SOCIAL CAPITAL, NEIGHBOURHOOD ENVIRONMENTS AND PHYSICAL INACTIVITY AMONG MONTREAL ADULTS

by

Hannah Louise Legh-Jones

A thesis submitted to the School of Kinesiology and Health Studies

In conformity with the requirements for

the degree of Master of Science

Queen’s University

Kingston, Ontario, Canada

(August, 2011)

Copyright ©Hannah Louise Legh-Jones, 2011
Abstract

Research on social capital and physical activity has relied on proxy measures of trust and participation to assess individuals’ social capital. However, less is known about how social network capital is associated with physical inactivity. More recently, the association between neighbourhood context and health behaviours has been highlighted, suggesting that the social and physical environments can enhance or deter physical activity. The purpose of these two studies was to 1) assess and compare the association of trust, participation and network capital with physical inactivity; and 2) to assess the association between neighbourhood factors and physical inactivity in Montreal. These studies used data from the 2008 Montreal Neighbourhood Networks and Health Survey (MoNNet-HA), which consisted of 2707 adults residing in 300 Montreal neighbourhoods. Physical inactivity was assessed using an adapted version of the short International Physical Activity Questionnaire (IPAQ). Social capital was measured in three forms: generalized trust, social participation, and network capital. Network capital was measured using a position generator and consisted of network diversity, upper reachability, and range dimensions. Neighbourhood socioeconomic status and population density were used to assess aspects of the neighbourhood social and built environment. Multilevel logistic regression was used to examine the association of physical inactivity with social capital and neighbourhood factors. In the first study, network diversity (OR: 0.88; 95% CIs: 0.80-0.96), and social participation (OR: 1.81; 95% CIs: 1.08-3.01) were significantly associated with lower odds of physical inactivity. This study directs attention towards the association between network capital and physical inactivity. Further investigation of network capital might lead to a better understanding of how social capital is associated with physical inactivity. In the second study, population density was significantly associated with lower odds of physical inactivity (OR: 0.97 95% C.I: 0.95, 0.99). Further investigation of neighbourhood context is recommended to
understand the underlying mechanisms involved in the association of neighbourhood population density and physical inactivity. Greater knowledge of neighbourhood context could lead to the development of supportive neighbourhood social and physical resources that promote and enhance physical activity behaviour.
Acknowledgements

Thank you to everyone who has made my six years at Queen’s such an incredible experience. Your love, encouragement and support along the way has meant the world to me. There are not enough words for me to describe how much I appreciate each of you.

Thank you to my supervisor, Dr. Spencer Moore, for giving me this opportunity. All your support, guidance, feedback and encouragement throughout have been invaluable. I have learned so much, and owe a great deal of that to you. I cannot thank you enough.

Thank you to my mom, Trish, my sister, Ali, and my Grandmother, Cath. You have always had faith in my abilities and been a constant source of encouragement, inspiration and strength for me.

Thank you to all my friends for all the laughs, the good times, and support.
Table of Contents

Abstract ................................................................................................................................. ii
Acknowledgements ............................................................................................................. iv
Table of Contents ................................................................................................................ v
Chapter 1 Introduction ..................................................................................................... 1
References ............................................................................................................................. 9
Chapter 2 Literature Review ......................................................................................... 15
Overview ............................................................................................................................ 15
Importance of Physical Activity ....................................................................................... 15
Measuring Physical Activity .............................................................................................. 22
Self-Report physical activity measures .............................................................................. 22
Objective Physical Activity Measures ............................................................................... 25
  International Physical Activity Questionnaire (IPAQ) ..................................................... 27
Social Determinants of Physical Activity .......................................................................... 29
Socioeconomic Status ......................................................................................................... 29
Sex ...................................................................................................................................... 32
Age .................................................................................................................................... 34
Social Capital and Physical Activity ............................................................................... 34
Social Trust, Social Participation and Physical Inactivity .................................................. 36
Network Social Capital and Physical Activity ................................................................... 37
Neighbourhoods and Physical Activity .......................................................................... 38
Area/Neighbourhood SES ................................................................................................. 40
Neighbourhood Density ..................................................................................................... 41
Summary ............................................................................................................................ 43
References .......................................................................................................................... 45
Chapter 3 Network social capital, social participation, generalized trust and physical inactivity among Montreal adults ...................................................................................... 57
Introduction ....................................................................................................................... 57
Method ................................................................................................................................. 63
Measures ............................................................................................................................. 64
  Main outcome .................................................................................................................. 64
  Main exposure .................................................................................................................. 66
Appendix B MoNNET-HA Survey ................................................................. 149
Appendix C IPAQ scoring protocol.................................................................. 191
List of Tables

Table 1: Characteristics of Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA) (n=2672), 2008.................................................................79
Table 2: Characteristics of social network capital (n=2672), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.................................................................81
Table 3: Unadjusted (Bivariate) Odds ratio and 95% confidence intervals of physical inactivity (n=2672), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008. ........................................................................................................................................82
Table 4: Adjusted Odds ratios and 95% confidence intervals of physical inactivity (n=2672; n_c=300), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.84
Table 5: Characteristics of Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA) (n=2672), 2008........................................................................................................111
Table 6: Characteristics of neighbourhood factors (n_c=300), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.................................................................113
Table 7: Unadjusted (Bivariate) Odds ratio and 95% confidence intervals of physical inactivity (n_l=2672; n_c=300), 2008..........................................................................................................................114
Table 8: Adjusted Odds ratio and 95% confidence intervals of physical inactivity (n_l=2672; n_c=300), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008. ..................................................................................................................................................116
Chapter 1
Introduction

Social capital and neighbourhood contextual factors have been associated with a number of health-related behaviours but, it is less well known how social capital and neighbourhood contexts are associated with physical inactivity. The purpose of these studies is to investigate the association of individual social capital and neighbourhood contextual factors with physical inactivity amongst Montreal adults. The first study investigates the association between social capital and physical inactivity. This study aims to provide greater insight on the association between social capital and physical inactivity by using a network theory approach. It is thought that network capital dimensions may be more useful than conventional social capital measures at capturing network mechanisms and the hierarchical access to resources that are associated with physical inactivity. The second study investigates the association between the neighbourhood context and physical inactivity. Indicators of area socioeconomic status and context maybe tapping into different aspects and may be differently associated with physical inactivity than individual level indicators. This study aims to provide insight into how area population density and area socioeconomic status are associated with individual physical inactivity, and to investigate whether neighbourhood socioeconomic status moderates the association of social capital and physical inactivity.

Physical activity has been linked to the prevention of a number of chronic diseases and conditions. Specifically, physical inactivity is a modifiable risk factor for cardiovascular disease, and an increasing number of chronic conditions including, type 2
diabetes mellitus, cancer (colon and breast), obesity, hypertension, bone and joint disease (osteoporosis and osteoarthritis), and depression (Warburton, Nicol, & Bredin, 2006). Not only does physical activity prevent disease, regular physical activity helps to develop cardiovascular fitness, strength, flexibility and bone density, as well as helps to maintain a healthy body weight, and reduces depression, anxiety and stress (Warburton et al., 2006; World Health Organization, 2005). Physical activity may also benefit communities, workplaces, and individuals through increased productivity, lower absenteeism and turnover, and increased performance in school (World Health Organization, 2005). The Canadian and United States governments have both created physical activity guidelines to help promote physical activity and establish the amounts and types of physical activity needed for health benefits (U.S Department of Health & Human Services, 2009; Canadian Society for Exercise Physiology, 2011). The guidelines are age-specific for children, adults, and older-adults to maintain and promote safe physical activity across the life-span. For example, it is recommended that adults 18-64 accumulate at least 150 minutes of moderate-to vigorous physical activity per week to achieve health benefits (Canadian Society for Exercise Physiology, 2011). Despite the development of these guidelines and physical activity goals, the prevalence of physical inactivity remains alarmingly high.

Results from the Canadian Community Health Survey (CCHS) suggest that approximately 80% of Canadians aged 12 and older did not reach the optimal health benefit of a Daily Energy Expenditure (DEE) of greater than 3.0 kcal/kg (Liu, Wade, Faught, & Hay, 2007). Other studies have suggested that 48% of Canadians 20 years or
older were at least moderately active, achieving 30 minutes of moderate-to-vigorous activity daily (Canadian Fitness & Lifestyle Research Institute, 2009). Individuals who are sedentary or physically inactive are at an increased risk for chronic diseases and conditions. It is suggested that at least 80% of premature heart disease, stroke and type 2 diabetes, and 40% of cancer cases could be prevented through healthy diet and regular physical activity (World Health Organization, 2005).

Not only does physical inactivity have individual health consequences, but there is also a substantial economic burden associated with physical inactivity. For the year 1999, it was estimated that the contribution of physical inactivity to the total direct costs of chronic disease was $2.1 billion, or 2.5% of total healthcare costs in Canada (Katzmarzyk, Gledhill, & Shepard, 2000). In 2001, the economic burden of physical inactivity was estimated at $5.3 billion dollars in Canada. The expenditure on physical inactivity represented 2.6% of the total health care costs in that year (Katzmarzyk & Janssen, 2004). Katzmarzyk, Gledhill, and Shepard (2000) suggest that a 10% reduction in the prevalence of physical inactivity could potentially reduce direct health care expenditures by $150 million a year. These figures suggest that if physical activity levels are improved, not only will individuals reduce their risk of disease but the burden on the health care system will also be greatly reduced.

Physical activity may be influenced by individual, social, and environmental factors. Due to the complex nature and interdependency of individual, social, and environmental factors, it is necessary to look at how these factors work together to influence individual physical activity levels. Individual factors that have been associated
with health include individual socioeconomic status (SES), sex (male or female), age, race or ethnicity, and self-rated health status (Meyer, Niemann, & Abel, 2004; Ellis, Grimsley, Goyder, Blank, & Peters, 2007; Chad, et al., 2005; Giles-Corti & Donovan, 2002; Sallis & Owen, 1999; Marshall, et al., 2007). At the neighbourhood level, studies have shown an association between neighbourhood/area deprivation or SES and physical activity (Gidlow, Johnston, Crone, Ellis, & James, 2006; Riva, Gauvin, & Barnett, 2007). The neighbourhood social and physical environments have also been shown to encourage or deter physical inactivity (Giles-Corti & Donovan, 2002; Poortinga, 2006).

It has been suggested that components of social embeddedness, such as social participation and social trust, may have a positive impact on health and health behaviours (Lindstrom, 2008; Kim, Subramanian, Gortmaker, & Kawachi, 2006). Health sciences research has shown that there is a significant association between measures of social capital and self-rated health as well as health related behaviours (Kawachi, Kennedy, & Glass, 1999; Schultz, O'Brien, & Tadesse, 2008; Kawachi & Kennedy, 1997; Lindstrom, 2008). Given the significance of these relationships, it is worth investigating how social capital may influence physical inactivity. Social embeddedness factors may influence physical activity through a number of mechanisms, such as the norms and attitudes that affect physical activity; psychosocial mechanisms; and social networks (Lindstrom, 2008).

Research on the association between social capital and health behaviours has increased over the past 15 years. The investigation of social capital and physical activity in Canada has, however, been limited. Canadian studies have investigated the association
between social capital and self-reported health and mental health status (Veenstra, 2000; Veenstra et al., 2005; Carpiano & Hystad, 2011) and overweight and obesity (Moore, Daniel, Paquet, Dube, & Gauvin, 2009). Studies of physical activity and social capital have been conducted in Sweden, Australia, the United States and Japan (Lindstrom, 2008; Ueshima, et al., 2010). While these studies provide support for the association between social capital and physical activity generalizability to a Canadian context may be limited. Structural, political, and cultural differences between countries may contribute to the significance of the found associations. The Canadian context, while sharing similarities with other developed countries, has its own set of beliefs, values and norms that may contribute to how individuals conceptualize social capital, and therefore have a different association with physical activity behaviours. This study contributes to the growing literature on the association between social capital, neighbourhood factors, and physical activity in a Canadian context.

Individual models of physical inactivity provide a significant amount evidence supporting the role of associated determinants; however, these models do not fully explain the prevalence of physical inactivity or variation in physical inactivity between places. Already, there is considerable evidence showing variation in health disparities across neighbourhoods. Neighbourhood measures of area deprivation and poverty have been associated with increased risk of higher body mass index, lower quality diet, poorer self-rated health and partner violence. Using an ecological approach to modelling determinants of physical activity can facilitate greater awareness and understanding(knowledge) of how the environment affects physical activity outcomes.
(Saelens et al., 2003). The social and physical environments have been proposed to have a significant impact on physical activity levels. Evidence is emerging suggesting that neighbourhood differences can either exacerbate physical activity disparities, or the neighbourhood environment can enhance or deter physical activity. Individuals living in resource deficient neighbourhood environments have an increased risk of unhealthful behaviours such as physical inactivity. Resources and facilities of physical activity have been shown to be more accessible within wealthier neighbourhoods which increases the socio-economic divide (Renalds, 2010).

Using the neighbourhood environment as an intervention setting can naturally embed features that promote physical activity and healthy behaviours which facilitate integration into daily life (Renalds, 2010). Studies of physical inactivity and area effects have investigated a range of measures including, population density, area deprivation, socioeconomic status and income inequality. The neighbourhood context has also been associated with a number of physical activity outcomes such as walking or cycling to shops or work, leisure-time physical activity including gardening, and sports participation (van Lenthe et al., 2005).

It is suggested that economic and social capital disadvantage usually coincide, for instance, when chances of reciprocity are low and consequences are potentially harmful it is more difficult to trust and support social contacts (neighbours, friends, relatives). Kawachi (1999) suggests that the association between poor health outcomes and income inequality maybe mediated by sociability, trust and reciprocity. Cerin and Lesie (2008) demonstrated that social support from friends, presence of open space, team sports
facilities, and neighbourhood aesthetics were primarily a function of neighbourhood socioeconomic status. Picket and Pearl (2001) suggest that neighbourhood socioeconomic status has an indirect effect on health outcomes through the availability and accessibility of health services, food and recreation facilities, environmental pollution, norms and attitudes towards health, and social support. Investigating how individual and neighbourhood factors are associated with physical inactivity could lead to a better knowledge of the underlying mechanisms and pathways that influence behaviour.

For the current studies, data came from the 2008 Montreal Neighbourhood Networks and Health Survey (MoNNET-HA). The MoNNET-HA was designed to investigate the distribution and association of social capital and health conditions across Montreal neighbourhoods and between the adult population. To assess physical inactivity specifically an adapted version of the International Physical Activity Questionnaire (IPAQ) was used. The IPAQ is a tool that can be used internationally to obtain comparable estimates of physical activity. It was developed for surveillance activities and to help inform policy decision to promote physical activity in response to the demand for comparable and valid measures of physical activity. There are two versions of the IPAQ, the long and the short version. The short version, as used in MoNNET-HA, is suitable for use in national and regional surveillance systems. The IPAQ is a self-report assessment tool that is suitable for use in adults ages 18-64 years. It has been tested in both developed and developing countries for reliability and validity. It has exhibited measurement properties similar to other self-reported measures of physical activity, and has fair to moderate agreement with CSA accelerometers (Craig et al., 2003).
Social capital and social network capital were assessed by social participation, generalized trust, and a position generator. Social participation was measured with a two-part question concerning participation in organizations within and outside the neighbourhood. Generalized trust was assessed using the U.S General Social Survey question which asks whether people can be trusted generally speaking. These questions are commonly used in social capital research. The position generator measures individuals’ social capital by assessing a person’s ties to others working in specific types of occupations. Three components of network capital were calculated, diversity, reach and range rather than assessing networks as a single measure. The use of a network approach may provide additional insight on the hierarchical resources accessible to network members that conventional social capital measure do not capture.

Reducing the prevalence of physical inactivity requires the development of effective physical activity programs that look beyond individual behaviour change. Social and physical environmental factors may also contribute to physical inactivity. Targeting individual behaviour change may be beneficial to the person; however, interventions that target not only the individual, but also the environmental supports that help facilitate physical activity can influence more people and can be maintained over a longer period of time. Ecological interventions are important for improving population health and reducing the associated burden of disease (Yen & Syme, 1999).
References


World Health Organization. (2005). Chronic Disease and Health Promotion. Retrieved 2010-10-04 from The Impact of Chronic Disease in Canada:
http://www.who.int/chp/chronic_disease_report/media/canada.pdf

Chapter 2
Literature Review

Overview
Physical activity is influenced by individual, social, and environmental factors. Due to the complex nature and interdependency of individual, social and environmental factors, it is necessary to look at how these factors work together to influence individual physical activity.

It is well established that individual factors including individual socioeconomic status, sex, age, education, and self-rated health are significant determinants of physical activity. A person’s degree of social integration captured by such measures as social participation, generalized trust, and social networks are also an important influence on physical activity. Beyond the individual level, aspects of neighbourhood social and built environments also play an important role in physical activity behaviour.

This chapter provides an overview of the literature concerning (1) the prevalence of physical inactivity and the importance of physical activity for health, (2) the different methods of assessing physical activity levels, and (3) research on the individual socio-demographic and economic influences on physical inactivity, including social capital, and on neighbourhood environments and physical inactivity. Researchers and public health practitioners need to understand why physical inactivity is a population health concern and the individual, social, and environmental determinants of inactivity to be successful in the design, implementation and maintenance of physical activity interventions and programs.

Importance of Physical Activity
The most recent Canadian physical activity guideline recommends that adults 18-64 years accumulate at least 150 minutes of moderate-to-vigorous intensity aerobic activity per week in
bouts of 10 or more minutes to achieve health benefits (Canadian Society for Exercise Physiology, 2010). Additional health benefits can be achieved with muscle and bone strengthening activities using major muscle groups at least 2 days per week. These guidelines are based on evidence that physical activity reduces the risk of chronic disease.

The association between physical activity and health benefits is well established. Physical inactivity is associated with adverse health consequences and has been identified as a modifiable risk factor for disease. Physical inactivity is associated with higher rates of all-cause mortality and coronary-heart disease related mortality (Morris & Heady, 1953; Paffenbarger & Hale, 1975; Leon, Connett, Jacobs, & Rauramaa, 1987; Lee, Hsieh, & Paffenbarger 1995). In a 2000 follow-up, to the Harvard Alumni Health Study (Lee & Hale, 1995), Lee and Paffenbarger (2000) reported that vigorous physical activity compared to moderate and light physical activity had the greatest benefit in reducing the odds of mortality and increasing longevity among men. Among a sample of middle-age women, physical inactivity has been associated with a 52% increase in all-cause mortality, a twofold increase in cardiovascular mortality and an increased risk of cancer-related mortality (Hu et al., 2004) Physical inactivity has also been associated with increased risk of diabetes mellitus, cancer (breast and colon), bone and joint disease (ostoporosis and osteoarthritis), obesity, and depression and anxiety (Warburton, 2006). One of the most recent estimates suggests that 2 million deaths per year worldwide are attributable to physical inactivity (Bauman, 2009).

Despite the importance of physical activity for health, the prevalence of physical inactivity remains a significant public health concern. The prevalence of physical inactivity varies considerably worldwide. An investigation of physical inactivity in 51 mainly low- and middle-income countries worldwide revealed that the age-standardized country prevalence of physical inactivity ranged from 1.6% (Comoros) to 52.6% (Mauritania) for men and from 3.8% (Comoros)
to 72% (Mauritania) for women. Overall, 17.7% of the pooled sample was considered physically inactive, 15.2% of men and 19.8% of women (Guthold, 2008). The prevalence of physical inactivity tends to be greater in higher income countries. This trend in physical inactivity has been closely associated with increased urbanization and industrialization, which has led to decreases in occupation and household activity, replacement of active transportation with mechanization, and increased sedentary pursuits in leisure time (Katzmarzyk & Mason, 2009). Data from the US 2003 Behavioral Risk Factor Surveillance Survey indicated that 52.8% of U.S citizens were inactive (50.2% of men and 55.4% of women). In England, the Health Survey for England 2003 reported the prevalence of physical inactivity as high as 76% for women and 63% for men (Guthold, 2008). In Canada, between 2007-2008, 48% of Canadians 20 years and older were shown to be at least moderately active (≥ 1.5 MET Hours) (Canadian Fitness and Lifestyle Research Institute, 2009).

Between 2002 and 2004 the International Prevalence Study was coordinated in which 20 countries or large within country regions participated. Using the IPAQ, the aim of this study was to compare and collect nationally representative prevalence of physical activity from a diverse set of countries (Bauman et al., 2009). The results from this study indicated that 12.3% of Canadian men and 15.1% of Canadian could be classified as inactive (Bauman, 2009). Results from the Canadian Health Measures Survey (CHMS) based on accelerometer data collected between 2007-2009 showed that 68% of men’s and 69% of women’s waking hours are sedentary (Colley et al., 2011). Only 15% of adults 20-79 years accumulated the recommended 150 minutes/week of moderate-to-vigorous physical activity to meet the Canadian guidelines. These results align with objectively measured data from the 2005-2006 National Health and Nutrition Examination Survey (NHANES) conducted in United States (Colley et al., 2011; Tudor-Locke, Brashear, Johnson, & Katzmarzyk, 2010). According to the Canadian Community Health Survey (CCHS),
more than half of Canadians are least moderately active during leisure-time (Colley et al., 2011; Gilmour, 2007). Another study using CCHS 2004-2005 data reported that over half of Canadians 25 years and older were physically inactive with a daily energy expenditure <1.5 kcal/kg/day (Liu et al., 2008). It is important to recognize that the measurement of physical inactivity used by these studies is likely to contribute to the variation in prevalence. However, what can be taken away is that physical inactivity among Canadians is a serious concern.

Not only is physical inactivity contributing to increases in adverse health consequences for Canadians but it is also a large economic burden on the Canadian healthcare system. In 1999, it was estimated that the direct healthcare costs associated with physical inactivity was $2.1 billion, or 2.5% of healthcare spending. Indirect costs are unknown and therefore the total economic burden could not be calculated (Katzmarzyk, Gledhill, & Shepard, 2000). Direct costs are defined as the value of goods and services for which payment was made and resources were used in treatment, care, and rehabilitation related to illness and injury. Components of direct costs include hospital care expenditures, physician care expenditures, cost for care in other institutions, and other direct health expenditures (health professionals, public health, and research). Indirect costs are measured by the value of economic output lost because of illness, injury-related work disability, or premature death. Components include value of years lost due to premature death and value of activity days lost due to short-term or long-term disability (Katzmarzyk & Janssen, 2004). In 2001, the economic burden of physical inactivity was estimated as $5.3 billion, with $1.6 billion spent on direct costs and indirect costs totaled $3.7 billion. The costs of physical inactivity made up 2.6% of Canadian healthcare costs ($95.3 billion). Coronary artery disease ($1.7 billion), osteoporosis ($1.5 billion) and stroke ($765 million) were the three most expensive diseases associated with physical inactivity (Katzmarzyk & Janssen, 2004).
When designing surveillance strategies to monitor physical (in)activity, there are a number of issues that researchers need to take into consideration. Differences in surveillance strategies make comparisons difficult and can cause confusion among researchers, policy-makers and the public (Katzmarzyk & Tremblay, 2007). First, the definition of physical activity should be taken into consideration. Caspersen (1985) defined physical activity as the behaviours that result in ‘any movement contributing to human total energy expenditure’. It should be recognized by survey designers that physical activity is not the same as exercise, which is a subset of ‘total physical activity’, being purposive and repetitive movements with the aim of improving measurable cardio-respiratory or other dimension of fitness (Caspersen, 1985). Also physical activity should not be confused with energy expenditure, which has been used to express the metabolic equivalents (METs) of various forms of physical activity, or with the energy an individual expends over a 24-hour period (Katzmarzyk & Tremblay, 2007). It can be used as an estimate of physical activity levels in the absence of direct measurements; however, important information about the type, context, bouts, and intensity of the activity is lost (Keim, Blanton, & Kretsch, 2004). Once an operational definition of physical activity has been established, it is important that the threshold used to define physical activity is tied to a specific outcome or recommendation (Keim et al., 2004; Katzmarzyk & Tremblay, 2007). This will help to assess the specific health benefits derived from physical activity.

