Associations between Walking Behaviour and Personal and Environmental Factors in Older Adults Living in a Downtown Neighbourhood

By

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A Thesis submitted to the Faculty of Graduate Studies of

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ABSTRACT

The purpose of this study was to investigate the association between personal and environmental factors and walking behaviour among older adults. The sample consisted of 60 people aged 65 years or more (mean = 77 ±7.27, range 65 to 92). Perceived environment was assessed using the Neighbourhood Environment Walkability Scale (NEWS-A, abbreviated version). Physical function was measured using the Functional Fitness Test. Walking behaviour was assessed with pedometers. Three participants had an average number of steps above two standard deviations from the mean, and were considered influential observations. After adjustments for age, health status and physical function, and removing influential observations, increased walking was significantly associated with higher income (β= 0.274, $p<0.05$). After adjusting for age, health and income, and removing influential observations increased walking was significantly associated with higher physical function (β= 0.300, $p<0.05$). No association was found between walking and environmental factors after adjustments for personal factors, and removing influential observations. Among this sample, personal factors (age, annual income, and physical function) accounted for 40.7% (R^2 = 0.407) of the variation. The environment explained 8.7% (R^2 = 0.087) of the variation after controlling for personal factors.

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Chapter 1- Introduction

According to United Nations Organization projections, by the year 2025 the world will include approximately 1.1 billion elderly people (Gandolfi and Skora 2001). In 2011, Canada's total population is projected to be 35.4 million, 5 million of whom will be 65 years of age and over (Rosemberg and Moore 1997). In Manitoba this population will constitute approximately 196,100 people in 2016, and 294,800 in 2031. The 75-84 age group is expected to grow 50% by 2031, totaling 36,000 people (Belanger et al. 2005). Reasons for this occurrence may be the increase in the average life span, especially during the second half of the 20th Century in the developed countries (Bean et al. 2004).

The aging process is associated with physiological changes such as a loss of muscle mass, a decline in nerve conduction compromising reaction speed (Shephard 1997), a decrease in pulmonary ventilation (Chambers et al. 2008), decrease in bone mineral density (Kohrt et al. 2004), and increased fat mass (Sowers et al. 2007). However, the extent of these changes varies from one individual to another (Hillsdon et al. 2005). These age-related changes may lead to a decline in physical capacity (Carlson et al. 1999) compromising the level of physical function and limiting the ability to interact with the social and physical environment (Cavani et al. 2002; Bean et al. 2004).

Significant implications of an aging population include a high incidence of chronic diseases (Abegunde et al. 2007), and increased costs related to health care. These costs may be observed by an increased use of medication (Blumstein et al. 2008; Fillenbaum et al. 1996) and higher hospitalization rate (Jun et al. 2007). Priority has been given to develop adequate and cost-effective health policies in order to enhance quality of life among older adults, such as preventive health care (Gallegos-Carillo et al. 2008), home care services (Leon-Munoz et al. 2007), and chronic care education for health professionals (Boult et al. 2008), as well as an increased number of health professionals in geriatric medicine, particularly in the United States (Besdine et al. 2005).

Regular physical activity has been shown to have numerous health benefits for older adults. These range from the physiological, for example improvements in blood pressure, increased muscle strength (Bean et al. 2004), and better balance control (Buatois et al. 2007), to the psychological, such as improvements in depressive symptoms (Juarbe et al. 2006) and mood management (Sallis and Owen 1999). Better cognitive performance (Landi et al. 2007) and social benefits such as social networks (Greaves and Farbus 2006) have also been reported.

Walking is the most common type of physical activity engaged in by older adults (Michael et al. 2006) accounting for an important portion of total daily activity (Humpel et al. 2004(a)). It is convenient, offers low risk of injuries, and can be performed at different intensities (Ekkekakis et al. 2008, ACSM 2006). Some recognized benefits include improvements in cardio respiratory fitness (ACSM 2006), and in functional capacity (Rooks et al. 1997).

Physical activity is influenced by a variety of factors, including biological, social, psychological, and environmental parameters (Sallis and Owen 1999). Among these, personal factors such as age, gender, health status (Gagliardi et al. 2007), income level (Eyler et al. 2003), functional capacity (Lim and Taylor 2005) and support coming from friends and family (Phongsavan et al. 2007) may influence people's decisions to engage in regular physical activity.

