for the three-way interaction between sense of connectedness, education and sex for Model 3[a] (active people vs. moderately active people).

Parameters	Estimates (b)	Standard Error	P value
Intercept	-0.4691	0.1714	0.0062
Sense of community belonging			
Very strong	0.1169	0.2131	0.5834
Somewhat strong	0.0119	0.1852	0.9486
Somewhat weak	0.0688	0.2039	0.7358
Very weak†	-	-	-
Age			
25-29	0.3208	0.0385	<.0001
30-39	0.1474	0.0312	<.0001
40-49	0.1216	0.0295	<.0001
50-64†	-	-	-
Sex			
Male	-.2849	0.2336	0.2225
Female†	-	-	-
Marital status			
Married/common law†	-	-	-
Single/widowed/divorced/separated	0.1631	0.2336	0.2225
Household Income			
Less than $30,000†	-	-	-
$30,000-$49,999	-0.0140	0.0451	0.7558
$50,000-$79,999	-0.0695	0.0431	0.1073
More than $80,000	0.0776	0.0434	0.0740
Education			
Less than secondary school graduation†	-	-	-
Secondary school graduation, no post-secondary education	-0.2949	0.2228	0.1855
Some post-secondary education	-0.4597	0.2966	0.1212
Post-secondary degree/diploma	-0.0779	0.1820	0.6687
Employed during past year			
Yes†	-	-	-
No	0.2009	0.0346	<.0001
Alcohol use			
Regular	0.00680	0.0362	0.8511
Occasional	-0.0850	0.441	0.0538
Former/never†	-	-	-
Country of birth			
Canada†	-	-	-
Outside of Canada	-0.0526	0.3151	0.1336
Race			
White†	-	-	-
Aboriginal/other visible minority	-0.0627	0.0408	0.1236

INTERACTIONS			
Sense of belonging * sex			
Very strong * male	-0.2461	0.2930	0.4008
Somewhat strong * male	-0.00218	0.2599	0.9933
Somewhat weak * male	-0.4502	0.02842	0.1132
Sense of belonging * education			
Very strong * post secondary degree/diploma	0.3577	0.2302	0.1202
Very strong * some post secondary education	0.6252	0.3537	0.0771
Very strong * high school diploma	0.1895	0.2801	0.4987
Somewhat strong * post secondary degree/diploma	0.2321	0.2012	0.2486
Somewhat strong * some post secondary education	0.4431	0.3206	0.1670
Somewhat strong * high school diploma	0.2401	0.2445	0.3261
Somewhat weak * post secondary degree/diploma	-0.0946	0.2200	0.6672
Somewhat weak * some post secondary education	-0.00927	0.3477	0.9787
Somewhat weak * high school degree/diploma	0.1808	0.2667	0.4980
Education * Sex			
Post secondary degree/diploma * male	-0.2438	0.2564	0.3417
Some post secondary education * male	0.0885	0.3873	0.8192
High school diploma * male	-0.0433	0.3197	0.8923
Sense of connectedness * education * sex			
Very strong * post secondary degree/diploma * male	0.3582	0.31279	0.2598
Very strong * some post secondary education * male	-0.1869	0.4731	0.6928
Very strong * high school diploma * male	0.5445	0.3929	0.1658
Somewhat strong * post secondary degree/diploma * male	0.1110	0.2831	0.6951
Somewhat strong * some post secondary education * male	-0.00473	0.4215	0.9911
Somewhat strong * high school diploma * male	0.00412	0.2492	0.9906
Somewhat weak * post secondary degree/diploma * male	0.6332	0.3075	0.0395
Somewhat weak * some post secondary education * male	0.3413	0.4580	0.4562
Somewhat weak * high school degree/diploma * male	0.2397	0.3797	0.5278

[a] Model 1: Active (n=16,187); Moderately active (n=17,841)
† Reference Group
Model Fit Statistics: -2 Log L = 44,698.51; c = 0.556