The next important consideration is the measurement of physical activity. It is presumed that the intensity, duration, and frequency of physical activity result in benefits as long as adequate overall volume of physical activity is achieved (Health Canada, 2002; CSEP, 2010). Frequency refers to how often a person engages in physical activity within a specified time frame. Duration is the total amount of time spent engaging in physical activity. Intensity represents the amount of energy expended while performing the activity and is usually expressed using METs.
A number of physical activity measures commonly combine this information into a measure of leisure-time physical activity. Leisure-time physical activity is considered to be activity for exercise or recreation which includes organized activity such as team or individual sport, organized recreation or walking groups, and gym classes, or non-organized, recreational sport, physical activity such as walking for exercise or recreation, incidental physical activity in everyday life (Bauman, Phongsavan, Scheppe, & Owen, 2001). Leisure-time physical activity is usually undertaken during individuals’ discretionary time, and Bouchard et al. (2007) suggest that the element of personal choice is inherent to its definition. However, leisure-time physical activity only accounts for a relatively small part of total daily physical activity. Energy expended in earning a living (occupational physical activity), domestic chores and activities, and active transportation also contributes to total daily physical activity (Katzmarzyk & Tremblay, 2007).

While information on the amount of leisure-time or daily physical activity may be beneficial in assessing overall accumulation of physical activity, it does not provide any information on the frequency, intensity, or duration of the activity, which may be more beneficial in determining its association with health benefits (Katzmarzyk & Tremblay, 2007). It may be useful to assess physical activity according to intensity and duration. Three classifications of physical activity levels have been developed according to intensity and duration, low-, moderate- and vigorous-intensity activity. Moderate intensity physical activity is generally considered to be the equivalent to a brisk walk and noticeably accelerates the heart rate. It is recommended that moderate-intensity physical activity be performed a minimum of 30 minutes at least 5 days per week and can be accumulated in bouts of 10 minutes or more (Haskell et al., 2007). Vigorous-intensity activities will cause adults to sweat and “be out of breath” (Public Health Agency of Canada, 2003). Activities having > 6.0 METs that cause rapid breathing and substantial increases
in heart rate (i.e., jogging, cross-country skiing) are classified as vigorous (Public Health Agency of Canada, 2003; Haskell et al., 2007).

Differences in the definition of physical activity and physical inactivity also need to be considered when assessing physical activity levels. Using the IPAQ scoring protocol, adults can be classified into three categories of physical activity: high, moderate, and inactive (low) physical activity. To be categorized as highly active, either one or the other of the following two criteria have to be met: (1) vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week; or, (2) 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week. To be considered moderately active, one of the following criteria have to be met: (1) three or more days of vigorous activity at least 20 minutes per day; (2) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day; or (3) 5 or more days of any combinations of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes/week. Adults who are considered physically inactive may report no activity, or some activity but not enough to meet the moderate or high category criteria (IPAQ Research Committee, 2005).

There are a wide variety of tools that have been used to assess physical activity levels including subjective and objective measures. Both objective and subjective measures have their own set of benefits and limitations. The choice of physical activity tool depends greatly on the type of physical activity under investigation (leisure-time, occupational, total physical activity), the population, sample size, sampling frequency, the location and duration of investigation, and the resources available to the researchers (Ong & Blumenthal, 2010).
Measuring Physical Activity

There are a number of tools that can be used to measure physical activity. Self-report questionnaires, activity logs, pedometers, accelerometers, and heart rate monitors have been used by researchers to assess physical activity levels. The accurate measurement of physical activity is vital to the study of the relationship between physical activity and health outcomes. However, with each tool comes a different set of strengths and weaknesses in measuring physical activity. The variability of physical activity measurements makes comparability of results difficult across, as well as makes it difficult to provide consistent reports of the prevalence of activity levels within populations. In choosing a tool to measure physical activity, it is important to consider the validity, reliability and feasibility of the tool in relation to the study purpose and objectives (Kriska & Caspersen, 1997).

Self-Report physical activity measures

The most commonly used physical activity assessment tools are self-report physical activity measures, such as a 7-day recall questionnaire. Self-reported physical activity questionnaires can be either interviewer or self-administered, and can be collected in a variety of manners, including telephone or self-completed. There are a number of benefits and limitations presented by self-reported physical activity questionnaires. One of the advantages of self-reported physical activity measures is the ability to collect data from a large number of people with low cost (Sallis & Saelens, 2000). The low cost, feasibility, and ability to characterize physical activity by type, frequency, duration, and type make the questionnaire a useful tool in the assessment of physical activity. Intensity is expressed as either an absolute expenditure relative to body mass or resting metabolism, or as a value relative to peak performance. Frequency is normally expressed as the number of times a certain activity has been performed over the course of a period of time. Duration and amount of activity can be combined to indicate the total amount of accumulated
physical activity (Shephard, 2003). Self-report questionnaires have the advantage that they can be used with a range of ages and measures can be adapted to fit the needs of the population under investigation and can be used to assess physical activity over a number of time frames from usual activity to lifetime (Ong & Blumenthal, 2010; Sallis & Saelens, 2000).

There are, however, a number of limitations associated with self-reported physical activity measures. Social desirability, recall bias, and their interpretation or understanding, have been discussed by researchers as drawbacks to the use of self-report physical activity measures (Ainsworth, Montoye, & Leon, 1994; Warnecke, Johnson, Chavez, Sudman, O’Rourke, Lacey, & Horm, 1997; Baranowski, 1988). The use of questionnaires can introduce over-reporting of activity levels as a result of social desirability, and can be cognitively demanding. Individuals may be more likely to report socially desirable behaviour, present themselves more favourably, and may be more likely to answer self-report physical activity questionnaires in ways that they think they are expected (Rzewnicki, Auweele, & Bourdeaudhuij, 2003; Sallis & Saelens, 2000; Shephard, 2003). There is a tendency for people to over report physical activity and underestimate sedentary activities (Shephard, 2003) Physical activity questionnaires can vary in cognitive demands. Ambiguous terms such as “physical activity”, “moderate-intensity” and “leisure time” are often used, and may be interpreted differently by respondents and investigators. Children and older adults are also likely to have particular memory and recall skill limitations (Kriska & Caspersen, 1997; Sallis & Saelens, 2000; Shephard, 2003; Janz, 2006). The measures used by questionnaires may not assess the primary modes of activity for certain gender, age, cultural, occupational, or income groups. There is also limited accuracy and detail provided by questionnaires. The classification of activity levels of subjects is based on sometimes rather arbitrary cut-off points, the reliability of information decreases with the length of period surveyed, responses can be influences by cultural and personal factors, as well as the number and
types of activities assessed can be limited with the use of questionnaires (Kriska & Capersen, 1997; Sallis & Saelens, 2000; Shephard, 2003; Keim et al., 2004; Janz, 2006; Ong & Blumenthal, 2010).

There are a number of questionnaires that have been developed (summaries of these tools have been reported elsewhere, e.g., Kriska & Caspersen, 1997; Bauman et al., 2006). A well-developed survey should be accurate and reliable. Reliability is the stability of a measure, which should classify physical activity in the same way when the measure is repeated. Changes in how a person’s physical activity is classified should not change. Validity is a way of assessing if the tool is measuring what it is intending to measure. A number of reviews have discussed the use and limitations of physical activity questionnaires. Emphasis has focused on their capacity to monitor leisure-time physical activity, which does not capture activities such as occupational physical activity, household or miscellaneous categories of activity that certain groups may engage in more often than leisure-time physical activity (Sallis & Saelens, 2000). Studies that are more complex in nature, that assess multiple dimensions of physical activity have difficulties in classifying activity levels. For example, conversion of physical activity intensity into an estimate of metabolic expenditure tends to be based on data for young adults, and they may overestimate the intensity of an activity for adults and older-adults (Rikli, 2000). With frequency, there may be large variation in activity participation in countries with seasonal extremes and whether the activities are performed in a single session or in smaller bouts throughout the day (Shephard, 2003).

A review by Sallis and Saelens (2000) identified seven physical activity instruments that have been validated for use with young- to middle-aged adults. Four more instruments, self-reported and interviewer-administered questionnaires, were identified for older adults. Instruments for adults tended to have high test-retest reliability scores, reliability for vigorous
physical activity tended to be higher compared to moderate physical activity. This finding was similar for the validity of instruments where vigorous activity scales were shown to have higher validity. This suggests that questionnaires are better at assessing vigorous physical activity then lower levels of physical activity. It has been suggested that it is easier to recall vigorous/intense activity.

Self-reported physical activity measures are still widely used as a result of their demonstrated practicality, applicability, and accuracy. Self-report measures have the ability to collect data from a large number of people at a relatively low cost. Other benefits of self-report physical activity measure are that behaviour of individual is not altered, and it is possible to assess multiple dimensions of physical activity so patterns of behaviour can be examined. Researchers can adapt self-reports measures to fit the needs of the population or research question (Kriska & Caspersen, 1997; Sallis & Saelens, 2000). When choosing a physical activity measure, researchers need to take into consideration the strengths and limitations of the tool. Physical activity tools are continually being developed; along with the development of these tools there is a need to continue assessing the validity and reliability of these tools. Improvements and reduction in cost of objective measures for physical activity, such as accelerometers, are allowing these tools to be more widely used in field research. However, researchers may still wish to consider the unique role of self-report data to assess the context and type of physical activity being performed (Sallis & Saelens, 2000).

**Objective Physical Activity Measures**

Physical activity monitors or objective measurement tools, such as heart rate monitors, accelerometers, and pedometers are being used to assess the relationship between physical activity and health (Janz, 2006). Objective measures provide detailed information on patterns of physical activity accumulation, frequency, duration, and intensity of movement. The development
of pedometer and accelerometer technology has allowed for these tools to become more portable, unobtrusive, and cheaper making them more accessible for field research. The use of pedometers and/or accelerometers allows for low-intensity activities such as walking and incidental activity to be assessed, which are not easily captures using questionnaires, along with moderate and vigorous activities (Schmidt, 2008; Shephard, 2006). Objective physical activity reduces reporting error that is introduced in questionnaires by translation errors, misinterpretation, and social desirability (Janz, 2006).

Janz’s (2006) review of the published literature on activity monitors identified over 300 papers with key words or title words of physical activity and pedometry, accelerometry, heart rate monitoring (or some variation). Compared with self-reports of physical activity, the use of objective activity monitors has been shown to be more likely to detect significant and meaningful associations between physical activity and health outcomes (Janz, 2006; Eslinger & Tremblay, 2007). While there tends to be high user compliance with these tools, they are not without their limitations either. There is considerable variation in performance among models, which makes it difficult to compare results (Keim et al., 2004). Pedometers detect and record vertical pelvic displacement during ambulatory activities such as walking or running. They are fairly accurate in counting steps for regular, steady gait patterns but may under-estimate steps taken at slower speeds. The use of pedometers is limited to the assessment of walking or running as they do not have the ability to monitor non-vertical movement, seated activity, or load-bearing activities. Data on the intensity, frequency, or duration of activity are also not available with the use of pedometers. Accelerometers allow for the measurement of frequency, pattern, duration, and intensity of movement along the horizontal, vertical, or mediolateral planes (Keim et al., 2004). One of the main disadvantages of using accelerometry techniques alone is that information on the mode or context of physical activity cannot be assessed (Eslinger & Tremblay, 2007). Like
pedometers, accelerometers are unable to assess load carrying, upper-body movement, or activities such as swimming.

**International Physical Activity Questionnaire (IPAQ)**

The International Physical Activity Questionnaire (IPAQ) has been one of the more prominent self-reported physical activity assessment tools found in the literature. There are two versions that exist, a short version that consists of 9 items that is suitable for use in national and regional surveillance systems, and a long version consisting of 31 items providing more detailed information needed for research and evaluation purposes (Craig et al., 2003). The IPAQ was designed to provide a set of well-developed instruments that can be used internationally to obtain comparable population estimates of physical activity. The IPAQ has been tested in both developed and developing countries demonstrating acceptable reliability and validity properties, especially in urban samples (Craig et al., 2003).

A benefit of using the IPAQ is that unlike other physical activity questionnaires, for example the US Behavioral Risk Factors Surveillance Survey which measures mostly leisure-time physical activity, the IPAQ can be used to assess multiple domains of physical activity including walking, moderate and vigorous intensity leisure-time physical activity, occupational and transport-related domains, and a total physical activity sum (Bauman et al., 2009). The reliability and validity of the IPAQ has been assessed in a number of studies, and has been compared against other subjective and objective physical activity measurements. Brown and colleagues (2004) examined the test-retest reliability of four physical activity instruments that have been commonly used in population surveys: the Active Australia Survey, the US Behavioral Risk Factors Surveillance Survey (BRFSS), the Australian National Health Survey, and the IPAQ-short version. Each of the four surveys examined demonstrated acceptable percent
agreement and kappa statistics used to assess test-retest reliability of classification of activity status. Of these four measures, the IPAQ reported the highest percentage of persons meeting 150 minutes/week and had 77% agreement in the classification of respondents (Brown et al., 2004). However, interclass correlations results suggested that moderate intensity questions had the lowest reliability scores ranging from 0.16 to 0.44. Reliability scores for walking and vigorous intensity activities showed better agreement, especially for the BRFSS and IPAQ surveys. Across the four physical activity measures, differences in the prevalence of physical inactivity were reported. Brown et al. (2004) thus recommend the use of the same survey instrument for continued and ongoing monitoring of population physical activity trends.

A study by Rosenberg et al. (2008) assessed sedentary behaviour examining the relationship between sitting time and physical inactivity using items from the IPAQ. Test-retest Spearman correlations were strong for men and women on the long version and short version correlations were also within reasonable ranges. Correlations between sitting time with accelerometer counts were low to moderate in agreement. The sitting-time items from the last 7 days IPAQ were reliable and valid among participants from several countries. It should be acknowledged that authors distinguish physical inactivity from sedentary behaviour. Defining people as inactive based on lack of leisure-time physical activity can be useful, but care should be taken not to infer that inactive individuals are excessively sedentary (Rosenberg et al., 2008).

A 12-country reliability and validity study of IPAQ showed reasonably good reliability and comparable validity to other physical activity questionnaires (Craig et al., 2003). Reliability was assessed using spearman correlation coefficients, and ranged from 0.32 to 0.88 with 75% of correlations observed above 0.65. The concurrent validity coefficients showed that the long and short versions had reasonable agreement ($\rho=0.67$ CI:0.64, 0.70) and for differences between short versions correlations was 0.58 (CI: 0.51, 0.64). The IPAQ was also tested for criterion validity
against CSA accelerometers. The Spearman’s coefficient suggest that there is a fair to moderate agreement between the IPAQ short version and CSA accelerometers ($p=0.30$ CI: 0.23, 0.36) (Craig et al., 2003). The IPAQ demonstrated similar properties to other established self-report physical activity questionnaires and the results suggested that the IPAQ had demonstrated reasonable reliability and validity for use in assessing a variety of dimensions of physical activity in a variety of settings.

**Social Determinants of Physical Activity**

A diverse range of personal, social and environmental factors influences physical activity. At the individual level, socioeconomic status, sex, age, and social capital have demonstrated consistent and strong associations with physical activity (Trost et al., 2002; Lindstrom, 2008). Social and physical environmental factors, such as neighbourhood socioeconomic status and the neighbourhood built environment, have also shown significant associations with physical activity (Giles-Corti & Donovan, 2002; Cerin & Leslie, 2008). To address the growing prevalence of physical inactivity, it is important to examine the association between these determinants and physical activity and how these determinants may be interrelated in order to develop effective and sustainable physical activity promotion programs.

**Socioeconomic Status**

There are a number of ways in which socioeconomic status (SES) or socioeconomic position (SEP) has been defined and measured. Mueller and Parcel (1981) defined socioeconomic status as “the relative position of a family or individual on a hierarchical social structure, based on their access to or control over wealth, prestige and power.” Common individual-level socioeconomic measures include educational attainment, occupation, individual income, and social class (McNeill, 2006; Shavers, 2007). Area-level indicators have also been used and include median household income, income inequality, percentage of unemployed persons, per capita income
(Shavers, 2007) The absence of a gold standard measure has introduced a number of methodological issues that include lack of precision and reliability or measures, difficulty with the collection of individual data, the effect of socioeconomic status over lifetime, the classification of certain sub-groups, poor correlation between individual measures, and inaccurate or misleading interpretation of results (Shavers, 2007). Despite the variation in socioeconomic status measures, it does appear that there is a consistent and significant association between SES measures and health.

A review of the literature on the association between SEP and physical activity by Gidlow et al. (2006) identified 33 articles. The majority of the articles were cross-sectional, a total of 28, of which about half were from the United States. Five socioeconomic position indicators were identified within the literature including, education, occupational social class, income, assets, and area of residence. However, regardless of socioeconomic indicator used, physical activity was consistently associated with socioeconomic indicators. The general findings of Gidlow et al.’s review suggested that there is evidence of a relationship between SEP and physical activity; higher levels of physical activity were consistently seen for those of higher compared to those of lower SEP.

Of the five SEP, education appeared to have the strongest and most consistent relationship with physical activity. Of the 24 studies that used education as the measure of SEP or status, 17 found a positive relationship between education and physical activity. The likelihood of physical activity participation increased with higher levels of educational attainment. Cerin and Leslie (2008) suggested that educational attainment is associated with better health outcomes through greater exposure to health messages. Those with higher levels of education may have been instilled with higher levels of perceived benefits of physical activity, and have a greater capacity to seek, understand and internalize, and act upon these messages.
Individuals with higher education may seek out environments that are more conducive to physical activity and have the resources to buy sport/exercise equipment or club memberships that enhance physical activity (Cerin & Leslie, 2008). Similar associations are found between occupational social class and income, and physical activity. Occupational social class positions individuals within the social structure and is often operationalized as employment status (e.g., employed/unemployed/retired), specific occupational group, prestige of the occupation, aggregate occupation group (e.g., blue-/white-collar workers) and the physical work environment (Shavers, 2007). Gidlow and colleagues (2006) found ten studies that investigated the relationship between physical activity and occupational social class, eight of these studies were cross-sectional, and only one collected original data. Self-reported physical activity was significantly and consistently greater among those in higher compared with lower social classes (Gidlow et al., 2006).

Among the 18 studies that used income as the SEP indicator, results were more mixed. Nine cross-sectional studies reported a positive relationship with physical activity, indicating that those with higher income are more likely to be physically active than those with lower incomes. Six studies did not find any relationship between income and physical activity and one negative association was reported. Comparing education, social class, and education as indicators used in studies of SEP and physical activity, income was the measure that least consistently demonstrated a relationship between socioeconomic position and physical activity. Gidlow and colleagues (2006) suggested that this inconsistency may be due to inaccurate reporting of sensitive income data; the failure of studies to adjust for household size; the lack of sensitivity within broad income categories; and ethnic variation within the population under study.

There is no consensus on which measure of SEP is the best to use in the study of health and health behaviours (Gidlow et al., 2006). The relationship between SEP and health, in
particular physical activity, needs to be investigated using consistent and standard measures of SEP to determine the strength of the relationship (Gidlow et al., 2006). By identifying which SEP indicator has the strongest relationship with physical activity and health, interventions and policies can be developed to better address health disparities according to variations in SEP.

**Sex**

It has been consistently demonstrated that sex is an important correlate of physical activity behaviour in adults. Physical activity participation in men is consistently higher compared to women (Trost et al., 2002). Bryan and Walsh (2004) reported using data from the 2000-2001 CCHS that 57% of females over the age of 12 reported being physically inactive. When stratified by age group, more females than males were inactive, and this disparity between men and women was the greatest in the youngest and oldest age groups. Women became more inactive with age, 72% of women over the age of 70 were considered inactive compared to 56% of men in the same age group (Bryan & Walsh, 2004). Canadian Community Health Survey data from 2007/2008 showed that the proportion of women who are moderately active appears to decline with increasing age, whereas the proportion of moderately active men 65 years and older is similar to that of men 25-64 years. Overall, men were more likely to be moderately active than women (Canadian Fitness & Lifestyles Research Institute, 2009). Analysis of the Canadian Health Measures Survey 2007 to 2009 revealed that there was a difference in moderate to vigorous physical activity (MVPA) between men and women aged 20 to 39. Men accumulated 33 minutes while women only accumulated 24 minutes of MVPA per day (Colley et al., 2011).

Meyer, Niemann, & Abel (2004) have suggested that little is known about how physical activity, indicators of perceived health status, and health relevant attitudes differ between men and women or even if differences exist. In their study, Meyer, Niemann, and Abel (2004) looked to identify differences between men and women in their patterns of sport activity, habitual
physical activity and fitness. Differences between men and women were reported for all three. A greater percentage of men participated in sport activity and rated their physical fitness higher, while a higher percentage of women reported habitual physical activity. Compared to men, women more frequently reported that they were unfit or moderately fit. The specific male-female differences in the prevalence of participation in sport activity and habitual physical activity have been found in other studies as well (Chad et al., 2005). When investigating physical activity behaviour in adults, it may be important to investigate gender specific domains of activity and correlates of physical activity to better understand the difference in prevalence of physical (in)activity between men and women.

It is also important to recognize that over the lifespan, there are a number of biological changes that occur that impact women’s health and may impact their capacity to be physically active. There are a number of health benefits to regular physical activity in women. Regular physical activity has been shown to reduce the risk of premature death and disability in postmenopausal women (Brownson et al., 2000). However, little research has been conducted in women over 40 years of age, who are at increased risk of physical inactivity, to assess the factors that may lead to greater physical activity participation. A number of behaviourial risk factors also appeared to be related to physical inactivity (Brownson et al., 2000). Among this sample of women, physical inactivity was most prevalent among current smokers, persons not consuming five or more servings of fruits and vegetables per day, and for those who were overweight (Brownson et al., 2000). Different patterns of physical activity appeared in this sample of women, a large proportion of women reported being active in household and occupational tasks. When all domains of physical activity were taken into account there was less variation in participation. This finding suggests that a wide range of activities need to be included when measuring physical
activity in women as perceptions of activity may vary, and thus could lead to a better understanding of how to engage at risk populations in physical activity.

**Age**

Age is related to a number of health outcomes across the lifespan (Public Health Agency of Canada, 2003). With increasing age, the risk for numerous chronic conditions increases. For example, older persons are at increased risk for cardiovascular diseases, cancers, and diabetes (Health Canada, 2002). Along with increased risk of chronic disease, the prevalence of physical inactivity also increases with age. In Canada, it has been shown that 55% of men and 67% of women over the age of 50 are not active enough to reduce their risk of disease (Cameron, Craig, Stephens, & Ready, 2002).

Chad et al. (2005) studied the correlates of physical activity across different age groups within an older adult population. The prevalence of physical activity was much higher among adults 80 years and older compared with the age groups 50-64 years and 65-79 years. Given the relationship between physical activity and chronic disease, the high prevalence of physical activity in older adults may have significant implications for the economic costs and burden of these diseases. To prevent the prevalence of physical inactivity from increasing across the lifespan, it is important to understand the correlates of physical activity in different age groups. The association between age and physical inactivity cannot be taken for granted, it is important to uncover factors that contribute to a decrease in physical activity with age to improve physical activity intervention strategies (Chad et al., 2005).

**Social Capital and Physical Activity**

Putnam (1993) and Coleman (1990) have defined social capital as those features of social structures, such as levels of interpersonal trust and norms of reciprocity and mutual aid, which act
as resources for individuals and facilitate collective action. Due to the lack of consensus among researchers on what contributes to social capital and whether social capital should be conceptualized at the individual or community level, measurement of social capital is still evolving (Kawachi & Berkman, 2000). Conventional social capital indicators that have been used to study the relationship between social capital and various health behaviours (e.g., physical activity) including social trust, social participation, reciprocity, and social cohesion (Ball et al., 2010). Research has shown significant associations between measures of social capital and self-rated health, health status (e.g., obesity, overweight, diabetes, chronic diseases, mortality), and health behaviours (e.g., physical activity, nutrition, and alcohol consumption) (Kawachi, Kennedy, & Glass, 1999; Schultz, O'Brien, & Tadesse, 2008; Kawachi & Kennedy, 1997; Lindstrom, 2008). However, there may be components of social capital that influence health and health behaviours that are not being captured by these conventional measures. The operationalization of social capital has been suggested to influence the way in which the mechanisms of social capital are associated with health (Moore et al., 2010; Moore et al., 2011; Carpiano & Hystad, 2011). Researchers have suggested that using a formal network approach reveals significant social network capital components (i.e., diversity, reach and range) that are associated with health outcomes (Moore et al., 2011; Carpiano & Hystad, 2011). It is important to identify the different ways in which the mechanisms by which social capital to increase our understanding of the mechanisms behind social capital and the ways these mechanisms influence health.

Studies examining social capital and physical activity have demonstrated a fairly consistent association between social participation and generalized trust. Less is known about the role of how social networks may play in physical activity. Comparing the role of social capital
measures (i.e. social participation, generalized trust, and social network capital,) would help identify the mechanisms by which social capital influences physical activity.

**Social Trust, Social Participation and Physical Inactivity**

Physical activity is a health-related behaviour influenced by individual and contextual factors (Lindstrom, 2008). Results from individual-level studies of social capital and physical activity have been more consistent in demonstrating a relationship between social capital and physical activity than studies that have examined the importance of contextual social capital. (Lindstrom, 2008). These associations between individual social capital and physical activity have been demonstrated across a number of contexts and populations.

At the individual level, lower levels of social capital have been associated with lower levels of physical activity, while higher levels of social capital reduce the risk of physical inactivity. In addition, individual-level social capital has been shown to have a strong positive association with leisure-time physical activity (Lindstrom, Hanson, & Ostergren, 2001). Lindstrom, Hanson, & Ostergren (2001) found that social participation had a reduced the effect of socio-economic differences and gradients in low leisure-time physical activity. Low social participation was associated with an increased risk of low-leisure time physical activity in men (OR: 2.2 95% CI: 1.9-2.7) and women (OR: 2.3 95%CI: 1.8-2.5). Lindstrom and colleagues suggested that insufficient psychosocial resources in some groups help explain differences in physical activity (Lindstrom, Hanson, & Ostergren, 2001). Greiner et al. (2004) found similar results in their investigation of the association among civic participation, trust in one’s community, and physical activity. Individuals who rated their community highly in terms of a place to live were more likely to be active than those who rated their community lower (Greiner, Li, Kawachi, & Hunt, 2004). Mummery, Lauder, Schofield, and Caperchione (2008) found that individuals residing in Queensland, Australia who ranked in the second highest (OR: 0.43
95% CI: 0.28-0.66) and highest (OR: 0.33 95% CI: 0.21-0.52) social capital quartiles were more likely to be physically inactive compared to individuals in the lowest social capital quartile. Ueshima et al. (2010) reported that in a sample of adults living in Okayama, Japan, high trust significantly reduced the risk of physical inactivity (OR: 0.58 95% CI: 0.42-0.79).

Significant associations between physical activity and social capital have also been found among adolescents and women. McKay et al. (2007) found that as state-level social trust increased the odds of an adolescent not meeting physical activity recommendations increased. Ball et al. (2010) found that social participation was consistently associated with all types of leisure-time physical activity among women from 45 Melbourne neighbourhoods. Among this sample of women, higher levels of social participation and higher levels of neighbourhood-level interpersonal trust were both associated with a greater odds of meeting leisure-time physical activity recommendations (Ball et al., 2010).

**Network Social Capital and Physical Activity**

Within the field of social capital research, social capital has commonly been measured using proxy indicators of social capital (e.g., social participation and generalized trust). Proxy measures of social capital are assumed to reflect in some sense the resources that individuals and potentially groups have access to through individual network connections. One of the shortcomings of using proxy indicators of social capital is that the different dimensions of social capital, such as hierarchical resource accessibility, are often overlooked. Using a network approach in health research provides greater attention to the types of resources to which an individual or group has access, and the role of network mechanisms in the links between social capital and health status or health behaviours (Moore et al., 2009; Moore et al., 2011). The use of position generators to assess network social capital has become increasingly prominent within the health field. The position generator measures individuals’ social capital by assessing a person’s
ties to others working in specific types of occupations. Additional modifications to the instrument can allow assessment of whether those ties are with family, friends or acquaintances, and neighbours or non-neighbours. Lin (2001) has recommended the calculation of three dimensions of social capital based on the prestige score associated with each occupation: (1) upper reachability, (2) range of resources accessed, and (3) diversity of resources. Reachability represents the upper most resource a person can reach through their social ties. Diversity is the number of different occupations accessed, and reflects network size. Range is the difference between highest and lowest prestige job accessed, and reflects the different types of resources a person might access.

Previous studies that have used a position generator to measure social capital have shown that persons with a greater diversity of ties in their network were less likely to have higher waist circumferences or body mass index (Moore et al., 2009), tend to have a greater sense of mastery (Moore et al. 2009), have higher self-reported health (Moore et al., 2010), and higher self-rated general health and mental health status (Carpiano & Hystad, 2011). Less is known about the association of network capital with physical inactivity. Yet, previous studies would suggest that those with greater network capital would tend to be more physically active.

**Neighbourhoods and Physical Activity**

Aspects of neighbourhood environments have been linked to a variety of health conditions (e.g., infectious disease, infant mortality and low birth weight rates, body mass index and self-rated health) and health behaviours (e.g., cigarette smoking, physical activity, and alcohol consumption) (Kawachi & Berkman, 2003). Various measures of neighbourhood deprivation and poverty have been shown to be associated with increased individual risk of cigarette smoking, higher body mass index, depressive symptoms, lower quality diet, poorer self-rated health, and suffering intimate partner violence (Kawachi & Berkman, 2003). One of the problems in the
study of neighbourhoods and health is that there is a lack of theoretical development about plausible social, psychological, and biological links between specific neighbourhood features and specific health outcomes. There is also a significant amount of conflicting evidence about the extent and magnitude of area effects on health (Diex Roux, 2001; Macintyre, Ellaway, &Cummins, 2002).

Researchers have suggested that neighbourhoods influence health through characteristics of both the built and social environment. Features of the built environment include air and water quality, work and play such as decent housing, secure and non-hazardous employment, and safe areas for recreation and play; services provided publicly or privately which include education, transport, street conditions, policing, health and welfare services. Features of the social environment include socio-cultural features such as the political, economic, ethnic history, norms and values, levels of crime and incivilities and other threats to personal safety, and networks of community support; and the reputation of an area which may influence infrastructure, self-esteem and morale of individual residents, and who move into or out of the area (Macintyre et al., 2002). While the built and social environment may be conceptualized independently of each other, it is important to recognize that they are not mutually exclusive. Both the built and social environments play an important role in determining outcomes and may influence the development of each other. For example, a neighbourhood may provide the basic infrastructure needed for the development of industry, which in turn influences the density and types of residents and relations.

Over the past few years there has been a renewed interest in neighbourhood effects of health. Neighbourhood context has been investigated in association with a number of health outcome and health related behaviours. The evidence suggests that neighbourhood factors, such as the built and social environments are contributing to disparities in physical activity. An increase in individual risk for elevated body weight and engaging in unhealthful behaviours,
including physical inactivity have been shown to be associated with living in resource deficient neighbourhoods (Veenstra et al., 2005). In a review of neighbourhood built environmental influences on adult physical activity, Humpel, Owen, & Leslie (2002) identified 19 studies that examined the relationship between the physical environment and physical activity. These studies used both perceived and objective measures of the physical environment. Humpel and colleagues (2002) identified five groups of built environmental factors that contribute to physical activity: accessibility of facilities, opportunities for activity, weather, safety, and aesthetics. The presence (or lack thereof) of these features can either promote or deter physical activity within a neighbourhood (Renalds, Smith, & Hale, 2010). The presence of built environment features, such as walkability and mobility factors, architectural factors, and land use mix, were associated with an increased likelihood of engaging in physical activity.

**Area/Neighbourhood SES**

It has been widely established that the health status of individuals and communities tends to improve with increasing socioeconomic status (McNeill, Kreuter, & Subramanian, 2006; Pickett & Pearl, 2001). Studies investigating neighbourhood SES and physical activity have generally found that individuals living in the most disadvantaged areas are more likely to be inactive compared to those living in the most advantaged areas. Van Lethe, Burg and Mackenbach (2005) examined the association between neighbourhood inequalities, neighbourhood attractiveness, proximity to local facilities, and safety, with physical activity among adults in the Netherlands. This study revealed that individuals in the most socio-economically disadvantaged areas compared to those in the least disadvantaged areas were more likely to report almost never walking or cycling to shops or work, almost never walking, cycling or gardening in leisure time and almost no sports participation, (van Lenthe, Burg, & Mackenbach, 2005). Neighbourhood socioeconomic indicators have also been identified as having a greater effect on individual
physical activity than individual household income. In their investigation of neighbourhood deprivation, social capital, and regular exercise among Chicago adults Wen, Browning, & Cagney (2007) found that neighbourhood affluence and education had a positive influence on physical activity. Poverty, percentage of households on public assistance, prevalence of female-headed households, and neighbourhood deprivation were found to have a negative impact on physical activity. Adults in socio-disadvantaged areas characterized by general poor physical disorder, (lack of sidewalks, graffiti, disrepair) and high levels of traffic and noise pollution traffic were more likely never to have engaged in leisure-time physical activity. Poor proximity to recreational facilities was also a significant determinant of decreased leisure-time physical activity (Wen, Browning, & Cagney, 2007). An investigation of the influence of the built environment on physical activity showed significant associations between distances to facilities, access to recreation facilities, a high environmental score, with individual physical activity (Giles-Corti and Donovan, 2002). Among a sample of 20-65 year old adults in Adelaide, Australia, Cerin and Leslie (2008) showed that the presence of physical barriers to walking and access to individual sport facilities were related to area-level household income. Presence of open space, team-sports facilities, and neighbourhood aesthetics appeared to be a primary function of area-SES. Areas with higher socioeconomic status measures appeared to have better access to individual recreation facilities, higher level of aesthetics, fewer barriers; however, these areas also had poorer access to public open space and team sport facilities. Limited access to open space and team sport facilities appeared to contribute to a reduction in mean recreational walking in medium and high socioeconomic areas.

**Neighbourhood Density**

Neighbourhood population density has been shown to be an important determinant of physical activity. For example, Forsyth et al. (2007) found that density was associated with utilitarian
physical activity (i.e. walking for transport). Walking for utilitarian purposes has demonstrated consistent associations with area density, mixed land use (zoning) and presence of destinations such as local shops, parks or recreation facilities, street pattern or connectivity, and safety and interest. Utilitarian physical activity has been shown to be more prevalent in dense, mixed-use neighbourhoods (Saelens, Sallis, & Frank, 2003). Density may also serve as a proxy for other area dimensions such as income, mixed land use, architecture and walkable streets, and transit use (Ewing et al., 2003; Committee on Physical Activity, Health, Transportation, and Land Use, 2005; Frank et al., 2005). Density may have an impact on physical activity via the greater number of amenities and facilities in dense areas (Committee on Physical Activity, Health, Transportation, and Land Use, 2005).

Forsyth et al. (2007) found that density was associated with walking purpose (travel, leisure, errands) but not total amount of walking or overall physical activity among US adults. To assess density seven measurements were used including: population per unit land area, population per developed land area, residential population in residential parcels, population plus employment per unit land area, employment per unit area, housing units per unit land area, lot coverage. Significant differences between high and low-density areas were seen for IPAQ transport walking and IPAQ leisure walking. Residents of denser areas had a larger mean walking for transport minutes than residents in less dense areas. However, residents in less dense areas had larger mean walking for leisure minutes than denser areas. The findings of this study suggest that density is associated with physical activity; however, it remains unclear what forms of density matter more for physical activity.

Using objective measures, Frank et al. (2005) assessed the relationship between physical activity and urban form. Urban form was assessed by a walkability index comprised of net residential density, street connectivity, and land-use mix as these measure have been highly

42
correlated. Significant correlations between the natural log of minutes of moderate physical activity and land-use (r=0.145 p<0.01), net residential density (r=0.179 p<0.01), and intersection density (r=0.111 p<0.01) were reported. The walkability index was significantly associated with meeting the ≥30 minutes of moderate physical activity recommendation. With each standard deviation increase in walkability, individuals were 30% more likely to meet the moderate activity recommendation. Individuals living in the high walkability quartile compared to the referent group had 2.4x the odds to meet the recommended ≥30 minutes of moderate activity.

Traditionally, investigations of the built environment and its association with physical activity have relied on self-reported physical activity and subjective measures of the environment (Frank et al., 2005). Physical activity measures are also often limited assessing walking or bicycling for transport, not overall measures of physical activity. Currently, little work has been done examining total walking or total physical activity (Ewing & Cervero, 2001). However, there does appear to be a shift towards using objective measures to develop a better understanding of the built environment and physical activity. In future research, it may be useful to further investigate how density might impact other components of physical activity, such as moderate-intensity and overall physical activity levels, using these objective measures.

Summary

The purpose of these two studies is to investigate the association of individual social capital and neighbourhood environmental factors with physical inactivity amongst Montreal adults. Over the past decade, research on social capital and physical activity has conceptualized social capital as social participation and generalized trust. However, measures of trust and participation fail to provide information on the value of involvement and the degree of resources accessibility. It is suggested that a network theory approach to social capital provides greater insight into the issue of hierarchical resource accessibility and the mechanisms associated with physical inactivity.
Previous studies using a network approach have identified a significant association of network components with obesity and waist circumference, self-reported health and mental health status. Yet, knowledge of the association of social network with health behaviours remains limited. The first study aims to provide greater insight into the association between individual social capital and physical activity by comparing the association of conventional measures of social capital, trust and participation, and network capital.

Despite the consistent and significant association of individual determinants of physical inactivity, these factors do not fully account for the prevalence of physical inactivity or variations of physical inactivity between places. It is suggested that neighbourhood factors may contribute to the prevalence and variation of activity levels. The second study assesses the association of neighbourhood factors with physical inactivity in Montreal and examines whether neighbourhood socioeconomic status moderates the association of individual social capital with physical inactivity. This study aims to provide insight into how population density and area socioeconomic status are associated with physical inactivity. Investigation of the association of individual social capital, neighbourhood social capital with physical inactivity is likely to lead to a better understanding and greater awareness of the underlying mechanisms influencing physical inactivity. Increased knowledge of the mechanisms can be used to better inform public health and health promotion interventions to decrease the prevalence of physical inactivity.
References


Chapter 3
Network social capital, social participation, generalized trust and physical inactivity among Montreal adults

Introduction

Within health sciences research, there has been a lack of consensus concerning the definition and measurement of social capital (Kawachi, Subramanian, & Kim, 2008). Putnam conceived of social capital as a community-level resource that captured features of social organization such as networks, norms, and trust that facilitates coordination and cooperation. In this sense, social capital is seen as part of the structure of community-level relationships, and is both a public good and ecological characteristic (Putnam, 1995). On the other hand, Bourdieu (1986) focused on social capital as the resources that individuals gain access to through membership in social networks. Social capital is the aggregate or potential resources that are linked to possession of a network of more or less institutionalized relationships (Bourdieu, 1986). At its essence, social capital is relational and refers to the material, informational and affective resources to which individuals and potentially groups have access through social connections (Moore, Daniel, Gauvin, & Dube, 2009). When measuring social capital there are two potentially salient features to be captured: 1) resources available to members of social groups, and 2) network-accessed resources. Network-accessed resources are embedded within individuals’ networks such as, social support, information channels and social credentials (Kawachi, 2006; Kawachi, Subramanian, & Kim, 2008). Generally, social capital research has not used network measures of social capital but has relied on proxy measures, such as social participation and trust. Using network measures of social capital has greater content validity in representing an individual’s social connectivity and access to resources (Moore et al., 2011), and may in this
study provide additional insights into the mechanisms by which social networks are associated with physical activity behaviour.

Research investigating the relationship between social capital and health has increased over the past decade. Social capital has been associated with a range of health outcomes and health behaviours, from risk of obesity, drugs and alcohol consumption, chronic diseases, violent crime, mortality, and self-rated health (Lindstrom, 2008). The relationship between social capital and health-behaviours can vary according to socio-demographic factors such as age, gender, and income. The relationship between social capital and health behaviours may also be dependent on social, cultural, and historical settings. For example, contextual effects of social capital on physical activity have been found in the United States but not Sweden (Lindstrom, 2008). Despite the significant associations among social capital, health outcomes, and behaviours, research on physical inactivity and social capital is limited.

Physical inactivity is considered a modifiable risk factor for a number of chronic and cardiovascular diseases (Warburton, Nicol, & Bredin, 2006). Approximately 80% of Canadians do not meet the daily energy expenditure of greater than 3.0 kcal/kg of physical activity needed for optimal health benefit (Liu, Wade, Faught, & Hay, 2007). Recent studies have shown that physical inactivity places a significant burden on the Canadian economy. In 2001, $1.6 billion was spent on direct costs and $3.7 billion on indirect costs associated with physical inactivity (Katzmarzyk & Janssen, 2004). The association between individual determinants and physical activity has been well established. However, social networks may also influence individual physical activity. More recently, interest in the social determinants of physical activity has lead to the investigation of how social capital is associated with physical activity.

Studies of the relationship between social capital and physical activity have shown a fairly consistent association. At the individual level, lower levels of social capital have been
associated with lower levels of physical activity, while higher levels of social capital seem to reduce the risk of physical inactivity. Lindstrom, Hanson, and Ostergren (2001) in their study of Malmö, Sweden, found that social participation reduced the effect of socio-economic differences and gradients in low leisure-time physical activity. Low social participation was associated with an increased risk of low-leisure time physical activity in men (OR: 2.20; 95% CI: 1.90, 2.70) and women (OR: 2.20; 95%CI: 1.80, 2.50). This study suggests that insufficient psychosocial resources may contribute to differences in physical activity (Lindstrom, Hanson, & Ostergren, 2001). Mummery, Lauder, Schofield, and Caperchione (2008) found that individuals residing in Queensland, Australia who ranked in the second highest (OR: 0.43; 95%CI: 0.28, 0.66) and highest (OR: 0.33; 95% CI: 0.21, 0.52) social capital quartiles were less likely to be physically inactive compared to individuals in the lowest social capital quartile. Ueshima et al. (2010) reported that for adults living in Okayama, Japan, high trust significantly reduced the risk of physical inactivity (OR: 0.58; 95% CI: 0.42, 0.79). Bonding and bridging social capital were also statistically significant in reducing the odds of physical inactivity (Bridging OR: 0.63; 95% CI:s:0.5-0.78; Bonding OR:0. 53; 95%CI:s: 0.37-0.76) (Ueshima et al., 2010). Greiner, Li, Kawachi, and Hunt (2004) found similar results in their investigation of the association between civic participation and trust in one’s community, and physical activity. Individuals who rated their community highly in terms of a place to live were more likely to be active than those who rated their community lower (OR: 1.22; 95%CI:s: 1.13-1.32). Those who reported more community involvement also were more likely to be active that those who reported low community involvement (OR: 1.62; 95% CI:s: 1.31-2.01) (Greiner, Li, Kawachi, & Hunt, 2004).

Multi-level studies of physical activity and social capital have also reported significant associations between neighbourhood characteristics and physical activity. A study of physical activity, which included measures of walking, leisure-time physical activity, and neighbourhood
walking, and social capital found that individual participation and trust are associated with leisure-time physical activity (Ball, Cleland, Timperio, Giles-Corti, & Crawford, 2010). The multilevel analysis revealed that higher levels of social participation increased the odds of participation in leisure-time physical activity among women (OR: 3.3; 95%CIs: 2.15-5.05). It was also found that higher levels of neighbourhood interpersonal trust were associated with greater odds of leisure-time physical activity (OR: 1.73; 95%CIs: 1.01-2.95). Another multilevel study revealed that residence in a state with higher social capital was associated with lower odds of physical inactivity (Kim, Subramanian, Gortmaker, & Kawachi, 2006). Neighbourhood trust and norms of reciprocity have been shown to have positive effects on physical activity. Individuals living in high social capital areas of Chicago, characterized by high levels of trust and reciprocity, and low levels of violent crimes are more likely to engage in regular exercise (Wen, Browning, & Cagney, 2007). In another multilevel study of Swedish adults, the individuals in the low social participation group had much higher odds of physical inactivity (OR: 3.59; 95%CIs: 2.95-4.35) compared to individuals in the high social participation group (Lindstrom, Moghaddassi, & Merlo, 2003).

Using a social capital index, Wen, Browning and Cagney (2007) showed that there was a positive effect of social capital on regular exercise. Residents of neighbourhoods characterized by high levels of trust and norms of reciprocity, and low levels of violent crimes were more likely to engage in regular exercise (OR: 1.20; 95% CIs: Not Reported). One standard deviation in neighbourhood trust and norms of reciprocity increased the likelihood of regular exercise by 39% and 45% respectively (Wen et al., 2007). Social cohesion was demonstrated to have a significant effect on neighbourhood physical activity. Fisher, Li, Michael and Cleveland (2004) reported that individuals living in more socially cohesive neighbourhoods are more likely to have higher levels of neighbourhood walking. Poortinga’s (2006) investigation of the perceptions of the
environment, physical activity, and obesity revealed that high level of trust, medium and high levels of civic participation increased the likelihood of doing at least one walk of 30 minutes per week. All measures of social support and social capital were associated with walking behaviour. Social capital indicators of medium and high levels of civic participation increased the likelihood of being active at least 5 days a week. It was also reported that people with medium and high civic participation were more likely to engage in two or more sports activities a week (Poortinga, 2006). While the operationalization of social capital is not consistent across studies, the results from these studies do suggest that the association among social participation, trust, and physical activity warrants further investigation.

Social capital research has generally used proxy measures of social capital, social participation, and generalized trust. The shortcoming of this approach is that features of individuals’ social networks are often overlooked. Using a network approach in health research provides greater attention to the types of resources to which an individual or group has access (Moore et al., 2009). The use of position generators to assess network capital has been increasingly adopted within the health field. The position generator measures individuals’ social capital by assessing a person’s ties to others working in specific types of occupations and if those persons are family, friends, or acquaintances. Three indices of social capital are calculated based on the prestige score associated with each occupation accessed: (1) upper reachability, (2) range of resources accessed, and (3) diversity of resources. Using a position generator, Moore et al. (2009) showed that persons with a greater diversity of ties in their network were less likely to have higher waist circumferences (OR: 0.81; 95% CIs: 0.69, 0.96) or body mass index (OR: 0.81; 95% CIs: 0.71, 0.92). No research as far as we are aware has examined whether network social capital as measured with the position generator is associated with physical activity behaviour.
Knowledge of a potential association could provide greater insight into the social mechanisms influencing physical activity behaviour.

There are several causal mechanisms through which social capital is thought to benefit health including: (1) norms and attitude which affect health related behaviour; (2) psychosocial mechanisms; (3) social networks; and (4) having a lowering effect on crime rates (Kawachi, Kennedy & Glass, 1999). It is necessary to explore how these mechanisms are associated with physical activity, and whether one is more important for physical activity over the others, or even if these mechanisms can deter individuals from physical activity. It has been suggested that generalized trust may influence physical activity through feelings of safety or lack thereof in the community. Participation in organizations can increase an individual’s access to physical activity resources or exposure to health messages.

There are a number of tools that have been developed to assess physical activity that include accelerometers, questionnaires/surveys, step-counters/pedometers, physical activity diaries, and laboratory measures. Self-report surveys are still the most commonly used measurement tool (Sallis & Saelens, 2000). The International Physical Activity Questionnaire is a physical activity measurement tool that was developed for use in adult population to respond to the demand for comparable and valid physical activity assessment within and between countries. Despite a number of limitations associated with the use of self-report data especially the potential for over-reporting of physical activity, the IPAQ has demonstrated reasonable reliability and validity scores. While objectively measured physical activity would be ideal, it is not always a feasible or practical option for large population surveys. The IPAQ allows for data to be collected from a large number of people at a low-cost and is practical for studies assessing and monitoring changes in population physical activity and appears to be an acceptable tool to physical activity assessment (Craig et al., 2003; Brown et al., 2004; Hagstromer et al., 2005; Boon, 2008).
The following study uses a network approach to examine the association between physical inactivity and social capital. This approach is expected to lead to better identification of important components of accessed social resources that are important to physical activity behaviour. First this study will examine the association between social network capital and physical inactivity. Based on previous findings of network social capital and obesity (Moore, et al., 2009), it is hypothesized that network capital will be associated with physical inactivity: Individuals with higher network social capital will have a lower likelihood of being physically inactive than individuals with lower network social capital. Second, this study will examine the different dimensions of network capital, diversity, reach and range. Few studies have examined the association of the different dimensions of social network capital with health outcomes. Moore et al. (2011) found a significant association between greater network diversity in extra-neighbourhood social capital and higher self-rated health. It is hypothesized that diversity of network ties will have the strongest association with physical inactivity since network diversity provides individuals with access to different resources and opportunities. Network reach and range may not be associated with physical inactivity. Finally, this study will compare the association of network dimensions with the association of trust and participation and physical inactivity. Given the inconsistent results of previous studies, there are no a-priori hypotheses about the differences in associations between social capital measures and physical inactivity.

Method

Sample

Data came from the 2008 Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA). The MoNNET-HA study used a two-stage cluster sampling design. In stage one, using 2001 Canada Census data, Montreal Metropolitan Area (MMA) census tracts (N=862) were
stratified into low, medium, and high-income tertiles. From each tertile, one hundred census tracts were selected (n=300). In stage two of the sampling design, potential respondents in each census tract were stratified into three age groups, 25 to 44 years, 45-64 years, and 65 years and older. Within each age group and census tract three respondents were randomly selected for a total of nine respondents per tract. In seven tracts four participants were selected for a total sample size of 2,707. To be eligible for the study, participants had to be (1) non-institutionalized, (2) reside at their current address for at least a year, and (3) be able to complete the questionnaire in either French or English. Random digit dialing of listed telephone numbers was used to select households for participation. The questionnaire was administered using a computer-assisted telephone interviewing system. The telephone questionnaire was completed between mid-June and early August 2008.

**Measures**

**Main outcome.** The main outcome of interest for this study was physical inactivity. Physical activity level was based on self-report and assessed using an adapted version of the International Physical Activity Questionnaire. The IPAQ short form asks about three specific types of activities, walking, moderate-intensity, and vigorous-intensity activity across four domains including, leisure-time, domestic and yard-work activities, work-related physical activity and transportation activity. A score for each form is calculated by summing the frequency (number of days) and duration (number of minutes) of each form of activity (IPAQ Research Committee, 2005). To assess each form of physical (in)activity, participants are asked about the time they had spent doing vigorous, moderate or walking physical activity in the last 7 days. Vigorous activities are defined as activities that take hard physical effort, such as heavy lifting, digging, aerobics, or fast bicycling. Moderate activities are activities that make breathing somewhat harder than normal, such as carrying light loads, bicycling at a regular pace, or doubles
tennis. Walking activities included walking done at work or at home, walking to travel from place to place, and any other walking done solely for recreation, sport, exercise or leisure. Activities had to be done for at least 10 minutes at a time.

For each type of activity respondents are asked, “During the last 7 days, on how many days did you do this type of activity?” Respondents are also asked “how much time did you spend doing this activity on one of those days?” Responses are recorded as, days per week, hours per day, minutes per day, don’t know, and refused to answer. IPAQ guidelines are used to classify respondents into 3 levels of activity: high, moderate or low physical activity levels. The high category equates to at least one hour per day or more, of at least moderate –intensity above basal level of activity. High physical activity is defined as at least 3 days of vigorous activity on at least 3 days accumulating at least 1500 MET-min/week, or 7 or more days of any combination of walking, moderate or vigorous activity achieving a minimum of at least 3000 MET-min/week. The moderate activity category is the equivalent of half an hour of at least moderate-intensity physical activity on most days. To be classified as having a moderate level of activity, one of three criteria has to be met: (1) three or more days of vigorous activity of at least 20 minutes per day, (2) five or more days of moderate activity or walking of at least 30 minutes per day, or (3) five or more days of any combination of walking, moderate or vigorous activities achieving a minimum of at least 600 MET-min/week. The low physical activity category is simple not meeting any criteria for the moderate and high physical activity categories. Individuals are classified as being physically inactive if they do not meet the criteria for moderate or high physical activity (IPAQ Research Committee, 2005).

To calculate physical activity levels the guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) was used (IPAQ Research Committee, 2005). MET-values for each form of activity, walking, moderate-intensity, vigorous-intensity
activity, were calculated. The MET values used in the analysis of IPAQ data are: walking= 3.3 MET, moderate physical activity=4.0 MET and vigorous physical activity=8.0 MET. Continuous scores for each form of activity and total physical activity were calculated as:

- Walking MET minutes/week= 3.3*walking minutes*walking days
- Moderate MET minutes/week=4.0* moderate minutes* moderate days
- Vigorous MET minutes/week=8.0*vigorous minutes * vigorous days
- Total Physical Activity MET minutes/week= sum of walking+moderate+vigorous MET minutes/week scores (IPAQ Research Committee, 2005).

For this analysis, the physical activity variable was dichotomized into high/moderate physical activity versus being physically inactive.

**Main exposure.**

*Network Capital.* Network capital was measured using a position generator. The position generator measures individuals’ social capital by assessing a person’s ties to others working in specific types of occupations. Participants were asked to indicate whether they know someone on a first name basis who holds a certain occupation in society. Ten occupations were selected from a listing of 90 that had been ranked according to gender-neutral job prestige scores within Canada (Goyder, Guppy, & Thompson, 2003). The list was divided into octiles, ranging in low and high prestige scores. One occupation from each octile was randomly selected, with two additional occupations. Selected occupations were randomly listed in the position generator (highschool teacher, carpenter, musician/artist, taxi driver, physician, janitor, registered nurse, welder, accountant, and receptionist). Scores for reachability, diversity, and range were calculated and each dimension was considered separately rather than as a single measure. Diversity scores were calculated as the total number of different occupations accessed by an individual. The reach score was calculated as the highest prestige score accessed by an individual. The highest reach score
access was 93 and the lowest was 55, not including 0. Range scores were calculated as the difference between the highest and lowest prestige score accessed by an individual. The greatest range was 59 and lowest was 25, not including 0. The odds ratio of network dimensions can be interpreted as every one standard deviation increase (decrease) in network dimension is the amount the odds of the outcome increases (decreases). To facilitate comparison among network dimensions that each had their own scale, the dimensions were standardized.

Lin (2001) argues that the position generator captures three dimensions of social capital: (1) reachability, (2) diversity, and (3) range. The three indices of social capital can be calculated using the prestige score associated with each occupation accessed. Reachability represents the upper most resource a person can reach through their social ties. Diversity is the number of different occupations accessed, and reflects network size. Range is the difference between highest and lowest prestige job accessed, and reflects the different types of resources a person might access.

*Generalized trust* was assessed using the U.S General Social Survey question “Generally speaking, would you say that most people can be trusted or that you can’t be too careful?” Responses were recorded as: (1) most people can be trusted, (2) can’t be too careful, (3) depends, (4) most people cannot be trusted. Responses were recoded so higher numbers represented greater trust and then were dichotomized into low trust and high trust scores.

*Social participation.* Social participation was measured with a two-part question, first, “During the past five years, have you been active in a neighbourhood group or association as a volunteer or an officer?” And part two, “during the past five years, have you been active in any other voluntary associations as a volunteer or an officer?” Responses for both parts were recorded as “yes”, “no” “don’t know” or “no response”. Three categories of social participation were analysed: no social participation, low participation in either a neighbourhood or other voluntary
association or group, and high participation in both a neighbourhood and other voluntary association or group.

**Covariates.** Gender, household income category, educational attainment, age category, and health status were considered in this analysis. Inclusion of these factors was based on previous research and the specific characteristics of the MoNNET-HA sample, which over-represented women, older adults, and individuals with higher educational attainment (Moore et al., 2011).

*Gender.* Participants self-identified as male or female.

*Age.* Age was stratified into 6 categories 25-34, 35-44, 45-54, 55-64, 65-74, and 75 or older.

*Education.* Education was categorized as the highest level of education completed. Respondents could choose one of seven levels of education completed: No degree, certificate, or diploma; secondary (high) school diploma or equivalent; trades certificate or diploma; College certificate or diploma below Bachelor’s degree level; University certificate or diploma at Bachelor’s level; Master’s degree; earned Doctorate degree; or no response.

*Individual household income* was assessed by asking respondents to identify one of five total household income categories: less that $28,000; $28,000 - $49,000; $50,000 - $74,000; $75,000 - $100,000; and above $100,000.

*Health status* was classified as excellent, very good, good, fair, or poor.

**Statistical Analysis Procedures**

The MoNNET-HA response rate was 38.7%, calculated in accordance with American Association for Public Opinion Research standard definition (AAPOR, 2008). The representativeness of the MoNNET-HA sample was assessed using chi-square analyses compared to 2006 MMA Canada Census data. The sample over-represented (1) older adults (sampling
design), (2) individuals with income less than $50 000, (3) persons who lived in their place of residence more than 5 years, (4) females, and (5) those with more than high school education (Moore et al., 2011). Observations were excluded if information was missing on study variables.

Multilevel logistic regression analysis was used to assess the associations among physical inactivity, generalized trust, social participation, and network capital. Multilevel analyses were used to account for the clustered data structure (i.e., individuals nested within tracts). For this study only individual-level variables were included. Using the SAS 9.2 glimmix procedure, four multilevel logistic models were fitted. First, a null model was fitted for physical inactivity to examine the amount of physical inactivity clustering that existed among census tracts. The interclass correlation coefficient was calculated using the formula $\text{ICC} = \frac{Z}{(Z+\pi^3)}$, where $Z$ represents cross-neighbourhood variance in physical activity. In the second model individual demographic covariates were introduced. Two models for social capital variables were fitted separately. The first model was with generalized trust and social participation and the second was with network capital. The final model included both social capital and network capital measures while controlling for individual covariates.

Results

For these analyses, the final sample size was 2672. Table 1 provides a summary of the socio-demographic characteristics of the MoNNET-HA sample. Table 2 summarizes network capital characteristics. Table 3 reports the adjusted odds ratios for the fitted models and Table 4 shows the results for the multilevel logistic regression models.

**Descriptive Statistics.** Among MoNNET-HA participants 17.10% (n=461) reported being physically inactive, while 82.9% (n=2235) were classified as active according to the IPAQ. In the last five years 10.75% (n=291) of respondents reported participating in a neighbourhood
and other voluntary organization or group as a volunteer or officer while, 25.79 % (n=698) reported participating in a neighbourhood or other voluntary organization or group within the last five years as a volunteer or officer. For generalized trust, 42.5% (n=1142) of participants reported that “most people can be trusted” while 46.78% (n=1257) of participants reported “you can’t be too careful”.

Univariate analysis of social capital and network capital variables showed that with every one unit offset from the mean, network capital range significantly reduced the odds of physical inactivity (OR: 0.99; 95% CI: 0.98, 0.99). Each one unit offset from the mean of social network reach significantly reduced the odds of physical inactivity by 1% (OR: 0.99; 95% CI: 0.99, 0.99). Diversity of network capital significantly reduced the odds of physical inactivity by 16.6% for each one unit offset from the mean (OR: 0.83; 95% CI: 0.79, 0.87). Women were at increased odds of physical inactivity compared to men (OR: 1.50; 95% CI: 1.20, 1.87). Odds of physical inactivity increased with age category and with declining self-reported health status. Individuals who reported household income <$28,000 were at 3.25 increased odds of physical inactivity compared to the highest earning individuals (OR: 3.25; 95% CI: 2.11, 5.01). Increased education also decreased the odds of physical inactivity.

The ICC for the null model was 0.01 suggesting low levels of clustering of physical inactivity within Montreal neighbourhoods. The full model revealed that social participation and social network diversity were significantly associated with physical inactivity. Not participating in any formal associations increased participants’ odds of being physically inactive by 74% (OR: 1.74; 95% CI: 1.15, 2.73). For every one-unit increase in the network diversity of participants (i.e. for each additional occupation accessed), the odds of being physically inactive were reduced by 13% (OR: 0.87; 95% CI: 0.80, 0.95). Age group, gender, and health status were also significantly associated with physical inactivity in the multilevel model. Younger participants
were less likely to be physically inactive compared to the oldest age group. Participants 25-34 years were less likely to be physically inactive than participants 75 years or older (OR: 0.37; 95% CI: 0.2, 0.63). Males were less likely to be physically inactive than females (OR: 0.71; 95% CI: 0.55, 0.93). With increasing health status, participants with better self-reported health status were less likely to be physically inactive compared to participants with poor self-reported health status. Those with excellent health status were 85.6% less likely to be physically inactive compared to those with poor health status (OR: 0.14; 95% CI: 0.08, 0.28).

A previous study using MonNET survey data compared the observed sample counts to the 2006 Canada Census (Moore et al., 2011). Chi-square analyses were performed to compare the observed sample counts on a Census Tract-by-Census Tract basis. This analysis showed that the sample overrepresented 1) older adults (by sampling design), 2) individuals with an income less than $50,000 per year, 3) persons who live in their place of residence for more than five years, 4) females, and 5) those with more than a high school education (Moore et al., 2011).

**Discussion**

This study examined the association between physical inactivity and individual social capital and social networks among adults. Significant associations were found between network diversity and social participation. Individuals with higher social participation had reduced odds of physical inactivity than those with no social participation. Greater network diversity also significantly reduced the odds of physical inactivity. These findings suggest that individuals with more diverse network ties are less likely to be physically inactive compared to those with more similar ties. The results of this study are consistent with previous literature showing a significant association between social participation and physical activity. Unlike other studies, social trust and physical inactivity did not have a significant association.
What is already known

The results of this study add to the growing literature on the relationship of social capital and physical activity. Similar to studies in Sweden, the United States, Australia and Japan a significant association between measures of social capital and physical inactivity was found. Specifically, social participation has a relatively consistent association with physical inactivity. The current study examined participation in neighbourhood and outside neighbourhood voluntary organizations. Other studies used similar measures of participation such as asking respondents if they have been active in formal or informal groups within the past year. Among Swedish adults, low participation increased the odds of low physical activity (Lindstrom, et al., 2001; Lindstrom et al., 2003). In Australia, higher social participation and interpersonal trust among women increased the odds of any leisure-time physical activity (Ball et al., 2010). Some studies used a social capital index that included measures of social participation. These studies demonstrate mixed results (Kim et al., 2006; Wen, et al., 2007; Mummery, Lauder, Schofield, & Caperchione, 2008). However, using a social capital index makes it difficult to assess the direct association between participation and physical inactivity. Mummery et al. (2008) reported that high social capital index scores reduced the likelihood of inactivity among residents of Queensland, Australia. Wen, et al. (2007) found a positive social capital index effect suggesting that neighbourhoods characterized by high trust and norms of reciprocity are more likely to exercise regularly. Despite other studies reporting a significant association between trust and physical inactivity, the results from this study did not show an association between generalized trust and physical inactivity. This discrepancy may be due to the use of generalized trust versus more particular measures of trust such as neighbourhood trust or institutional trust. This may also reflect differences in attitudes of trust of the community or culture in which the study was performed (Abbott & Freeth, 2008).
Social capital is often viewed as influencing health through the following types of mechanisms: 1) the provision of social support; 2) social influence; 3) social engagement; and 4) access to material goods and resources (Kawachi & Glass, 2000). Greater physical activity may be encouraged through the provision of emotional, instrumental, appraisal, or informational support. These supports can provide economic opportunities and access to physical activity services. Individuals who receive positive support for physical activity are more likely to engage in regular activity than those individuals who lack support (Giles-Corti & Donovan, 2002; Cerin & Leslie, 2008). Social networks may exert social influence through shared norms and attitudes on physical activity behaviour. If an individual’s network holds positive attitudes towards physical activity, an individual is more likely to engage in similar physical activity behaviours. If those attitudes and norms are not a part of a person’s network, the individual may be less likely to engage in physical activity. Social engagement allows for increased opportunities to engage in physical activity. Individuals’ social networks help to define and reinforce meaningful roles and provide members with a coherent and consistent identity. Individuals who see themselves as a part of a physically active network are more likely to self-identify as being active. If this identity is shared and supported by the network an individual is more likely to engage in physical activity. Finally, networks are able to provide access to resources and services that may have a direct bearing on physical activity. Shared experiences and affiliations between network members can disseminate information about opportunities or provide individuals with greater access to physical activity opportunities or services. Participation in social activities may provide access to information and aid in the diffusion of the benefits of physical activity.

What this study adds

Network Social Capital Analysis
The use of the position generator in this study allows for a formal investigation of network social capital and helps identify the potential role of network mechanisms in the support of physical activity behaviour. Greater network diversity can expand a person’s range of informational sources and level of social support, and can provide greater access to materials and resources that influence individual physical activity.

The use of network capital measures in the study of social capital and health is limited. In previous studies health science research has relied more on social participation and social trust as proxy measures of social capital. Network measures capture the hierarchical resource accessibility dimension of social capital. The position generator, first proposed by Lin and Dumin (1986), samples hierarchical positions, counts, and measures access to structural positions in society. Positive and significant associations were demonstrated between highest status and range of statuses accessed, and current occupational status (Lin & Dumin, 1986). This suggests that access to better jobs can be linked to “who you know”. The introduction of network capital as a social capital measure in health research has shown a significant association between network measures and reduced waist circumference and reduced odds of obesity and overweight (Moore et al., 2009). In this study of network capital and physical inactivity, a similar relationship was demonstrated. Network diversity had a significant association with physical inactivity in that with every one unit deviation from the mean the odds of physical inactivity were reduce. Network measures of social capital capture aspects of the networks and resources accessible to individuals. The hierarchical, resource accessibility dimension that is captured by network measures contributes to its strength. Given the support that this study gives to network measures of social capital, further investigation of network capital and its association is warranted. Making it easier for individuals to interact with a wider range of people would likely increase their physical activity. Network diversity may provide individuals with different access to health information,
such as the benefits of physical activity, or other physical activity resources, such as facilities or programs, that may not be accessible through a more homogeneous network.

Social participation and generalized trust are the most commonly used measures of social capital. Only recently have network measures appeared within health science studies of social capital. Social participation provides information on the extent to which individuals are involved in society. However, information on the value for health benefits of this involvement remains unmeasured. Trust may capture psychosocial instead of network mechanisms that link social relationships to health. In other words, generalized trust may capture individual perceptions of belonging or feeling secure rather than a person’s actual connectivity or resource accessibility. Increased use of network capital measures, such as those used in this study, would also allow for the hierarchical resource accessibility dimensions to be studied. Network capital measures can help increase researchers’ knowledge of social capital mechanisms that promote physical activity.

Developing one definition of social capital and standard measures would increase the generalizibility across studies and provide consistency in methods. However, a single conceptualization may be difficult to establish as social capital is contextual and variability in outcomes or meaning will often depend on the specific context.

It is important to consider that while social capital may be beneficial in many ways to individuals, it may also lead to detrimental outcomes for others. Social capital can provide support, social control, and access to resources as discussed previously. However, individual freedoms and opportunities may also be restricted or be burdened with excessive claims or obligations (Moore et al., 2009). There is a general tendency for individuals to associate with those of similar characteristics. Individuals who are embedded in disadvantaged networks with fewer resources will likely have lower social capital (Lin, 2000). It is likely that individuals who associate with others who are physical inactive are more likely to be physically inactive.
themselves. Social capital can enhance the likelihood of instrumental returns as well as expressive returns such as better health (Lin, 2000). It might be worthy of further exploration into the types of social activities individuals participate in, the importance given to these activities, and the association with physical activity. Certain social activities and networks might provide more opportunities for physical activity thus influencing individual activity, while others might provide other support for physical activity, or not provide support/opportunity for physical activity at all. Focus needs to shift towards how civic and social engagement is associated with health behaviours risks rather than solely on individual risk factors. The association between physical inactivity and social capital measures suggests that alternative public health interventions may be appropriate. The findings help to support the fostering of community development and interventions that target communities, organizations, or groups of individuals in the effort to improve physical activity rather than focusing solely on individuals’ behaviour.

Limitations

There are a number of limitations that need to be considered for this study. First, although cross-sectional survey data are commonly used in research on social capital and physical activity, causal inferences should be avoided. It is likely that physically inactive individuals face barriers to or lack social engagement, social support, social influence and access to resources, resulting in low social capital. Longitudinal data on social capital and physical inactivity would help discern the directionality of the social capital and physical inactivity relationship, as well as guide further research on the mechanisms behind social capital. Second, the physical inactivity data are self-reported. While it is recognized that self-report measures have the ability to collect data from a large sample with relatively low cost and can be used in a range of population, there are a number of associated limitations. Self-reported physical activity measures can introduce social
desirability and recall bias, which can lead to over-estimation of physical activity. There is evidence to suggest that adults tend to overestimate physical activity levels (Sallis & Saelens, 2000). Self-reported physical activity measures such as the IPAQ need to be tested for reliability and validity to ensure physical activity is properly assessed. It should be noted that the IPAQ has been tested for validity and reliability across developed and developing countries (Craig et al., 2003). It has shown modest correlation coefficients for reliability scores across 12 countries in which 75% of correlation coefficients were above 0.65 and moderate agreement with accelerometer data with a pooled correlation of 0.30 (Craig et al., 2003). Brown et al. (2004) showed that the IPAQ repeatability has a 79.4% agreement for the proportion of participants classified as “active, insufficiently active, or sedentary” on two occasions, 24-hours apart. The IPAQ when compared against accelerometer data has shown stronger correlations with total physical activity and vigorous activity, with weaker association found for moderated activity (Boon, 2008). Positive relations with activity monitor data for total physical activity have been reported at 0.55 and vigorous activity at 0.72. The Spearman rho correlation coefficient for moderate activity has been reported between 0.19 (Boon, 2008) and 0.21 (Hagstromer, Oja, & Sjostrom, 2005). It is recommended that objective measures of physical activity be used, such as accelerometers, direct observation or heart-rate monitors, when possible. However, objective measures may not always be feasible such as was the case in the MoNNET-HA Study where data were collected from a large sample.

**Conclusion**

This study revealed that there was a significant association between network capital diversity, social participation and physical inactivity among Montreal adults. The significance of network diversity suggests that there are important components of social capital that are not
captured with conventional measures. This study recommends that future investigations of social capital use a network approach to assess hierarchical resource access within social network structures. Further understanding of how social capital is associated with physical inactivity can be used to better inform physical activity programs and address inequalities in access to resources.
Table 1: Characteristics of Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA) (n=2672), 2008

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-34</td>
<td>396</td>
<td>14.63</td>
</tr>
<tr>
<td>35-44</td>
<td>476</td>
<td>17.58</td>
</tr>
<tr>
<td>45-54</td>
<td>545</td>
<td>20.13</td>
</tr>
<tr>
<td>55-64</td>
<td>441</td>
<td>16.29</td>
</tr>
<tr>
<td>65-74</td>
<td>565</td>
<td>20.87</td>
</tr>
<tr>
<td>75+</td>
<td>284</td>
<td>10.49</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>957</td>
<td>35.35</td>
</tr>
<tr>
<td>Female</td>
<td>1750</td>
<td>64.65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health Status</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>556</td>
<td>20.57</td>
</tr>
<tr>
<td>Very Good</td>
<td>925</td>
<td>34.22</td>
</tr>
<tr>
<td>Good</td>
<td>844</td>
<td>31.22</td>
</tr>
<tr>
<td>Fair</td>
<td>288</td>
<td>10.65</td>
</tr>
<tr>
<td>Poor</td>
<td>90</td>
<td>3.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education (Missing n=21)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No degree</td>
<td>320</td>
<td>11.91</td>
</tr>
<tr>
<td>High school/Trade</td>
<td>784</td>
<td>29.19</td>
</tr>
<tr>
<td>College</td>
<td>556</td>
<td>20.70</td>
</tr>
<tr>
<td>University</td>
<td>1026</td>
<td>38.20</td>
</tr>
</tbody>
</table>

<p>| Household Income |</p>
<table>
<thead>
<tr>
<th>Income Level</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;28,000</td>
<td>483</td>
<td>22.35</td>
</tr>
<tr>
<td>28,000-49,000</td>
<td>597</td>
<td>27.63</td>
</tr>
<tr>
<td>50,000-74,000</td>
<td>508</td>
<td>23.51</td>
</tr>
<tr>
<td>75,000-100,000</td>
<td>271</td>
<td>12.54</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>302</td>
<td>13.98</td>
</tr>
</tbody>
</table>

Generalized Trust

(Missing n=20)

<table>
<thead>
<tr>
<th>Option</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most can be trusted</td>
<td>122</td>
<td>4.54</td>
</tr>
<tr>
<td>Can’t be too careful</td>
<td>166</td>
<td>6.18</td>
</tr>
<tr>
<td>Depends</td>
<td>1257</td>
<td>46.78</td>
</tr>
<tr>
<td>Most CANNOT be trusted</td>
<td>1142</td>
<td>42.50</td>
</tr>
</tbody>
</table>

Participation

<table>
<thead>
<tr>
<th>Option</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1718</td>
<td>63.47</td>
</tr>
<tr>
<td>Yes to one question</td>
<td>698</td>
<td>25.79</td>
</tr>
<tr>
<td>Yes to both questions</td>
<td>291</td>
<td>10.75</td>
</tr>
</tbody>
</table>

Physical Inactivity

(Missing n=11)

<table>
<thead>
<tr>
<th>Option</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>461</td>
<td>17.10</td>
</tr>
<tr>
<td>Active</td>
<td>2235</td>
<td>82.90</td>
</tr>
</tbody>
</table>
Table 2: Characteristics of social network capital (n=2672), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity</td>
<td>10</td>
<td>4.28</td>
<td>2.36</td>
</tr>
<tr>
<td>Reach</td>
<td>93</td>
<td>78.72</td>
<td>24.05</td>
</tr>
<tr>
<td>Range</td>
<td>59</td>
<td>37.12</td>
<td>20.69</td>
</tr>
</tbody>
</table>
Table 3: Unadjusted (Bivariate) Odds ratio and 95% confidence intervals of physical inactivity (n=2672), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age Group</strong></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>1.00</td>
</tr>
<tr>
<td>35-44</td>
<td>1.29 (0.84, 1.99)</td>
</tr>
<tr>
<td>45-54</td>
<td>1.50 (0.99, 2.26)</td>
</tr>
<tr>
<td>55-64</td>
<td>1.67 (1.10, 2.55)</td>
</tr>
<tr>
<td>65-74</td>
<td>2.73 (1.85, 4.01)</td>
</tr>
<tr>
<td>75+</td>
<td>4.19 (2.76, 6.36)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.66 (0.53, 0.83)</td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Health Status</strong></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>0.133 (0.07, 0.22)</td>
</tr>
<tr>
<td>Very Good</td>
<td>0.21 (0.13, 0.33)</td>
</tr>
<tr>
<td>Good</td>
<td>0.39 (0.24, 0.61)</td>
</tr>
<tr>
<td>Fair</td>
<td>0.54 (0.33, 0.89)</td>
</tr>
<tr>
<td>Poor</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td>(Missing n=21)</td>
<td></td>
</tr>
<tr>
<td>No degree</td>
<td>1.00</td>
</tr>
<tr>
<td>High school/Trade</td>
<td>0.44 (0.33, 0.60)</td>
</tr>
<tr>
<td>College</td>
<td>0.39 (0.28, 0.54)</td>
</tr>
<tr>
<td>University</td>
<td>0.26 (0.19, 0.35)</td>
</tr>
<tr>
<td><strong>Household Income</strong></td>
<td></td>
</tr>
<tr>
<td>Income Range</td>
<td>Generalized Trust</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------</td>
</tr>
<tr>
<td>&lt;28,000</td>
<td>1.00</td>
</tr>
<tr>
<td>28,000-49,000</td>
<td>0.57 (0.44, 0.74)</td>
</tr>
<tr>
<td>50,000-74,000</td>
<td>0.43 (0.32, 0.57)</td>
</tr>
<tr>
<td>75,000-100,000</td>
<td>0.30 (0.20, 0.45)</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>0.28 (0.18, 0.43)</td>
</tr>
<tr>
<td>High Trust</td>
<td>1.00</td>
</tr>
<tr>
<td>Low Trust</td>
<td>0.98 (0.60, 1.61)</td>
</tr>
</tbody>
</table>

Generalized Trust
(Missing n=20)

Participation

None
Low
High

Diversity

Reach

Range
Table 4: Adjusted Odds ratios and 95% confidence intervals of physical inactivity (n_i=2672; n_c=300), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>0.37 (0.24, 0.59)</td>
<td>0.35 (0.22, 0.56)</td>
<td>0.37 (0.23, 0.58)</td>
<td>0.36 (0.23, 0.58)</td>
</tr>
<tr>
<td>35-44</td>
<td>0.51 (0.34, 0.77)</td>
<td>0.50 (0.33, 0.75)</td>
<td>0.53 (0.34, 0.79)</td>
<td>0.52 (0.34, 0.79)</td>
</tr>
<tr>
<td>45-54</td>
<td>0.53 (0.36, 0.79)</td>
<td>0.52 (0.35, 0.77)</td>
<td>0.54 (0.37, 0.81)</td>
<td>0.55 (0.37, 0.82)</td>
</tr>
<tr>
<td>55-64</td>
<td>0.55 (0.37, 0.81)</td>
<td>0.53 (0.35, 0.78)</td>
<td>0.56 (0.38, 0.84)</td>
<td>0.57 (0.38, 0.85)</td>
</tr>
<tr>
<td>65-74</td>
<td>0.78 (0.56, 1.10)</td>
<td>0.78 (0.55, 1.10)</td>
<td>0.80 (0.56, 1.13)</td>
<td>0.81 (0.57, 1.14)</td>
</tr>
<tr>
<td>75+</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.73 (0.58, 0.92)</td>
<td>0.73 (0.58, 0.92)</td>
<td>0.73 (0.58, 0.93)</td>
<td>0.72 (0.57, 0.91)</td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Health Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>0.19 (0.11, 0.33)</td>
<td>0.18 (0.10, 0.32)</td>
<td>0.18 (0.10, 0.32)</td>
<td>0.19 (0.11, 0.33)</td>
</tr>
<tr>
<td>Very Good</td>
<td>0.30 (0.18, 0.50)</td>
<td>0.29 (0.17, 0.48)</td>
<td>0.29 (0.17, 0.49)</td>
<td>0.31 (0.18, 0.51)</td>
</tr>
<tr>
<td>Good</td>
<td>0.50 (0.31, 0.82)</td>
<td>0.48 (0.29, 0.78)</td>
<td>0.47 (0.28, 0.77)</td>
<td>0.50 (0.30, 0.81)</td>
</tr>
<tr>
<td>Fair</td>
<td>0.56 (0.33, 0.95)</td>
<td>0.55 (0.32, 0.93)</td>
<td>0.54 (0.31, 0.92)</td>
<td>0.56 (0.33, 0.95)</td>
</tr>
<tr>
<td>Poor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No degree</td>
<td>1.82 (1.28, 2.61)</td>
<td>1.71 (1.18, 2.46)</td>
<td>1.51 (1.04, 2.20)</td>
<td>1.48 (1.02, 2.14)</td>
</tr>
<tr>
<td>High</td>
<td>1.15 (0.86, 1.55)</td>
<td>1.10 (0.81, 1.48)</td>
<td>1.02 (0.75, 1.38)</td>
<td>1.00 (0.74, 1.36)</td>
</tr>
<tr>
<td>College</td>
<td>1.41 (1.03, 1.93)</td>
<td>1.34 (0.98, 1.84)</td>
<td>1.29 (0.94, 1.77)</td>
<td>1.30 (0.95, 1.78)</td>
</tr>
<tr>
<td>University</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Household Income</td>
<td>Generalized Trust</td>
<td>Participation</td>
<td>Diversity</td>
<td>Reach</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
<td>---------------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;$28,000</td>
<td>1.44 (0.89, 2.33)</td>
<td>1.35 (0.83, 2.18)</td>
<td>1.20 (0.73, 1.95)</td>
<td>1.24 (0.77, 2.02)</td>
</tr>
<tr>
<td>28,000 - 49,000</td>
<td>1.17 (0.74, 1.84)</td>
<td>1.12 (0.83, 1.77)</td>
<td>1.06 (0.67, 1.68)</td>
<td>1.08 (0.68, 1.70)</td>
</tr>
<tr>
<td>$&lt;$50,000</td>
<td>1.08 (0.68, 1.70)</td>
<td>1.05 (0.66, 1.65)</td>
<td>1.02 (0.65, 1.62)</td>
<td>1.03 (0.65, 1.62)</td>
</tr>
<tr>
<td>50,000 - 74,000</td>
<td>0.89 (0.53, 1.51)</td>
<td>0.88 (0.52, 1.49)</td>
<td>0.86 (0.50, 1.45)</td>
<td>0.86 (0.50, 1.45)</td>
</tr>
<tr>
<td>$&lt;$75,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75,000 - 100,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&gt;$100,000</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Trust</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Trust</td>
<td>1.44 (0.85, 2.42)</td>
<td>1.40 (0.83, 2.35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2.01 (1.29, 3.12)</td>
<td>1.74 (1.15, 2.73)</td>
<td>1.65 (1.07, 2.55)</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.58 (0.98, 2.53)</td>
<td>1.50 (0.93, 2.42)</td>
<td>1.41 (0.89, 2.24)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Diversity</td>
<td>0.87 (0.80, 0.95)</td>
<td>0.91 (0.86, 0.95)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reach</td>
<td>0.99 (0.99, 1.00)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>1.01 (1.00, 1.02)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
References


Chapter 4
Physical inactivity and Montreal neighbourhood environments

Introduction

Research on the determinants of physical inactivity has shown a consistent association with individual-level measures such as age, gender, individual income, race/ethnicity, and health status. With the prevalence of physical inactivity and associated chronic health conditions in the Canadian population growing at an alarming rate, there is a need to examine how neighbourhood social and physical environments are associated with physical inactivity. The neighbourhood context has been linked to a variety of health conditions such as infectious disease, infant mortality and low birth rates, body mass index (BMI), and self-rated health and health behaviours such as, cigarette smoking and alcohol consumption (Kawachi & Berkman, 2003). Neighbourhood measures of area deprivation and poverty have been linked to individual risks of cigarette smoking, higher BMI, depressive symptoms, lower quality diet, poorer self-rated health, and partner violence (Kawachi & Berkman, 2003). Recently, researchers have been investigating how these neighbourhood factors are associated with physical activity. The evidence suggests that neighbourhood factors, such as the physical and social environments are contributing to disparities in physical activity.

Research on the importance of neighbourhood environments for physical activity has broadly focused on the effects of 1) access to amenities, such as sports facilities or leisure-centres; 2) physical or built environmental features, such as green spaces, pavements and cycle paths, and degree of urbanization; 3) reputation of the neighbourhood, such as feelings of safety, social nuisance, and crime figures; 4) aesthetics, attractiveness of the neighbourhood, and; 5) the social organization of the local community (Macintyre, Ellaway, & Cummins, 2002; Poortinga, 2003).
It has been shown that individuals in resource deficient social and physical environments are at increased risk for elevated body weight and engaging in unhealthful behaviours, including physical inactivity (Veenstra et al., 2005).

Most activities occur within communities, families and neighbourhoods, thus individuals’ own physical activity can be enhanced or reduced by the social environment (Li, et al., 2005). McNeill, Kreuter and Subramanian (2006) suggest five social environmental dimensions and related mechanisms that influence physical activity behaviour including: social support and social networks; socioeconomic position and income inequality; racial discrimination; neighbourhood factors; and social cohesion and social capital. The social environment is suggested to influence physical activity through several mechanisms that include: 1) the availability and accessibility of health services; 2) infrastructure deprivation; 3) prevalence of attitudes towards health and health behaviours; 4) stress and availability of social support; and 5) exposure to harmful physical environments (Macintyre, et al., 2002). Evidence of an association between neighbourhoods and physical inactivity is increasing, yet identification of the specific mechanisms by which neighbourhoods influence physical inactivity is not well defined in these studies.

Studies of the neighbourhood social environment have shown significant associations with physical activity. Studies have used a variety of measures of physical activity and neighbourhood factors. Physical activity outcomes have included: walking, leisure-time physical activity, mean physical activity, vigorous and moderate intensity physical activity, and exercise. Giles-Corti and Donovan (2003) identified three social environmental variables that predicted walking. The likelihood of meeting recommended levels of walking increased with the number of significant others who exercised with the respondent, ownership of a dog, living in the top quartile of access to public open space, living on a street with trees and little traffic, and having access to sidewalks and shops. Fisher, Li, Michael and Cleveland (2004) found that social
cohesion aggregated to the neighbourhood level was significantly associated with increased neighbourhood walking in older adults. Neighbourhood measures of social cohesion, senior population density, average facilities per neighbourhood, and proportion of low-income households were also significantly associated with neighbourhood walking activity (Fisher, Li, Michael, & Cleveland, 2004). Ross (2000) found that individuals living in a higher average education neighbourhood (% of residents with college degree), or living in a below poverty line neighbourhood were more likely to walk. Neighbourhood trust and norms of reciprocity also had a positive association, increasing the likelihood individual physical activity (Wen, Browning, & Cagney, 2007).

Neighbourhood measures of socioeconomic status are often used as a proxy for the social environment. Neighbourhoods with higher socioeconomic status are more likely to have better access to social resources, promote healthy behaviours, and reduce harmful physical environmental factors. Studies investigating neighbourhood socioeconomic status have generally found that individuals living in the most disadvantaged areas are more likely to be inactive compared to those living in the most advantaged areas. This association has been shown across studies in the Netherlands, Australia, and the United States. A study of adults in the Netherlands on the influence of neighbourhood socioeconomic status and physical inactivity showed that individuals living in the most socioeconomically disadvantaged neighbourhoods compared to the most advantaged neighbourhoods had increased odds of almost never walking, cycling, or gardening in leisure-time (van Lenthe, Burg, & Mackenbach, 2005). Kavanagh et al. (2005) showed that area-level socioeconomic status was associated with overall physical activity in a sample of Melbourne adults. Yen and Kaplan (1998) also reported that between 1965 and 1973, greater declines in mean physical activity scores were seen for those with decreased income and living in poverty areas (Yen & Kaplan, 1998). Wen, Browning and Cagney (2007) showed that
neighbourhood socioeconomic status had a greater effect on physical activity than individual annual household income.

Along with the social environment the built environment is an important part of the neighbourhood context is significantly associated with physical activity. It is important to recognize that the built environment includes not only green spaces and parks but also captures the presence and conditions of sidewalks, traffic flow, cleanliness and maintenance of public spaces, perceptions of safety and community security, zoning and mixed-land use, and population density (Giles-Corti & Donovan, 2002; Humpel, Owen, & Leslie, 2002; Renalds, Smith, & Hale, 2010). The built environment is a modifiable determinant of physical inactivity that can have a considerable health promoting or damaging effect. Studies have shown that the built environment can diminish or enhance physical activity participation. A recent review revealed four major health outcomes, physical activity, obesity and overweight, social capital and mental health, that were influenced by the built environment (Renalds et al., 2010). Walkability, the presence and condition of sidewalks, mobility factors, architectural factors, and land use mix were identified as having significant impacts of physical activity. Adults living in socially-disadvantaged areas characterized by general poor physical design and high noise pollution from traffic increased the probability of almost never engaging in leisure-time activity. Poor proximity to facilities was also a significant determinant of decreased leisure time activity (van Lenthe et al., 2005). Having a supportive built environment that promotes physical activity has positively influenced physical activity among individuals of various ages and ethnic/cultural backgrounds. An earlier review of the environmental factors associated with physical activity reported that there were consistent findings of the association of physical activity with access to facilities and opportunities for physical activity (Humpel et al., 2002). By addressing such structural aspects of the
neighbourhood, such as improving access to facilities and reducing barriers, more people are able to benefit from this change and greater improvement in population health may occur.

Neighbourhood population density is also an important determinant of physical activity. Neighbourhood population density has a direct association with utilitarian physical activity (i.e. walking for transport), although it is often used as a proxy for other area variables (Forsyth, Oakes, Schmitz & Hearst, 2007). Density may have an impact on physical activity as different neighbourhood contexts may offer different incentives or barriers to physical activity. For instance, denser areas frequently offer a variety of amenities and facilities within walking distance whereas these amenities may not be easily accessible in less dense areas (Committee on Physical Activity, Health, Transportation, and Land Use, 2005). Density has been used as a proxy for such area-level dimensions as income, mixed land use, architecture and walkable streets, and transit use (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003; Committee on Physical Activity, Health, Transportation, and Land Use, 2005; Frank, Schmich, Sallis, Chapman, & Saelens, 2005). While it is thought that utilitarian physical activity can increase overall physical activity, little research has focused on the investigation of the direct effects of density on physical activity. Forsyth et al. (2007) examined how residential density influenced walking and physical activity. This study used several density measures, which were measured at a number of geographical scales. Higher density areas were significantly more likely to increase travel walking. Ewing Schmid, Killingsworth, Zlot, and Raudenbush (2003) examined the relationship between urban sprawl and physical activity using a sprawl index of six area variables including population density. The study showed a significant correlation between net residential density and minutes of moderate physical activity per day. The sprawl index was significantly associated with minutes walking at both the county and metropolitan levels. The likelihood of walking decreased as the sprawl index increased. Greiner, Li, Kawachi, and Hunt (2004) also showed that there were
significant differences in physical activity between high and low-density areas. In higher density areas residents were more likely to report more physical activity and better health status.

Social capital has a significant association with physical activity behaviours as well. Individuals with higher levels of social participation are less likely to be physically inactive compared to those with low social participation (McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006). Within neighbourhood health research, the differential vulnerability thesis suggests that neighbourhood environmental characteristics can have a stronger impact on the health of certain groups compared to others (Glass & Balfour, 2003). For example, Moore et al. (2010) found that older adults were more likely to use a nearby park if they lived in neighbourhoods with a higher proportion of adults older than 65 years compared to older adults who lived in neighbourhoods with a lower proportion. Yet, given the importance of individual social capital, on the one hand, and residing in a socially advantaged area, on the other, for physical activity, there is reason to examine whether neighbourhood environmental characteristics moderate the association between individual social capital and physical inactivity.

There is increasing interest and evidence supporting the importance of neighbourhoods for physical activity. The purposes of this study are, firstly, to examine the association of a neighbourhood socioeconomic status and population density with physical inactivity with adjustment for individual socio-demographic and –economic factors and, secondly, to assess whether neighbourhood socioeconomic status moderates the association of social capital with physical inactivity. With regard to the first purpose, it is hypothesized that people who live in neighbourhoods with either higher average socioeconomic status or population density will less likely be physically inactive compared to those persons who live in neighbourhoods with lower socioeconomic status or population density. With regard to the second purpose, it is hypothesized that neighbourhood socioeconomic status will moderate the association between social capital
and physical inactivity so that individuals with higher social capital and who reside in socially-advantaged areas are less likely physically inactive than individuals with higher social capital and who reside in less advantaged areas.

Method

Sample

Data came from the 2008 Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA). The MoNNET-HA study used a two-stage cluster sampling design. In stage one, using 2001 Canada Census data, Montreal Metropolitan Area (MMA) census tracts (N=862) were stratified into low, medium, and high-income tertiles. For each tertile, one hundred census tracts were selected (n=300). In stage two of the sampling design, potential respondents in each census tract were stratified into three age groups, 25 to 44 years, 45-64 years, and 65 years and older. Within each age group and census tract three respondents were randomly selected for a total of nine respondents per tract. In seven tracts, four participants were selected for a total sample size of 2,707. To be eligible for the study, participants had to be (1) non-institutionalized, (2) reside at their current address for at least a year, and (3) be able to complete the questionnaire in either French or English. Random digit dialing of listed telephone numbers was used to select households for participation. The questionnaire was administered using a computer-assisted telephone interviewing system. The telephone questionnaire was completed between mid-June and early August 2008.

Measures

Main outcome. The main outcome of interest for this study was physical inactivity. Physical activity was assessed using an adapted version of the International Physical Activity Questionnaire (IPAQ). To assess physical (in)activity, participants were asked about the time they
had spent being physically active in the last seven days. For vigorous, moderate, and walking activities participants were asked how many days in the past seven, they did this type of activity, and how much time was spent doing this activity on those days? Activities had to be conducted for at least 10 minutes at a time. Vigorous activities were defined as activities that take hard physical effort, such as heavy lifting, digging, aerobics, or fast bicycling. Moderate activities were activities that make breathing somewhat harder than normal, such as carrying light loads, bicycling at a regular pace, or doubles tennis. Walking activities included walking at work or home, walking to travel from place to place, and any other walking done solely for recreation, sport, exercise, or leisure.

Responses were recorded as days per week, hours per day, minutes per day, don’t know, and refused to answer. Using the IPAQ guideline for data processing and analysis responses were classified as high, moderate or low physical activity (IPAQ Research Committee, 2005). High physical activity was considered as at least three days of vigorous activity on at least three days accumulating at least 1500 MET-min/week, or seven or more days of any combination of walking, moderate or vigorous activity achieving a minimum of at least 3000 MET-min/week. To be moderately active, one of three criteria had to be met; three or more days of vigorous activity of at least 20 minutes per day, five or more days of moderate activity or walking of at least 30 minutes per day, or five or more days of any combination of walking, moderate, or vigorous activities achieving a minimum of at least 600 MET-min/week. Individuals were classified as being physically inactive if they did not meet the criteria for moderate or high physical activity. To calculate physical activity levels the guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) was used (IPAQ Research Committee, 2005). MET-values for each form of activity, walking, moderate-intensity, vigorous-intensity activity, were calculated. The MET values used in the analysis of IPAQ data are: walking= 3.3
MET, moderate physical activity = 4.0 MET and vigorous physical activity = 8.0 MET. Continuous scores for each form of activity and total physical activity were calculated as:

- Walking MET minutes/week = 3.3 * walking minutes * walking days
- Moderate MET minutes/week = 4.0 * moderate minutes * moderate days
- Vigorous MET minutes/week = 8.0 * vigorous minutes * vigorous days

Total Physical Activity MET minutes/week = sum of walking + moderate + vigorous MET minutes/week scores (IPAQ Research Committee, 2005).

For this analysis, a dichotomous variable representing physical inactivity was used (inactive = 1, moderately and high activity = 0).

**Individual exposure variables.** Based on the individual-level findings, social participation and network diversity were used in this study.

*Social participation.* Social participation was measured with a two-part question, first, “During the past five years, have you been active in a neighbourhood group or association as a volunteer or an officer?” And part two, “during the past five years, have you been active in any other voluntary associations as a volunteer or an officer?” Responses for both parts were recorded as “yes”, “no”, “don’t know”, or “no response”. Three categories of social participation were analysed: no social participation, low participation in either a neighbourhood or other voluntary association or group, and high participation is both a neighbourhood and other voluntary association or group.

*Network Capital.* A position generator was used to assess network capital. Participants were asked to indicate whether they know someone on a first name basis who holds a certain occupation in society. Ten occupations were selected from a listing of 90 that had been ranked according to gender-neutral job prestige scores within Canada (Goyder, Guppy, & Thompson, 2003). The list was divided into octiles, ranging in low and high prestige scores. One occupation
from each octile was randomly selected, with two addition occupations. Selected occupations were randomly listed in the position generator (Highschool teacher, carpenter, musician/artist, taxi driver, physician, janitor, registered nurse, welder, accountant, and receptionist). Lin (2001) argues that the position generator captures three dimensions of social capital: (1) reachability, (2) diversity, and (3) range.

Reachability represents the upper most resource a person can reach through their social ties. Diversity is the number of different occupations accessed, and reflects network size. Range is the difference between highest and lowest prestige job accessed, and reflects the different types of resources a person might access. Reachability, diversity, and range were each considered separately rather than as a single measure. Diversity scores were calculated as the total number of different occupations accessed by an individual. The reach score was calculated as the highest prestige score accessed by an individual. The highest reach score was 93 and the lowest was 55, not including 0. Range scores were calculated as the difference between the highest and lowest prestige score accessed by an individual. The greatest range was 59 and lowest was 25, not including 0.

**Socio-demographic and economic Covariates.** Gender, household income category, educational attainment, age category, and health status were considered in this analysis. Inclusion of these factors was based on previous research and the specific characteristics of the MoNNET-HA sample, which over represented women, older adults, and individuals with higher educational attainment (Moore et al., 2011).

*Gender.* Participants self-identified as male or female.

*Age.* Age was stratified into 6 categories 25-34, 35-44, 45-54, 55-64, 65-74, and 75 or older.
Education. Education was categorized as highest level of education completed. Respondents could choose one of seven levels of education completed: No degree; certificate, or diploma; secondary (high) school diploma or equivalent; trades certificate or diploma; College certificate or diploma below Bachelor’s degree level; University certificate or diploma at Bachelor’s level; Master’s degree; earned Doctorate degree; or no response.

Individual household income was assessed by asking respondents to identify one of five total household income categories: less that $28,000; $28,000 - $49,000; $50,000 - $74,000; $75,000 - $100,000; and above $100,000.

Health status was based on respondent’s self-reported classification of their as being excellent, very good, good, fair, or poor.

Neighbourhood factors. Neighbourhood socioeconomic status was operationalized using 2006 Canada census data of the percentage of persons with a college degree or higher within each census tract. Neighbourhood population density is the number of persons per square kilometer. It is calculated by dividing the total population by land area (Statistics Canada, 2010). This measure was log transformed in the analyses to account for its skewed distribution.

Statistical Analysis Procedures

The MoNNET-HA response rate was 38.7%, calculated in accordance with the American Association for Public Opinion Research standard definition (AAPOR, 2008). The representativeness of the MoNNET-HA sample was assessed using chi-square analyses compared to 2006 MMA Canada Census data. The sample over-represented (1) older adults (sampling design), (2) individuals with income less than $50,000, (3) persons who lived in their place of residence more than 5 years, (4) females, and (5) those with more than high school education (Moore et al., 2011). Observations were excluded if information was missing on study variables.
Multilevel logistic regression analysis was used to assess the associations among physical inactivity, neighbourhood socioeconomic status, population density, social participation, and network capital. Multilevel analyses were used to account for the clustered data structure (i.e., individuals nested within census tracts). Multilevel analyses were performed using SAS 9.2 glimmix procedure. For this analysis random intercepts of area-level variance were assumed. Bivariate models were fitted initially to examine area-level variables, neighbourhood socioeconomic status, and population density, with physical inactivity. These models were then adjusted for individual socio-demographics. Following this initial examination, multilevel models were fitted to examine individual social participation and network diversity. Finally, interaction terms were created between census tract education and social network capital variables. Interclass correlation was calculated for the empty (null) model. The Interclass correlation coefficient was calculated as neighbourhood variance in physical inactivity/(neighbourhood variance + $\pi^2$). Odds ratios and 95% confidence intervals were estimated and reported.

Results

For these analyses, the final sample size was 2672 after excluding observations for missing study variables. Table 1 provides information on the socio-demographic characteristics of the MoNNET-HA sample. Characteristics of neighbourhood factors are presented in Table 2. Table 3 provides the unadjusted, bivariate odds ratio of physical inactivity. Table 4 provides the adjusted odds ratios of physical inactivity for the multilevel logistic regression models.

In general, the results suggest that there is a significant association between neighbourhood-level factors and physical inactivity. The ICC for the null model was 0.01 suggesting low levels of clustering of physical inactivity within Montreal neighbourhoods. Census tract variables, education, and population density were examined to determine if there
was a neighbourhood association of these factors with physical inactivity. This investigation revealed that census tract education significantly reduced the odds of physical inactivity (OR: 0.23; 95% C.I: 0.09, 0.54); however, once individual socio-demographic characteristics were included in the model, census tract education was no longer significant. The opposite effect was found for census tract density. Before adjustment for compositional differences between neighbourhoods, census tract density was not significantly associated with physical inactivity. After adjustment for individual and other neighbourhood factors, the log-transformed neighbourhood population density reduced the odds of physical inactivity by 3% (OR: 0.97; 95% C.I: 0.95, 0.99). Residents of densely populated neighbourhoods were less likely to be physically inactive. To determine which individual factors contributed to the significance of neighbourhood population density, ancillary analyses introduced the socio-demographic and economic factors separately into models. This investigation revealed that adjustment at the individual level for respondents’ health status and household income contributed to the significance of population density as an environmental factor.

The multilevel logistic models revealed that census tract density reduced the odds of physical inactivity among residents. The odds of physical inactivity with higher social participation and greater network diversity were slightly attenuated compared to the model without neighbourhood variables yet remained significant (p-value <0.05). There was only slight variation between the five multilevel models. The first model which included only census tract variables controlling for individual demographics and no network capital variables, showed that individuals living in a denser neighbourhood were less likely to be physically inactive than those living in a less dense area (OR: 0.97 95% C.I: 0.95, 0.99). Census tract education was not significant; however, higher individual education reduced the odds of physical inactivity by 12% (OR: 0.88; 95% C.I: 0.79, 0.99).
Model 3 investigated how individual social network variables, participation and network diversity, modified the relationship between physical inactivity and neighbourhood factors. Living in a census tract with greater population density reduced the odds of physical inactivity by 4% (OR: 0.96; 95% C.I: 0.95, 0.99). Network diversity reduced the odds of physical inactivity by 10%, suggesting that individual who had greater network diversity (i.e. accessed a greater number of occupations) had reduces odds of reporting physical inactivity compared to those with less network diversity (OR: 0.90; 95% CI: 0.85, 0.95).

Analyses assessing whether neighbourhood socio-economic status moderated the association of social capital or social participation with physical inactivity showed that there was no cross-level interaction.

Discussion

The findings of this study suggest that neighbourhood population density has a significant association with physical inactivity in Montreal. This supports the inclusion and further investigation of neighbourhood contextual factors that contribute to physical inactivity. However, the association between neighbourhood variables and physical inactivity varied across models. Regardless of the neighbourhood in which individuals live, social network diversity and participation significantly reduced the odds of physical inactivity. The findings of this study are consistent with other studies that have examined the effect of neighbourhood factors on physical activity and show the importance of environmental influences on physical inactivity.

The current study examined census tract population density as a neighbourhood-level measure of the social and physical environment. Across the MMA, areas with greater population density tend to be on the Montreal Island. In the general literature, denser areas are thought to have better access to parks, green space and recreational facilities; denser areas have greater
mixed land use that contributes to decreased odds of physical inactivity through access to resources (Frank et al., 2005; Forsyth et al., 2007; Xu et al., 2009). Denser areas may also contain more individuals who are physically active. Using objective and self-reported measures of density and physical activity, Forsyth et al. (2007) compared physical activity between low- and high-density areas. The study found that there were statistically significant differences between density areas for transport walking and leisure walking. Higher density areas had a higher mean for transport walking, while low-density areas had a significantly higher mean for leisure walking.

Other neighbourhood measures that have been examined include, proportion of low-income households, availability and accessibility of facilities for physical activity, percentage of residents with a college degree, density of senior residents, physical design of neighbourhood and mixed-land use (King, Castro, Wilcox, Eyler, Sallis, & Brownson, 2000; Pickett & Pearl, 2001; Humpel et al., 2002; Giles-Corti & Donovan, 2003; Fisher et al., 2004; McNeill et al., 2006; Wen et al., 2007; Ross, 2000; Cerin & Leslie, 2008). Significant associations between the built environment (perceived and objectively measured) have been consistent in showing that a positive physical environment, one that includes sidewalks, access to recreational facilities/services, and green space, have adequate lighting, enjoyable scenery, and mixed land use, increases the likelihood of a variety of physical activity behaviours such as, walking, physical activity for transport, and leisure-time activity (Renalds et al., 2010).

This study also showed a significant association between social participation, network diversity and physical inactivity. While the use of network capital measures in health research is limited the significant association that was found in this study suggests that using formal network capital measures should be used to further investigate how network ties contribute to physical inactivity. The formal measure of social network capital allows for the investigation of network ties and access to resources, which measures of trust and participation do not capture. This could
lead to a better understanding and knowledge of how networks are associated with physical inactivity. The significant association between social participation and physical activity may suggest that increased social participation may contribute to the development or expansion of social networks. This in turn could lead to increases in physical activity participation by network members. Engagement in social organizations has the potential to expose participants to a greater range and diversity of individuals that increases heterogeneity of social networks. Heterogeneity increases ideas, opportunities, richness of relationships, and works to increase social capital. Homogeneous networks may reduce economic and information opportunities, overburden individuals in terms of demands within the network, and limit access to resources and social support (Dominguez & Arford, 2010). In a community where healthy norms exist, social capital might serve to reinforce physical activity and health behaviours. More studies are needed to further develop the strength of network capital measures and its association with physical inactivity.

This study suggests that neighbourhood socioeconomic status does not moderate the association between social capital and physical inactivity. Finding do not suggest that individuals with higher social capital and who reside in socially-advantaged areas are less likely to be physically inactive than individuals with higher social capital and who reside in less advantaged areas. Although social capital is important on its own, there does not appear to be a significant moderating association with neighbourhood socio-economic status. Whereas other studies have found neighbourhood to moderate the association, in this study neighbourhood does not alter the association between social capital and physical inactivity.
Limitations

There are a few limitations to this study. First, the survey design is cross-sectional which only allows for the examination of the types of resources available at one point in time. The cross-sectional survey used is unable to capture changes in individual and neighbourhood factors that are likely to occur. A longitudinal study would allow for the investigation and monitoring of how these factors change over time and would help to determine the cause and effect relationship between social network capital, neighbourhood factors (contextual factors), and physical inactivity. It is possible that social capital and neighbourhood factors have an upstream role that contribute to the development of neighbourhoods to either encourage or deter physical inactivity. However, this cross-sectional study does not allow for the investigation of how neighbourhoods and social capital changes over time and the impact these changes may have on the association with physical inactivity. Second, the use of census variables as proxy indicators of the neighbourhood built and social environment limits the identification of the specific mechanisms linking neighbourhoods to physical inactivity. Third, census tracts do not necessarily reflect peoples’ conception or sense of neighbourhood boundaries. Use of census tracts as neighbourhoods is driven by convenience rather than theory (Diez-Roux, 2001. The development of precise definitions and measurement of neighbourhood factors would likely lead to a more careful identification and definition of theorized causal pathways of neighbourhood effects on health and health behaviours (Pickett & Pearl, 2001).

Another limitation that should be recognized is the use of self-reported physical activity data. While it is recognized that self-report measures have the ability to collect data from a large sample with relatively low cost and can be used in a range of population, there are a number of associated limitations. Self-reported physical activity measures can introduce social desirability bias, and recall bias, which can lead to over-estimation of physical activity. There is evidence to
suggest that adults tend to overestimate physical activity levels (Sallis & Saelens, 2000). Self-reported physical activity measures such as the IPAQ used in this study need be tested for reliability and validity to ensure physical activity is properly assessed. It should be noted that the IPAQ has been tested for validity and reliability across developed and developing countries (Craig et al., 2003). It has shown modest correlation coefficients for reliability scores across 12 countries in which 75% of correlation coefficients were above 0.65 and moderate agreement with accelerometer data with a pooled correlation of 0.30 (Craig et al., 2003). Brown et al. (2004) showed that the IPAQ repeatability has a 79.4% agreement for the proportion of participants classified as “active, insufficiently active, or sedentary” on two occasions, 24 hours apart. The IPAQ when compared against accelerometer data has shown stronger correlations with total physical activity and vigorous activity, with weaker association found for moderated activity (Boon, 2008). Positive relations with activity monitor data for total physical activity have been reported at 0.55 and vigorous activity at 0.72. The Spearman rho correlation coefficient for moderate activity has been reported between 0.19 (Boon, 2008) and 0.21 (Hagstromer, Oja, & Sjostrom, 2005). It is recommended that objective measures of physical activity be used, such as accelerometers, direct observation or heart-rate monitors, when possible. However, objective measures may not always be feasible such as was the case in the MoNNET-HA Study where data was collected from a large sample.

Conclusion

In conclusion, future studies of neighbourhoods and physical activity should look to identify the specific neighbourhood mechanisms that are linked with physical inactivity. Identifying how neighbourhoods promote or deter physical activity can lead to improvements in
the social and built environments, and by extension lead to greater physical activity levels and improvements in overall population health.
Table 5: Characteristics of Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA) (n=2672), 2008.

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age Group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>396</td>
<td>14.63</td>
</tr>
<tr>
<td>35-44</td>
<td>476</td>
<td>17.58</td>
</tr>
<tr>
<td>45-54</td>
<td>545</td>
<td>20.13</td>
</tr>
<tr>
<td>55-64</td>
<td>441</td>
<td>16.29</td>
</tr>
<tr>
<td>65-74</td>
<td>565</td>
<td>20.87</td>
</tr>
<tr>
<td>75+</td>
<td>284</td>
<td>10.49</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>957</td>
<td>35.35</td>
</tr>
<tr>
<td>Female</td>
<td>1750</td>
<td>64.65</td>
</tr>
<tr>
<td><strong>Health Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>556</td>
<td>20.57</td>
</tr>
<tr>
<td>Very Good</td>
<td>925</td>
<td>34.22</td>
</tr>
<tr>
<td>Good</td>
<td>844</td>
<td>31.22</td>
</tr>
<tr>
<td>Fair</td>
<td>288</td>
<td>10.65</td>
</tr>
<tr>
<td>Poor</td>
<td>90</td>
<td>3.33</td>
</tr>
<tr>
<td><strong>Education</strong> (Missing n=21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No degree</td>
<td>320</td>
<td>11.91</td>
</tr>
<tr>
<td>High school/Trade</td>
<td>784</td>
<td>29.19</td>
</tr>
<tr>
<td>College</td>
<td>556</td>
<td>20.70</td>
</tr>
<tr>
<td>University</td>
<td>1026</td>
<td>38.20</td>
</tr>
<tr>
<td><strong>Household Income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;28,000</td>
<td>483</td>
<td>22.35</td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>Percent</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>28,000-49,000</td>
<td>597</td>
<td>27.63</td>
</tr>
<tr>
<td>50,000-74,000</td>
<td>508</td>
<td>23.51</td>
</tr>
<tr>
<td>75,000-100,000</td>
<td>271</td>
<td>12.54</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>302</td>
<td>13.98</td>
</tr>
</tbody>
</table>

Generalized Trust
(Missing n=20)

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>High trust</td>
<td>122</td>
<td>4.54</td>
</tr>
<tr>
<td>Low Trust</td>
<td>2565</td>
<td>95.45</td>
</tr>
</tbody>
</table>

Participation

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1718</td>
<td>63.47</td>
</tr>
<tr>
<td>Yes</td>
<td>989</td>
<td>36.53</td>
</tr>
</tbody>
</table>

Physical Inactivity
(Missing n=11)

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>461</td>
<td>17.10</td>
</tr>
<tr>
<td>Active</td>
<td>2235</td>
<td>82.90</td>
</tr>
</tbody>
</table>
Table 6: Characteristics of neighbourhood factors (n=300), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Census Tract Education</td>
<td>0.33, 0.91</td>
<td>0.60</td>
<td>0.12</td>
</tr>
<tr>
<td>Census Tract Density</td>
<td>1.35, 35.32</td>
<td>16.37</td>
<td>5.75</td>
</tr>
</tbody>
</table>
Table 7: Unadjusted (Bivariate) Odds ratio and 95% confidence intervals of physical inactivity (n_i=2672; n_c=300), 2008.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-34</td>
<td>1.00</td>
</tr>
<tr>
<td>35-44</td>
<td>1.29 (0.84, 1.99)</td>
</tr>
<tr>
<td>45-54</td>
<td>1.50 (0.99, 2.26)</td>
</tr>
<tr>
<td>55-64</td>
<td>1.67 (1.10, 2.55)</td>
</tr>
<tr>
<td>65-74</td>
<td>2.73 (1.85, 4.01)</td>
</tr>
<tr>
<td>75+</td>
<td>4.19 (2.76, 6.36)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.66 (0.53, 0.83)</td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health Status</th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>0.133 (0.07, 0.22)</td>
</tr>
<tr>
<td>Very Good</td>
<td>0.21 (0.13, 0.33)</td>
</tr>
<tr>
<td>Good</td>
<td>0.39 (0.24, 0.61)</td>
</tr>
<tr>
<td>Fair</td>
<td>0.54 (0.33, 0.89)</td>
</tr>
<tr>
<td>Poor</td>
<td>1.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education (Missing n=21)</th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No degree</td>
<td>1.00</td>
</tr>
<tr>
<td>High school/Trade</td>
<td>0.44 (0.33, 0.60)</td>
</tr>
<tr>
<td>College</td>
<td>0.39 (0.28, 0.54)</td>
</tr>
<tr>
<td>University</td>
<td>0.26 (0.19, 0.35)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household Income</th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;28,000</td>
<td>1.00</td>
</tr>
<tr>
<td>Revenue Range</td>
<td>Generalized Trust</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>28,000-49,000</td>
<td>0.57 (0.44, 0.74)</td>
</tr>
<tr>
<td>50,000-74,000</td>
<td>0.43 (0.32, 0.57)</td>
</tr>
<tr>
<td>75,000-100,000</td>
<td>0.30 (0.20, 0.45)</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>0.28 (0.18, 0.43)</td>
</tr>
</tbody>
</table>

Generalized Trust
(Missing n=20)

High Trust 1.00
Low Trust 0.98 (0.60, 1.61)

Participation

None 1.00
Yes 0.63 (0.50, 0.79)
Table 8: Adjusted Odds ratio and 95% confidence intervals of physical inactivity (n<sub>i</sub>=2672; n<sub>c</sub>=300), Montreal Neighbourhood Networks and Healthy Aging Study (MoNNET-HA), 2008.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-34</td>
<td>0.39 (0.25, 0.62)</td>
<td>0.39 (0.24, 0.61)</td>
<td>0.38 (0.24, 0.61)</td>
<td>0.39 (0.24, 0.61)</td>
<td></td>
</tr>
<tr>
<td>35-44</td>
<td>0.50 (0.25, 0.62)</td>
<td>0.52 (0.34, 0.79)</td>
<td>0.52 (0.34, 0.79)</td>
<td>0.52 (0.34, 0.79)</td>
<td></td>
</tr>
<tr>
<td>45-54</td>
<td>0.53 (0.36, 0.79)</td>
<td>0.56 (0.38, 0.83)</td>
<td>0.56 (0.38, 0.83)</td>
<td>0.56 (0.38, 0.83)</td>
<td></td>
</tr>
<tr>
<td>55-64</td>
<td>0.55 (0.37, 0.81)</td>
<td>0.57 (0.38, 0.84)</td>
<td>0.57 (0.38, 0.85)</td>
<td>0.57 (0.38, 0.84)</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>0.77 (0.37, 1.08)</td>
<td>0.80 (0.56, 1.12)</td>
<td>0.80 (0.57, 1.13)</td>
<td>0.79 (0.56, 1.12)</td>
<td></td>
</tr>
<tr>
<td>75+</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.74 (0.59, 0.94)</td>
<td>0.73 (0.58, 0.93)</td>
<td>0.73 (0.58, 0.93)</td>
<td>0.73 (0.58, 0.93)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Health Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>0.18 (0.10, 0.32)</td>
<td>0.18 (0.10, 0.32)</td>
<td>0.18 (0.10, 0.32)</td>
<td>0.18 (0.10, 0.32)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Very Good</td>
<td>Good</td>
<td>Fair</td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>No degree</td>
<td>0.29 (0.18, 0.49)</td>
<td>0.50 (0.31, 0.81)</td>
<td>0.56 (0.33, 0.96)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>High school/Trade</td>
<td>0.30 (0.18, 0.49)</td>
<td>0.49 (0.30, 0.80)</td>
<td>0.55 (0.32, 0.94)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>College</td>
<td>0.30 (0.18, 0.49)</td>
<td>0.49 (0.30, 0.80)</td>
<td>0.55 (0.32, 0.94)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>0.30 (0.18, 0.50)</td>
<td>0.49 (0.30, 0.80)</td>
<td>0.56 (0.33, 0.95)</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household Income</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;28,000</td>
<td>0.29 (0.18, 0.49)</td>
<td>0.50 (0.31, 0.81)</td>
<td>0.56 (0.33, 0.96)</td>
<td>1.00</td>
</tr>
<tr>
<td>28,000-49,000</td>
<td>0.30 (0.18, 0.49)</td>
<td>0.49 (0.30, 0.80)</td>
<td>0.55 (0.32, 0.94)</td>
<td>1.00</td>
</tr>
<tr>
<td>50,000-74,000</td>
<td>0.30 (0.18, 0.49)</td>
<td>0.49 (0.30, 0.80)</td>
<td>0.55 (0.32, 0.94)</td>
<td>1.00</td>
</tr>
<tr>
<td>75,000-100,000</td>
<td>0.30 (0.18, 0.49)</td>
<td>0.49 (0.30, 0.80)</td>
<td>0.55 (0.32, 0.94)</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>0.30 (0.18, 0.50)</td>
<td>0.49 (0.30, 0.80)</td>
<td>0.56 (0.33, 0.95)</td>
<td>1.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generalized Trust</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>No degree</td>
<td>1.67 (1.15, 2.40)</td>
<td>1.34 (0.92, 1.96)</td>
<td>1.33 (0.91, 1.94)</td>
<td>1.00</td>
</tr>
<tr>
<td>High school/Trade</td>
<td>1.05 (0.77, 1.42)</td>
<td>0.90 (0.66, 1.23)</td>
<td>0.89 (0.65, 1.21)</td>
<td>1.00</td>
</tr>
<tr>
<td>College</td>
<td>1.64 (1.00, 2.68)</td>
<td>1.45 (0.88, 2.38)</td>
<td>1.43 (0.87, 2.35)</td>
<td>1.00</td>
</tr>
<tr>
<td>University</td>
<td>1.28 (0.80, 2.03)</td>
<td>1.20 (0.76, 1.91)</td>
<td>1.19 (0.75, 1.89)</td>
<td>1.00</td>
</tr>
<tr>
<td>&lt;28,000</td>
<td>1.13 (0.72, 1.78)</td>
<td>1.09 (0.63, 1.72)</td>
<td>1.07 (0.68, 1.70)</td>
<td>1.00</td>
</tr>
<tr>
<td>28,000-49,000</td>
<td>0.89 (0.53, 1.51)</td>
<td>0.86 (0.50, 1.45)</td>
<td>0.84 (0.50, 1.43)</td>
<td>1.00</td>
</tr>
<tr>
<td>50,000-74,000</td>
<td>0.89 (0.53, 1.51)</td>
<td>0.86 (0.50, 1.45)</td>
<td>0.84 (0.50, 1.43)</td>
<td>1.00</td>
</tr>
<tr>
<td>75,000-100,000</td>
<td>0.89 (0.53, 1.51)</td>
<td>0.86 (0.50, 1.45)</td>
<td>0.84 (0.50, 1.43)</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>High Trust</td>
<td>Low Trust</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>-----------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Participation</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diversity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT Education</td>
<td>0.24</td>
<td>0.72 (0.27, 1.95)</td>
<td>0.79 (0.29, 2.13)</td>
<td>2.15 (0.35, 12.91)</td>
</tr>
<tr>
<td>CT Density</td>
<td>0.98 (0.97, 1.00)</td>
<td>0.97 (0.95, 0.99)</td>
<td>0.96 (0.94, 0.98)</td>
<td>0.96 (0.94, 0.98)</td>
</tr>
<tr>
<td>Interaction Terms</td>
<td>Diversity*CTEdu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Participation*CTEdu</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
References


IPAQ Research Committee. (2005, November). Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) - Short and long forms [PDF]. Retrieved from https://sites.google.com/site/theipaq/scoring-protocol


World Health Organization. (2005). *Chronic Disease and Health Promotion*. Retrieved from the Impact of Chronic Disease in Canada:
http://www.who.int/chp/chronic_disease_report/media/canada.pdf


Chapter 5
General Discussion and Conclusion

Summary of Findings

The primary objective of this thesis was to determine what role different dimensions of social capital played in adult physical inactivity and if characteristics of neighbourhood environments were associated with physical activity. Few studies have examined the association between social network capital dimensions and health outcomes. The purpose of the first study was to examine the relative importance of three dimensions of individual social network capital (i.e., diversity, reach, and range) in comparison to conventional social capital indicators. It was hypothesized that diversity of network ties would have the strongest association with physical inactivity since greater diversity is likely to provide access to different resources and opportunities. The findings from this study suggested that network diversity was the only network capital dimension significantly associated with physical inactivity. Individuals with greater network diversity were less likely to be physically inactive compared to those with less diverse networks. A significant association was also found for social participation. Individuals who had higher levels of social participation were less likely to be physically inactive than individuals with no social participation. Further investigation using a formal network approach is needed to help identify potential mechanisms linking social capital with physical inactivity. Using a formal network approach will help to capture dimensions of network diversity and the hierarchical dimension of resources accessibility that could lead to reductions in the prevalence of physical inactivity among adults.

The second study examined whether characteristics of neighbourhood social and physical environments contributed to adult physical inactivity after adjusting for individual characteristics. There were two purposes to this study; firstly, to examine the association of neighbourhood
socioeconomic status and population density with physical inactivity with adjustment for individual socio-demographic and –economic factors; and secondly, to assess whether the association between social capital and physical inactivity was moderated by neighbourhood socio-economic status with physical inactivity. It was hypothesized that individuals residing in areas of higher socioeconomic status areas or greater population density would less likely be physically inactive compared to individuals residing in lower socioeconomic and less dense areas. It was also hypothesized that neighbourhood socioeconomic status moderated the association between social capital and physical inactivity so that individuals with higher social capital and who resided in socially advantaged areas were less likely to be physically inactive than individuals with higher social capital and who resided in less advantaged areas. The findings from this study suggested that individuals in greater population density neighbourhoods are less likely to be physically inactive, which may indicate that greater population density areas may have better access to a range of resources and opportunities for physical activity within the neighbourhood. Neighbourhood socioeconomic status did not appear to have a moderating effect on the association between individual social capital and physical inactivity.

**Implications of Findings**

The investigation of the role of social capital and neighbourhood environment in adult physical inactivity demonstrated that greater network capital diversity, social participation, and greater neighbourhood population density reduced the likelihood of physical inactivity. Findings from this research can be used to direct social capital health research as well as inform public health interventions and policies related to physical activity behaviour change. From a research perspective, this study raises attention to the importance of network social capital and the added value of network dimension in the study of physical inactivity and social capital. Using network capital measures provides greater insight into the hierarchical structure of resources accessed by
network members compared to psychosocial indicators of social capital such as trust and participation (Moore, Daniel, Paquet, Dube, & Gauvin, 2009). To develop a clear understanding of the mechanisms underlying social capital in association with physical inactivity, it is necessary that network and psychosocial mechanisms be disentangled and critically appraised. Findings suggest that social network diversity and social participation have the strongest associations with physical inactivity. This suggests that conventional measures may not be capturing important components of social capital that potentially play a role in physical inactivity. Network diversity may have contributed to the reduced likelihood of physical inactivity by increasing access to materials and resources that influence physical activity. Positive support for physical activity can be provided through emotional, instrumental, appraisal, or instrumental support (Berkman et al., 2000).

From a health promotion perspective, findings of the present study provide public health with evidence for the development of ecological-level physical activity interventions with emphasis on interpersonal (i.e., network) relationships and neighbourhood-level influences. Programs that target physical activity, rather than focusing on individual behaviour should consider how social networks and neighbourhoods could be used to support physical activity adoption among their members. In terms of network interventions, this study suggests that that increasing network diversity could be used to promote physical activity. Interventions that promote participation would facilitate strong dense associations among network members that set social norms and beliefs, function as a model for behaviour, and function as a communication channel to promote positive physical activity behaviours (Eriksson, 2011). In terms of neighbourhood-based interventions, the study highlights the role of neighbourhood population density in reducing the likelihood of physical inactivity and suggests that creating denser areas, which tend to be areas with greater land-use mix, would facilitate greater physical activity levels.
among residents of those areas. Furthermore, greater population density can also encourage the development of social networks by creating more opportunities for individual residents to become more socially active. Public health interventions and policies that target change at multiple levels of influence can expect greater impact when targeting relationships, and environments.

**Future Directions**

This study has shown that formal network capital measures of diversity and social participation are significantly associated with adult physical inactivity. In addition, the study showed an association between neighbourhood population density and physical inactivity. This investigation of social network capital, neighbourhood factors, and physical inactivity addresses a central question within social epidemiology - how do social conditions give rise to health and disease in individuals and populations (Berkman & Kawachi, 2000)? Together, this thesis provides a number of recommendations for future research and health promotion directions. This study suggests that future research should look towards further investigation into the mechanisms linking social capital to physical activity, specifically the development of network approaches to study social capital. Identifying the mechanisms of social capital linked to physical inactivity can provide new knowledge on how social networks can be used to design physical activity health promotion interventions. It is also recommended that future research investigating neighbourhood factors use definition of neighbourhood boundaries and measures that more accurately reflect residents’ conceptualizations. This will help to identify the mechanism linking the neighbourhood environment and physical activity, which can be used to inform neighbourhood-level health promotion interventions.

The association between social capital and physical activity has been fairly consistent; however, the use of social network capital measures has been limited. This study revealed that the diversity dimensions of social network capital reduce the likelihood of physical inactivity. This
information helps to identify the types of networks that are available. It is suggested that future research investigate the types of tie, whether the tie resides in the neighbourhood or outside the neighbourhood, or whether the tie is a relative, friend or acquaintance to sort out further the forms of social capital that may enhance physical activity behaviour.

Although not examined in this study, identification of whether a person’s ties tend to be in the neighbourhoods where they reside or outside their neighbourhood may help us better understand the importance of the neighbourhood social environment for physical activity. It has been suggested that participation in social organizations might vary according to neighbourhood characteristics (Swaroop & Morenoff, 2006). If so, participation in social organizations may in turn influence physical inactivity behaviour through the provision of a number of mechanisms including access to resources and materials, increase range of informational sources and level of social support or through the exertion of social influence.

Other places outside the neighbourhood, such as work or school environments, may be more or less important to some individual’s physical activity or provide others with even greater resources and opportunities for physical activity. Moore et al. (2011) observed that individuals with greater extra-neighbourhood diversity social capital are more likely to report high self-rated health. Future investigations could examine if ties inside the neighbourhood are more strongly associated with physical inactivity than outside neighbourhood ties. If participation develops social networks, individuals who participate closer to home may have more neighbourhood-ties that influence their physical activity levels. Neighbourhoods rich in social capital may be better able to support local norms, beliefs and values, and provide an environment that promotes physical activity. Identification of specific neighbourhood and social capital dimensions that are most strongly associated with physical inactivity can be better used to inform public health and health policy on where to target initiatives to improve population physical inactivity levels.
Whether the network ties are family, friend, or acquaintance might also play a significant role in adult physical inactivity behaviour. Family may provide more help in overcoming certain disadvantages compared to friend or acquaintance ties. Family ties consist of male and females, which embeds different resources within the family, whereas friend or acquaintance ties may be more gender-homogeneous (Lin, 2000). Further investigation into the association between strength of tie and physical activity would be beneficial in the identification of the type of ties that are important for influencing physical activity behaviour. For example, ties that provide support for physical activity can enhance individual physical activity levels; however, ties that do not provide any support for physical activity may actually make an individual more likely to be physically inactive. This would help to inform physical activity promotion campaign in terms of identifying outlets by which to filter health information.

Not all social resources or relationships are important at the same time, and some may even be detrimental to health outcomes. Social network norms and beliefs towards physical activity may be dependent on a number of factors such as cultural, ethnic, class variations or gender. Future research should look to investigate these specific issues in network structure and function to determine how physical activity patterns may vary. This could be examined by investigating cultural norms and practices around physical activity. For instance, what is considered appropriate behaviour in different cultures may influence how individuals engage in physical activity. It may be more acceptable for men to engage in certain activities (e.g., organized sports teams, or vigorous fitness related activities) while women may not be afforded the same opportunities or be limited in their opportunities for physical activity. For instance women might be more likely to engage in more activities of daily living as a result of family responsibilities or socio-cultural barriers (Brownson, Eyler, King, Brown, Shyu, & Sallis, 2000).
This may lead to greater insight on how network capital operates, which could lead to a better identification of the mechanisms linked to physical inactivity.

Despite the growing interest in the influence of environmental factors on physical activity, the mechanisms by which neighbourhoods influence physical activity are still being identified. Macintyre et al. (2002) proposed several neighbourhood mechanisms that include: 1) enabling or constraining adoption of physical inactivity through access to resources; 2) increasing biological stress through reduced accumulation and access to resources; 3) economic and social deprivation; 4) exposure to harmful physical environments and availability of services; and 5) ability to enforce group/social norms. These mechanisms are likely to influence physical activity behaviour through access to amenities such as sports facilities or leisure centres, built environment features enabling or prohibiting physical activity, feelings that it is safe to engage in activity within the neighbourhood, and a supportive neighbourhood social environment that supports and promotes physical activity behaviours. It is likely that these mechanisms are interrelated and may also influence each other. Evidence on the association between neighbourhoods and physical activity has increased over the past decade, yet it remains recommended that future research identify the specific mechanisms linking neighbourhoods to physical activity behaviour (Pickett & Pearl, 2001; McNeill et al., 2006).

To help with the identification of specific neighbourhood mechanisms, future research should look to provide precise definitions and measures that reflect actual neighbourhood boundaries. This study used census tract population density to measure neighbourhood as a proxy for the neighbourhood social and physical environment. However, the use of census tracts to identify neighbourhood boundaries is often driven by convenience rather than theory or residents’ own conception or sense of their neighbourhood boundaries. For instance, residents of neighbouring census tracts may have similar access to parks or recreation facilities that they
would consider to be part of their neighbourhood, yet these resources may not fall formally within their census tract boundaries. Clearly defining neighbourhood boundaries will not only help better identify the causal pathways of neighbourhoods that influence physical inactivity, it can also lead to the development of positive built environments that support and promote physical activity within neighbourhoods. The findings of this study suggest that identifying how neighbourhoods promote or deter physical activity can lead to improvements in the social and built environments. Targeting the neighbourhood social and built environments for physical activity interventions can reach a wider population and thus have a greater effect on reducing the prevalence of physical inactivity.

Limitations

There are several limitations to the two empirical studies that need be considered. First, there are a number of limitations associated with the use of the IPAQ to assess physical inactivity. The IPAQ is a self-reported physical activity questionnaire and estimates of physical activity levels may be inaccurate due to the social desirability of the behaviour, recall bias, and interpretation or understanding of the questions. Evidence comparing self-reported physical activity questionnaires to objective physical activity measures suggests that adults are more likely to overestimate physical activity, particularly vigorous intensity activity (Sallis & Saelens, 2000; Brown, Bauman, Chey, Trost, & Mummery, 2004). Physical activity domains examined in the IPAQ may not assess the primary modes of activity for certain gender, age, cultural, occupational, or income groups. The accuracy and detail on the components of physical activity and levels of activity provided by questionnaires does not truly capture physical activity levels and makes interpretation of the data difficult. The classification of activity levels of subjects is based on rather arbitrary cut-off points. Data collected on physical activity is then converted to a metabolic activity relative to resting condition (MET); however, these metabolic costs are usually based on
data for young adults (Shephard, 2003). These cut-offs may be inappropriate for older adults. The length of physical activity recall required can also influence the reliability of information. Recalling physical activity is a complex and cognitively demanding task, which may be difficult in populations that have limited recall or memory abilities (Sallis & Saelens, 2000). Cultural and personal factors can also influence physical activity responses. The number and types of activities assessed can be limited with the use of questionnaires and not assess primary modes of physical activity for certain groups which would lead to inaccurate reporting of physical activity levels (Kriska & Capersen, 1997; Sallis & Saelens, 2000; Shephard, 2003; Keim et al., 2004; Janz, 2006; Ong & Blumenthal, 2010).

The prevalence of physical inactivity within the MoNNET- HA sample was 17%. The previously reported limitations of the IPAQ suggest, however, that the actual prevalence of physical inactivity among Montreal adults may be higher. While the 17% figure is comparable to the reported prevalence of physical inactivity in other studies using self-report physical activity data, it is lower than those reported in other Canadian studies on physical inactivity. To address the limitations of the IPAQ and better assess physical inactivity, objective measures could be used in future studies. However, given the sample size and financial constraints of the study, it was not feasible for the MoNNET study to collect objective physical activity data from 2707 participants. Nevertheless, use of objective physical activity tools, such as accelerometers and activity monitors, would increase the reliability of estimates and more accurately assess moderate and low physical activity levels.

For aims of causal analysis, the second limitation to these studies is their cross-sectional designs. Cross-sectional analyses provide an assessment of the association at a single point in time. The analyses do not assess changes in individual or neighbourhood factors that may occur over time, and how those changes may relate to changes in individual physical activity behaviour.
There is also the possibility of lag-time between exposure and outcome that cannot be assessed with a cross-sectional survey. It cannot be determined whether those with greater social capital become more physically active or those who are more physically active are more likely to develop greater social capital. A longitudinal study would allow greater discernment of these specific relationships. Moreover, a longitudinal study might lead to a better understanding of how social and physical environments are associated with physical activity adoption and maintenance over the lifespan.

Third, the criterion used to define neighbourhoods is often inconsistent and definitions may not necessarily reflect peoples’ conception or sense of neighbourhood boundaries. The definition of neighbourhood often relies on administrative data or pre-defined areas, such as a census tract or postal code area. The current study used census tracts to define neighbourhoods. Using such definitions is limited in that it may not reflect a person’s actual conception of their neighbourhood environments.

The use of census tract education and census tract population density in this study to assess neighbourhood also has its limitations. There may be aspects of the neighbourhood that are not being captured by these neighbourhood measures that play an important role in adult physical inactivity. The use of these proxy indicators for the neighbourhood social and physical environments limits the identification of specific mechanisms linking neighbourhoods to physical inactivity. Not all neighbourhoods are equal in resources and having a measures used in this study did not allow for the accurate assessment of resources within the neighbourhood that may be associated with physical inactivity.

**Conclusion**

Research has shown significant associations between measures of generalized trust and social participation and physical activity. This study directs attention towards the importance of network
capital as an indicator of social capital in association with physical inactivity. As far as I am aware this is the first study to examine the association between social capital and physical inactivity using formal network measures. Greater social network diversity and social participation were shown associated with physical inactivity in a sample of Montreal adults. This study contributes to the literature investigating the role of social network capital in health and physical activity suggesting that there are important component of social capital not being captures. It also provides support for the use of social network capital to assess hierarchical resource accessibility. It is recommended that network approaches be further developed in the study of physical activity and social capital.

This study also suggests that neighbourhood social and physical environments may be associated with physical inactivity. However, proxy indicators were used which may not fully capture neighbourhood mechanisms linked to physical inactivity. Future research should look to identify specific neighbourhood mechanisms to understand better their association with physical inactivity.

Having an inaccurate estimate of the prevalence of physical inactivity may weaken the strength of association between social capital, neighbourhood factors and physical inactivity found in this study. Improved tools to assess physical inactivity, or using a combination of objective and self-report physical activity measures would likely increase the magnitude of the associations shown in this study.

Identifying components of social capital and neighbourhoods that promote or even deter physical activity can be used to inform public health practices and policies that can lead to improvements in social and physical environments. Targeting associational involvement, network diversity and the neighbourhood environment as means to increase individual physical activity.
moves us beyond individual-level interventions and toward ecological interventions that can help reduce population-level physical inactivity and improve overall population health.
References


Appendix A

Ethics and Consent Forms
CENTRE DE RECHERCHE
Comité d'éthique de la recherche
Edifice Cooper
3671, boulevard St-Laurent, Montréal
Montréal (Québec) H3W 1C5
Téléphone : 514-840-8000 - Poste 14866
Télécopieur : 514-412-7524
Courriel : ghшлоин.ст.а.chum@ssis.gouv.qc.ca

Le 05 octobre 2007

Dr Spencer Moore, PhD
A/S Mme Stella Artuso, B.Sc.
Coordonnatrice de la recherche - CHUM
Edifice Saint-Urbain
3875, rue St-Urbain - Porte 3-30
Montréal (Québec)
H2W 1W1

Objet : ND07.049 – Approbation accélérée initiale et finale CER

Le capital social, les réseaux sociaux et le vieillissement en santé

Docteur,

J'ai pris connaissance des documents reçus en date du 21 septembre 2007 en vue de l'approbation accélérée du projet mentionné ci-dessus :

- Formulaire de présentation – Formulaire A – Annexe 2.1
- Formulaire de renseignements supplémentaires – Annexe 2.2
- Résumé d'un protocole de recherche
- Protocole de recherche
- Routing Slip of Registration/Application
- Formulaire d'information et de consentement – Version française – 13 septembre 2007
- Information and consent form – Version September 13, 2007
- Projet de questionnaire des ménages
- Draft household questionnaire

En vertu des pouvoirs qui me sont délégués par le Comité d'éthique de la recherche du CHUM pour procéder à une évaluation accélérée, il me fait plaisir de vous informer que j'approvoie votre projet puisqu'il s'agit d'un projet se situant sous le seuil de risque minimal.

Toutefois, auriez-vous l'obligeance de nous faire parvenir le questionnaire dans sa version finale, lorsque complété.

La présente constitue l'approbation finale du comité suite à une procédure d'évaluation accélérée. Elle est valide pour un an à compter du 05 octobre 2007, date de l'approbation initiale. Je vous rappelle que toute modification au protocole et/ou au formulaire de consentement en cours d'étude, doit être soumise pour approbation du comité d'éthique.

CENTRE HOSPITALIER DE L'UNIVERSITÉ DE MONTRÉAL

HÔPITAL RUTHVEN
1366, rue Sherbrooke Est
Montréal (Québec) H2L 1V1

HÔPITAL SAIN-ELISI
196, rue Saint-Denis
Montreal (Québec) H2X 1R4

141
Le comité suit les règles de constitution et de fonctionnement de l'Énoncé de Politique des trois Conseils et des Bonnes pratiques cliniques de la CIH.

Vous souhaitant la meilleure des chances dans la poursuite de vos travaux, je vous prie d'accepter, Docteur, mes salutations distinguées.

Brigitte St-Pierre, conseillère en éthique
Adjointe à la présidente
Comité d'éthique de la recherche du CHUM

BSTP/90
Le 10 avril 2008

Dr Spencer Moore, PhD
A/S Mme Stella Artuso, B.Sc.
Coordonnatrice de la recherche – CHUM
Édifice Saint-Urbain
3875, rue St-Urbain - Porte 3-30
Montréal (Québec) H2W 1V1

Objet : ND07.049
Questionnaires (version française et anglaise):
- Sondage sur les réseaux de quartier et sur la santé à Montréal
- Montreal Neighbourhood Networks and Health Survey

Le capital social, les réseaux sociaux et le vieillissement en santé

Docteur,

Je confirme la réception de votre lettre datée du 17 mars 2008 ainsi que les deux questionnaires (Français et Anglais) – Version 13 mars 2008, concernant le projet décrit en rubrique. Le tout est jugé satisfaisant et je vous retourne, en annexe, lesdits questionnaires dûment approuvés et signés.

Je vous prie d’accepter, Docteur, mes salutations distinguées.

[Signature]

Me Marie-Josée Bernardi, avocate
Vice-présidente
Comité d’éthique de la recherche
Équipe Hôpital Notre-Dame du CHUM

MJB/90
P. j.
INFORMATION AND CONSENT FORM

This letter of information is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you have any questions related to the study, would like more detail about something mentioned here, or information not included, please ask. Before agreeing to participate in this project, please take the time to read and understand the information that follows.

PRINCIPLE INVESTIGATOR:

Spencer Moore, Ph.D. (Associate Researcher, Centre de recherche du Centre Hospitalier de l'Université de Montréal – Hôtel-Dieu).

CO-INVESTIGATORS:

Mark Daniel, Ph.D. (Researcher; Centre de recherche du Centre Hospitalier de l'Université de Montréal – Hôtel-Dieu)
Lucie Richard, Ph.D. (Professor; Université de Montréal- Nursing)
Lise Gauvin, Ph.D. (Professor; Université de Montréal- Social and Preventative Medicine)
Ulf Bockenholt, Ph.D. (Professor; McGill- Department of Management)
Katherine Frohlich, Ph.D. (Professor; Université de Montréal- Social and Preventative Medicine)
Yan Kestens, Ph.D. (Researcher; Université de Montréal- Social and Preventative Medicine)

FUNDING AGENCY:

Canadian Institutes of Health Research (CIHR).

TITLE OF STUDY:

Social Capital, Social Networks, and Successful Aging.

INTRODUCTION:

You are invited to participate in "Social Capital, Social Networks, and Successful Aging" a research project to that aims to examine the association between neighbourhood social capital (NSC) and health. This study will explore social capital’s influence on health and how its influence might vary according to age and degree of exposure to neighbourhood factors. It is being conducted by researchers at Université de Montréal, McGill University and the centre Hospitalier de Université de Montréal (CHUM). You are being asked to answer and complete a household questionnaire that will ask you about the your neighbourhood, your health, and your general interactions with neighbours.
Your participation in the project is confidential. Your name or address will not be associated with any of the information that we report or present about in our research.

Your participation is voluntary and you are not required to participate. There are no risks or consequences to you or your household if you refuse to participate. On the questionnaire, you can refuse to answer any of the questions. You will not experience any discomforts or inconveniences due to your participation. You will not incur any financial costs as a result of your participation.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of this study is to explore the association between neighborhood social capital and health, more specifically, to assess the presence of age- and network-related moderations in the association between neighborhood social capital and health.

WHAT WOULD I HAVE TO DO?

You are being asked to answer and complete a household questionnaire that asks you about yourself, your state of health, your social networks and to identify individuals with whom you spend the most time within Montreal and with other neighbourhood residents. This questionnaire may take you approximately 20-25 minutes to complete.

WHAT ARE THE RISKS?

Participation in the project will not place you at any risk for physical harm. If you feel uncomfortable about any questions that we may ask, feel free not to answer those questions.

WILL I BENEFIT IF I TAKE PART?

You will not benefit directly from participation in the research. You will not be paid. However, you will help us better understand importance of community and social support on health among different age groups and networks across the Montreal region.

DO I HAVE TO PARTICIPATE?

Your participation is completely voluntary. You do not have to be involved in the project. You do not have to answer every or any of the questions that will be asked in the questionnaire. In addition, you may stop completing the questionnaire at any time. If any new information becomes available that may affect your participation, you will be informed as soon as possible.
WHAT ELSE DOES MY PARTICIPATION INVOLVE?

Nothing else, your agreement to participate in the study does not imply your agreement to participate in any other parts of the study.

WILL I BE PAID FOR PARTICIPATING?

No, unfortunately we cannot pay you for your time.

WILL MY ANSWERS BE KEPT CONFIDENTIAL?

Your comments and answers to questions will remain confidential. Only the principal and co-investigators will have access to your comments and answers. Your name will not appear in any document, report or analysis related to the project.

RESOURCE PERSONS:

For any information regarding ethical considerations, comments or to file a complaint please contact Mrs. Diane-Isabelle Poirier, Assistant Commissioner for quality services for CHUM at (514) 890-8000 ext. 12761. For all questions pertaining to the study, you may contact Stella Artuso, the project coordinator at (514) 890-8000 ext.15922.

HOUSEHOLD QUESTIONNAIRE CONSENT FORM

(Telephone administration script)

Title: Social Capital, Social Networks, and Successful Aging.
HOUSEHOLD QUESTIONNAIRE CONSENT FORM
(Telephone administration script)

Title: Social Capital, Social Networks, and Successful Aging.

Sponsor: Centre de recherche du Centre Hospitalier de l'Université de Montréal

Principal investigator: Spencer Moore, Ph.D.
Co-investigators: Mark Daniel, Ph.D.; Lucie Richard, Ph.D.; Lise Gauvin, Ph.D.;
Ulf Bockholt, Ph.D.; Katherine Frohlich, Ph.D.; Yan Kostens, Ph.D.

HOUSEHOLD ID# ____________________
LOCATION ID# ____________________

You know then that you have been randomly selected to participate in a study being conducted by researchers at the Université de Montréal, McGill University and the centre Hospitalier de l'Université de Montréal (CHUM) aimed to examine the association between neighbourhood social capital (NSC) and health. This study will explore social capital's influence on health and how its influence might vary according to age and degree of exposure to neighbourhood factors. You understand that you are being asked to participate in the research project entitled “Social Capital, Social Networks, and Successful Aging”.

You understand then that your participation will take the form of answering by telephone approximately 40 questions that will take approximately 20-25 minutes to complete.

You understand that the purpose of the questionnaire is to gather information about perspectives on your neighbourhood relationships, your state of health, and your general interactions with neighbours.

The project's aim is to better understand the influence of age and network-related factors on the association between place and health in Montreal.

You understand that there are no known risks, discomforts or inconveniences associated with participation in the research study. Your participation is voluntary. You can refuse to participate. You can withdraw at any time and request removal of your responses without any consequences.

You understand that your confidentiality will be protected. All research data will be stored securely and access to the data will be restricted to project investigators. Your name will not appear in the data file, only your identification number.
WHO TO CONTACT WITH QUESTIONS

If you would like further information about the study, or have additional questions or concerns, please feel free to contact any of the researchers listed above, or the research coordinator:

Stella Artuso B.Sc.
Research Coordinator (CHUM)
3875 St-Urbain, 3rd Floor, 3-30
Montréal, Qc, H2W 1V1
Telephone: (514) 890-8000 ext. 15922

You may also contact Mrs. Diane-Isabelle Poirier, Assistant Commissioner for quality services for CHUM at (514) 890-8000 ext. 12761 for any information regarding ethical considerations, comments or to file a complaint.

Do you give your verbal consent to participate in this study?

YES  [  ]  I consent to participate.

NO   [  ]  I do not consent to participate.

Date: ____________________
Appendix B
MoNNET-HA Survey
MONTREAL NEIGHBOURHOOD NETWORKS AND HEALTH SURVEY
(MoNNET-Healthy Aging)

1. Screening questions
2. Social capital module
3. Neighbourhood Life
4. Health and Well-being
5. About yourself (Socio-demographic) items
INTRODUCTION/Screening

Questions
Can I count on your collaboration for the next 20 minutes?

Before we begin the interview, I have a few questions to verify that you are eligible to participate in this study.

1) Have you lived at your current residence for at least 12 months? Yes____ No____

**Interviewer Note:** If Yes, go to “1a”.

If No, interviewer says: “I’m sorry, according to the study’s guidelines you are not eligible to participate in this study. Thank you for your time”.

1a) Can you tell me, in years, how long have you lived at your current residence? ______ yrs

2) Please stop me when I reach your age category. Are you between:

- 25-34 [1]_____; 55-64 [4]_____
- 45-54 [3]_____; 75+ [6] _____

3) Are you: Male [1]_______ Female [2]_______?
4) This study comprises of two parts. The questionnaire you are completing today is the first part of the study. Would it be okay for us to contact you again in about 1 year, if necessary, for the second half of this study? Yes [1] No [2]

SOCIAL CAPITAL/RELATIONSHIP QUESTIONS
SECTION 1: GENERAL SC & PARTICIPATION: 3 ITEMS

SECTION 2: POSITION GENERATOR: 10-30 ITEMS

SECTION 3: NAME GENERATOR: 1-27 ITEMS

SOCIAL CAPITAL MODULE: RANGE OF ITEMS: 14-60 ITEMS
The following questions ask about your social relationships.

1. Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?

- Most people can be trusted [1]
- Can't be too careful [2]
- Depends [3]
- Most people CANNOT be trusted [4]
- I Don't Know [99]

No response/Refuses to answer [77]

2. During the past five years, have you been active in a neighbourhood group or association as a volunteer or an officer?

- Yes [1]
- No [2]
- Don't know [99]
- No response [77]

2a) During the past five years, have you been active in any other voluntary associations as a volunteer or an officer?

- Yes [1]
- No [2]
- Don't know [99]
- No response [77]
Now we would like to ask you about the people you know on a first name basis and the type of work they do.

3a) Do you know someone who is a high school teacher?

Yes [1]___
No [2]_____ (go to “3b”)

3a-i) Is this person a ...

Relative [1]_______
Friend [2]_______
Acquaintance [3]_______
Don’t know [99]
No response/refuses to answer [77]

3a-ii) Does this person live in your ...

Household [1]_______
Neighbourhood [2]_______
In the Montreal Metropolitan Area
None of the above_______
Don’t know [99]
No response/refuses to answer [77]

3b) Do you know someone who is a carpenter?

Yes [1]___
No [2]_____ (go to “3c”)

3b-i) Is this person a ...

Relative [1]_______
Friend [2]_______
Acquaintance [3]_______
Don’t know [99]
No response/refuses to answer [77]

3b-ii) Does this person live in your ...
Household [1]______
Neighbourhood [2]______
In the Montreal Metropolitan Area _______
None of the above[3] _______
Don’t know [99]
No response/refuses to answer [77]

3c) Do you know someone who is a Musician/artist?

   Yes [1]___
   No [2]_____ (go to “3d”)

3c-i) Is this person a ...

   Relative [1] ______
   Friend [2]______
   Acquaintance [3]________
   Don’t know [99]
   No response/refuses to answer [77]

3c-ii) Does this person live in your ...

   Household [1]______
   Neighbourhood [2]______
   In the Montreal Metropolitan Area_______
   None of the above [3] _______
   Don’t know [99]
   No response/refuses to answer [77]

3d) Do you know someone who is a Taxi driver?

   Yes [1]___
   No [2]_____ (go to “3e”)

3d-i) Is this person a ...

   Relative [1] ______
   Friend [2]______
   Acquaintance [3]________
   Don’t know [99]
   No response/refuses to answer [77]
3d-ii) Does this person live in your ...

  Household [1]______
  Neighbourhood [2]______
In the Montreal Metropolitan Area ______
None of the above[3] _______
Don’t know [99]
No response/refuses to answer [77]

3e) Do you know someone who is a Physician?

  Yes [1]___
  No [2]_____ (go to “3f”)

3e-i) Is this person a ...

  Relative [1] ______ 
  Friend [2] _____
  Acquaintance [3]________
  Don’t know [99]
  No response/refuses to answer [77]

3e-ii) Does this person live in your ...

  Household [1]______
  Neighbourhood [2]______
In the Montreal Metropolitan Area_______
None of the above[3] _______
Don’t know [99]
No response/refuses to answer [77]

3f) Do you know someone who is a Janitor?

  Yes [1]___
  No [2]_____ (go to “3g”)

3f-i) Is this person a ...

  Relative [1] ______
  Friend [2] ______
Acquaintance [3]________
Don’t know [99]
No response/refuses to answer [77]

3f-ii) Does this person live in your ...

Household [1]_______
Neighbourhood [2]_______
In the Montreal Metropolitan Area _______
None of the above[3] _______
Don’t know [99]
No response/refuses to answer [77]

3g) Do you know someone who is a *Registered nurse*?

Yes [1]___
No [2]_____ (go to “3h”)

3g-i) Is this person a ...

Relative [1]_______
Friend [2] _____
Acquaintance [3]________
Don’t know [99]
No response/refuses to answer [77]

3g-ii) Does this person live in your ...

Household [1]_______
Neighbourhood [2]_______
In the Montreal Metropolitan Area_______
None of the above[3] _______
Don’t know [99]
No response/refuses to answer [77]

3h) Do you know someone who is a *Welder*?

Yes [1]___
No [2]_____ (go to “3i”)

3h-i) Is this person a ...
Relative [1] ______
Friend [2] ______
Acquaintance [3] ______
Don’t know [99]
No response/refuses to answer [77]

3h-ii) Does this person live in your ...

Household [1] ______
Neighbourhood [2] ______
In the Montreal Metropolitan Area
None of the above[3] ______
Don’t know [99]
No response/refuses to answer [77]
3i) Do you know someone who is a Accountant?

Yes [1]____
No [2]_____ (go to “3j”)

3i-i) Is this person a ...

Relative [1]_______
Friend [2]_______
Acquaintance [3]________
Don’t know [99]
No response/refuses to answer [77]

3i-ii) Does this person live in your ...

Household [1]_______
Neighbourhood [2]_______
In the Montreal Metropolitan Area ______
None of the above [3]_______
Don’t know [99]
No response/refuses to answer [77]

3j) Do you know someone who is a Receptionist?

Yes [1]____
No [2]_____ (go to “Q4”)

3j-i) Is this person a ...

Relative [1]_______
Friend [2]_______
Acquaintance [3]________
Don’t know [99]
No response/refuses to answer [77]

3j-ii) Does this person live in your ...

Household [1]_______
Neighbourhood [2]_______
In the Montreal Metropolitan Area_______
None of the above [3]_______
Don’t know [99]
No response/refuses to answer [77]

The following questions ask about people with whom you discuss important personal matters such as health, family, work, and money issues. These people may live in your household, may be relatives, friends, work colleagues, neighbours or other persons living outside your household. You can give a fake name rather than the real name if you prefer.

4. Can you tell me up to three people with whom you have discussed important matters in the last six months?

   Person 1 _______________
   Person 2 _______________
   Person 3 _______________
   No one _______________
   Don’t want to name anyone (probe)

4a) The name of the first person? *** At the need: if you prefer, you can give a fictitious name rather than the truth.
5. The next set of questions asks you about the people whom you have discussed important matters within the last six months:

5a) Please tell me if (Person 1-listed in question 4) is a:

Male [1]______ Female [2]______

5b) How old is (Person 1), roughly?

_______ years

5c) How much formal education has (Person 1) had (roughly)? ...

Less than high school [1]_________
High school [2] _________
More than high school but no university degree [3]_________
University degree or more_______
Don’t know [99]_________
Refuses to answer [77] ____

5d) Is (Person 1) a ...

Relative [1]_____
Friend [2] _______
Acquaintance [3]_______

5e) Does (Person 1) live...(Roughly)?

5e-i) In your household [1]_________

5e-ii) In your neighbourhood [2]_________

5e-iii) Outside of Montreal Metropolitan Area [3]_________
(If not 5e-i, ii, iii), then: Which area of Montreal?
(e.g. Plateau, St. Laurent) ________

5h) Would you say that this person’s ethnic or cultural background is the same or different than yours?

Same
Different
DNK
DNA

5f) Does (Person 1) exercise regularly?

Yes [1]______ No [2]________

Does this person smoke?
Yes
No
DNK/DNA

5g) What occupation does (Person 1) have? ____________________
6a) Please tell me if (Person 2-listed in question 4) is a:

Male [1]______ Female [2]______

6b) How old is (Person 2), roughly?

_______ years

6c) How much formal education has (Person 2) had (roughly)? ...

Less than high school [1]________
High school [2]________
More than high school but no university degree [3] ________
University degree or more_______
Don’t know [99]________
Refuses to answer [77] ____

6d) Is (Person 2) a ...

Relative [1]______
Friend [2]_______
Acquaintance [3]________

6e) Does (Person 2) live...(Roughly)

6e-i) In your household [1]________
6e-ii) In your neighbourhood [2]__________
6e-iii) Outside of Montreal Metropolitan Area[3]________

(If not 6e-i,ii, iii), then: Which area of Montreal?
(e.g. Plateau, St. Laurent)_______
Would you say that this person’s ethnic or cultural background is the same or different than yours?

Same........
Different........
DNK.......
DNA........

6f) Does (Person 2) exercise regularly?

Yes [1]______ No [2] ________

6i) Does this person smoke?

Yes
No
DNK

6g) What occupation does (Person 2) have? _________________
7a) Please tell me if (Person 3) -listed in question 4) is a:

Male [1] ______ Female [2]_____

7b) How old is (Person 3), roughly?

_______ years

7c) How much formal education has (Person 3) had (roughly)? ...

Less than high school [1]_________
High school [2]_________
More than high school but no university degree [3]_________
University degree or more_____
Don’t know [99]_____
Refuses to answer [77]_____

7d) Is (Person 3) a ...

Relative [1]_____
Friend [2]_____
Acquaintance [3]_____

7e) Does (Person 3) live...(Roughly)

7e-i) In your household [1]_________
7e-ii) In your neighbourhood [2]_________
7e-iii) Outside of Montreal Metropolitan area [3]_________

(If not 7e-i,ii, iii), then: Which area of Montreal?
(e.g. Plateau, St. Laurent)_________
7h) Would you say that this person’s ethnic or cultural background is the same or different than yours?

Same
Different
DNK
DNA

7f) Does (Person 3) exercise regularly?

Yes [1]______ No [2]_______

7i) Does this person smoke?

Yes
No
DNK

7g) What occupation does (Person 3) have? ____________________

(Interviewer Note): If (5e AND 6e) OR (5e AND 7e) OR (6e AND 7e) is “in your neighbourhood” then ask question 8. If not, skip to the next question.
8. These next questions ask if the people who live in your neighbourhood know one another (as far as you are know).

a) Do (name of person 1) and (name of person 2) know each other?
   
   Yes [1]____
   No [2] _____
   Don’t know [99] _____
   Refuses to answer [77] ____

b) Do (Name of person 1) and (name of person 3) know each other?

   Yes [1]____
   No [2] _____
   Don’t know [99] _____
   Refuses to answer [77] ____

c) Do (Name of person 2) and (name of person 3) know each other?

   Yes [1]____
   No [2] _____
   Don’t know [99] _____
   Refuses to answer [77] ____
NEIGHBOURHOOD LIFE

(11 items)
9. The following are questions about different aspects of your neighbourhood and your relationships with neighbours. Would you say:

9b) your neighbourhood is clean?
   Strongly agree [1]________
   Agree [2]________
   Disagree [3]________
   Strongly Disagree [4]________
   Don’t Know [99]________
   Refuses to answer [77] ____

9d) You have trouble with your neighbours
   Strongly agree [1]________
   Agree [2]________
   Disagree [3]________
   Strongly Disagree [4]________
   Don’t Know [99]________
   Refuses to answer [77] ____
9e) people in your neighbourhood are willing to help each other
   Strongly agree [1]________
   Agree [2]________
   Disagree [3]________
   Strongly Disagree [4]_______
   Don’t Know [99]_________
   Refuses to answer [77]___

9f) people in your neighbourhood can be trusted
   Strongly agree [1]________
   Agree [2]________
   Disagree [3]________
   Strongly Disagree [4]_______
   Don’t Know [99]_________
   Refuses to answer [77]___

9g) if there is a problem in your neighbourhood, people in your
neighbourhood can get it solved.
   Strongly agree [1]________
   Agree [2]________
   Disagree [3]________
   Strongly Disagree [4]_______
   Don’t Know [99]_________
   Refuses to answer [77]___

9i) you have someone **in your neighbourhood** who you can really
talk to.
   Strongly agree [1]________
   Agree [2]________
   Disagree [3]________
   Strongly Disagree [4]_______
   Don’t Know [99]_________
   Refuses to answer [77]___

9j) you have someone **in your neighbourhood** who could help you
out with things, like give you a ride, watch the house or kids, or fix
something.
Strongly agree [1]_______
Agree [2]________
Disagree [3]_________
Strongly Disagree [4]_______
Don’t Know [99]_________
Refuses to answer [77]_____

9k) most people in your neighbourhood know you.
   Strongly agree [1]_______
   Agree [2]________
   Disagree [3]_________
   Strongly Disagree [4]_______
   Don’t Know [99]_________
   Refuses to answer [77]_____

YOUR HEALTH & WELL-BEING

- SF-12v2: 4 items
- Chronic Illness: 6 items
- Alcohol consumption: 3 items
- BMI: 2 items
- IPAQ: 6 items
- CES-D: 10 items
- Locus of control: 4 items

Total items: 35 items
HEALTH AND WELL-BEING QUESTIONS:

This section of the survey asks for your views about your health.

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

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

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

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

3. How well are you able to get around?

<table>
<thead>
<tr>
<th>Very Good</th>
<th>Good nor poor</th>
<th>Poor</th>
<th>Very Poor</th>
</tr>
</thead>
</table>
4. How would you rate your memory?

<table>
<thead>
<tr>
<th>Very Good</th>
<th>Good</th>
<th>Neither good nor poor</th>
<th>Poor</th>
<th>Very poor</th>
</tr>
</thead>
</table>
5. Has a doctor ever told you whether or not you suffer from any of the following symptoms or conditions?

   **a)** Diabetes  
   Yes [1]_______ No [2]________

   **b)** Hypertension (high blood pressure)  
   Yes [1]_______ No [2]________

   **c)** High cholesterol  
   Yes [1]_______ No [2]________

   **d)** Cardiac problems (angina, heart attack/myocardial infarction, by-pass)?  
   Yes [1]_______ No [2]________

   **e)** Osteoporosis?  
   Yes [1]_______ No [2]________

   **f)** Arthritis/or rheumatism?  
   Yes [1]_______ No [2]________

6. Can you tell me, roughly speaking, what your current weight is in pounds or in kilos?  
   **(Interviewer note):** please clarify if their response in lbs or kilos.

   _____ lbs or ______ kilos

   Can you tell me on average which is your current weight in pounds?

   Can you tell me on average which is your current weight in kilos?
7. Can you tell me, roughly speaking, how tall you are? (Interviewer note): please clarify if their response in feet or cm

_____ feet or ______ cm

Can you tell me on average how much you measure in feet?

Can you tell me on average how much you measure in metres?

8) In the past 30 days, have you smoked?
   Yes
   No
   DNK
   DNA
Alcohol consumption

9a. A drink of alcohol is 1 can or bottle of beer, 1 glass of wine, 1 bottle of wine cooler, 1 cocktail, or 1 shot of liquor. During the past 30 days, how many days per week or per month did you have at least 1 drink of any alcoholic beverage?

1 ___ Days per week
2 ___ Days in past 30 (month)
888 _ No drinks in past 30 days. GO TO Question 9.
99 _ Don’t know/not sure
77 _ Refused GO TO Question 9.

9b) During the past 30 days, how many days per week did you have at least 1 drink of any alcoholic beverage?

9c) During the past 30 days, how many days per month did you have at least 1 drink of any alcoholic beverage?

9d. On the days when you drank, about how many drinks did you drink on average?

_____ Number of drinks
99 _ Don’t know/not sure
77 _ Refused

8e. Considering all types of alcoholic beverages, how many times during the past 30 days did you have 5 or more drinks on an occasion?

_____ Number of times
88 ___ None
99 ___ Don’t know/not sure
77 ___ Refused
Adapted IPAQ (International Physical Activity Questionnaire):

Now, I am going to ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

*Only include the activities that you did for at least 10 minutes at a time.*

---

**Think about all the vigorous activities that you did...** (These are activities that take hard physical effort, such as heavy lifting, digging, aerobics, or fast bicycling).

9a) During the **last 7 days**, on **how many days** did you do this type of activity?

Days per week _______
Don’t know [99]_________
Refused to answer [77]________

9b) **How much time** did you spend doing this activity on one of those days?

Hours per day ___________
Minutes per day ___________
Don’t know [99]_________
Refused to answer [77]_________

---

**Think about all the moderate activities that you did...** (These are activities that make you breathe somewhat harder than normal, such as
carrying light loads, bicycling at a regular pace, or doubles at tennis). *Do not include walking.*

9c) During the last 7 days, on how many days did you do this type of activity?

Days per week _____
Don't know [99]________
Refused to answer [77]________

9d) How much time did you spend doing this activity on one of those days?

Hours per day __________
Minutes per day __________
Don't know [99]________
Refused to answer [77]________

Think about the time you spent walking...(This includes at work and at home, walking to travel from place to place, and any other walking you might do solely for recreation, sport, exercise or leisure).

9e) During the last 7 days, on how many days did you do this type of activity?

Days per week _____
Don't know [99]________
Refused to answer [77]________

9f) How much time did you spend doing this activity on one of those days?
Hours per day __________
Minutes per day __________
Don’t know [99]_________
Refused to answer [77]________
I will now read a list of some of the ways you may have or may not have felt over the past week. Please answer by yes or no to the following statement.

10. **CESD** (Centre for Epidemiologic Studies Depression Scale) (10-item version):

   **a)** I felt that everything I did was an effort
   Yes [1]______ No [2] _______

   **b)** My sleep was restless
   Yes [1]______ No [2] _______

   **c)** I was happy
   Yes [1]______ No [2] _______

   **d)** I felt lonely
   Yes [1]______ No [2] _______

   **e)** People were unfriendly
   Yes [1]______ No [2] _______

   **f)** I enjoyed life
   Yes [1]______ No [2] _______

   **g)** I felt sad
   Yes [1]______ No [2] _______

   **h)** I felt that people disliked me
   Yes [1]______ No [2] _______
i) I could not get “going”
   Yes [1]______ No [2] ______

j) I felt depressed
   Yes [1]______ No [2] ______

(Interviewer Note):

FLAG: If a participant scores > 4, offer them Mental Health resources by saying:

“We are offering all participants a phone number for support services. Would you like me to provide you with this number?” 514-738-4873

   Yes ______(please provide this number: ______________)

   No ______ (skip to next question)

11. Can you tell me how strongly you feel about the following statements?:

a) I am responsible for my own successes. (1 LOC)

   Strongly agree [1]____
   Agree [2]____
   Disagree [3]____
   Strongly Disagree [4]____
   Don’t Know [99]____
   Refuses to answer [77] ____
b) The really good things that happen to me are mostly luck. (1LOC)

Strongly agree [1]_______
Agree [2]________
Disagree [3]________
Strongly Disagree [4]_______
Don’t Know [99]________
Refuses to answer [77]____

c) I can do just about anything I set my mind to. (1LOC)

Strongly agree [1]_______
Agree [2]________
Disagree [3]________
Strongly Disagree [4]_______
Don’t Know [99]________
Refuses to answer [77]____

d) There's no sense planning a lot - if something good is going to happen it will. (1LOC)

Strongly agree [1]_______
Agree [2]________
Disagree [3]________
Strongly Disagree [4]_______
Don’t Know [99]________
Refuses to answer [77]____

e) It is difficult for me to make new friends?

Strongly agree.......
Agree........
Disagree........
Strongly Disagree
Don’t Know....
Refuses to answer....
ABOUT YOURSELF

- Socio-demographic questions: 8-11 items
These last questions ask a little about you. Your answers will be used for general comparison purposes only and your responses will remain strictly confidential.

1. Which situation best describes your marital status?
   - Married/Common law relationship [1] 
   - Single, never married [2] 
   - Separated [3] 
   - Divorced [4] 
   - Widowed [5] 

2. Do you have any children? Yes [1] ______ No [2]_______
   2a). If Yes, How many? _______
   b) Including yourself, how many people live in your household?

3. In what country were you born? ________

4. To which ethnic or cultural group do you identify? ________

5. What is the primary language spoken in your household? ___________

6. What is the highest level of education you have completed?

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>No degree, certificate, or diploma</td>
<td>[1]</td>
</tr>
<tr>
<td>Secondary (high) school diploma or equivalent</td>
<td>[2]</td>
</tr>
<tr>
<td>Trades Certificate or Diploma</td>
<td>[3]</td>
</tr>
<tr>
<td>College certificate or diploma below Bachelor’s degree level</td>
<td>[4]</td>
</tr>
<tr>
<td>University certificate or diploma at bachelor level</td>
<td>[5]</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>[6]</td>
</tr>
<tr>
<td>Earned Doctorate Degree</td>
<td>[7]</td>
</tr>
</tbody>
</table>
7. Are you currently employed?


8. What is your present occupation? ______________________

9. Is your postal code ___ ___ ___ ___ ____  ____?

10. Please stop me when I reach the category that includes your total household income in [the past year]; that is, the income for all members of the household during the past year.

   Less than $28,000  [1]_______
   $ 28,000 - $49,000 [2]_______
   $ 50,000 - $74,000 [3]_______
   $ 75,000- $100,000 [4]_______
This study comprises of two parts. The questionnaire you just completed is the first part of the study. Would it be okay for us to contact you again in about 1 year, if necessary, for the second half of this study?

Yes [1]________ No [2]________
Appendix C

IPAQ scoring protocol
APPENDIX 1

At A Glance
IPQA Scoring Protocol (Short Forms)

Continuous Score

Expressed as MET-min per week: MET level x minutes of activity/day x days per week

Sample Calculation

<table>
<thead>
<tr>
<th>MET levels</th>
<th>MET-minutes/week for 30 min/day, 5 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking = 3.3 METs</td>
<td>3.3<em>30</em>5 = 495 MET-minutes/week</td>
</tr>
<tr>
<td>Moderate Intensity = 4.0 METs</td>
<td>4.0<em>30</em>5 = 600 MET-minutes/week</td>
</tr>
<tr>
<td>Vigorous Intensity = 8.0 METs</td>
<td>8.0<em>30</em>5 = 1,200 MET-minutes/week</td>
</tr>
<tr>
<td>TOTAL</td>
<td>= 2,295 MET-minutes/week</td>
</tr>
</tbody>
</table>

Total MET-minutes/week = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days)

Categorical Score - three levels of physical activity are proposed

1. **Low**
   - No activity is reported OR
   - Some activity is reported but not enough to meet Categories 2 or 3.

2. **Moderate**
   
   Either of the following 3 criteria
   - 3 or more days of vigorous activity of at least 20 minutes per day OR
   - 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day OR
   - 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes/week.

3. **High**

   Any one of the following 2 criteria
   - Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week OR
   - 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week.

Please review the full document “Guidelines for the data processing and analysis of the International Physical Activity Questionnaire” for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].

*Revised November 2005*