The environment is one of the least understood factors known to influence physical activity behaviour (Humpel et al. 2002). Neighbourhood characteristics such as aesthetics (King et al. 2006(b)), accessibility to services, street connectivity (Leslie et al. 2005), and land use mix (Frank et al. 2005), may be associated with physical activity participation. However, most research has focused on physical activity in general, and was done with younger adults. There is a need to determine the extent of the relationship between personal and environmental factors on walking in older adults living in the community, and to understand which factors in particular play an important role for walking engagement. This may help health professionals as well as city planners promote effective strategies to increase physical activity participation.

This study addressed the association of environmental factors, each attribute studied individually, as well as several personal factors with physical activity. Several explanatory variables were considered in order to explain walking behaviour among older adults.

1.1 Statement of Purpose

This study examined the association of personal factors and perceived neighbourhood environment with walking levels in community-residing older adults. The specific purposes of the study were two-fold:

1) To examine the relationship between personal factors (age, gender, income, education, number of health conditions self-rated health, social support, and levels of physical function) and walking behaviour in older adults residing in a downtown neighbourhood.

2) To examine the relationship between the perceived local physical environment (accessibility of services, street connectivity, places for walking, neighbourhood aesthetics, and safety) and walking behaviour in older adults residing in a downtown neighbourhood.

1.2 Study Hypotheses

With respect to the relationship between personal factors and walking behaviour (purpose number 1), it is hypothesized that:

1. Younger age, male, higher education and income, better health, higher levels of physical function, and better social support will be associated with a greater number of steps.
2. Participants who do not drive will have a greater number of steps.
3. Participants who walk outdoors, will have a greater number of steps.
4. Participants who walk primarily for health purposes will have a greater number of steps compared to those who walk primarily for recreation or for transportation.

With respect to the relationship between the perceived local physical environment and walking behaviour (purpose number 2), it is hypothesized that:

5. There will be a significant and positive association between perceived access to services, neighbourhood aesthetics, street connectivity, places for walking, and the total score for NEWS-A (which reflects the total friendliness of the neighbourhood), and average number of steps.
6. There will be a significant and negative association between perceived traffic hazards and crime and average number of steps.

1.3 Framework

This study was based on the International Classification of Functioning, Disability and Health (ICF) proposed by the World Health Organization (WHO 2001). This model explains health in a biopsychosocial context. Health conditions are influenced by changes in the micro level, such as alterations in body organs and systems, as well as in the macro level such as social participation and civic life. This model also acknowledges the influence of personal and environmental factors on health. The relationship among these domains does not follow a linear influence, but rather, is all interrelated. Focusing on opportunities for health among older adults, the WHO proposed the Active Aging framework. The objective is not only to promote but also to maximize health, security, and participation among older adults and to provide quality of life (WHO 2002).

Ecological model also was used as framework. This model states that health and well-being are based on a broad interaction between the physical environment, such as architecture and geography, and the social cultural environment in which one lives. This approach acknowledges the importance of public policies, including laws, and rules to influence healthy behaviour (Stokols 1992). Ecological models have been used to explain physical activity participation, as the physical and social environments, as well as public policies exhibit a significant influence on a decision to be physically active (Sallis et al. 2006). As observed, these models acknowledge the broad influence of the environment for health enhancement, thus will be considered as frameworks for this study.

1.4 Study Delimitations

1. This study was done with healthy, community (apartment) dwelling older adults aged 65 and above, thus limiting the generalizability of the results.
2. This study was conducted in the fall and spring in a large Canadian city.

1.5 Study Limitations

These are situations that may impact the results of the study

1. The assessment of environmental factors was done using self reported measurement, consequently it considered participants' perception about the neighbourhood environment rather than an objective measurement.
2. Participants were asked to volunteer for the study; therefore there is the possibility of biased results.
3. Pedometers were self administered and read.

1.6 Assumptions

1. Pedometers (used for a 3-day period) will accurately reflect physical activity levels.
2. Volunteer subjects will be representative of older adults in the community.
3. The perceived neighbourhood environment was measured using a Likert Scale. For statistical analyses, this implies that the difference between any two successive values are equivalent in significance; this means that the difference between "strongly disagree" and "disagree" is equivalent to the difference between "agree" and "strongly agree".

1.7 Definitions

Aging

An intrinsic, progressive and biological process characterized by anatomical, physiological and psychological changes. It is not a consequence of diseases and it is variable among individuals (Freitas et al. 2002(a)).

Age Classification

Middle age extends from age 40 to age 64. Old age extends from 65 to 74 years of age. Very old age extends from age 75 to age 84. Oldest old age comprises individuals 85 years of age and over (Shephard 1997).

Activities of Daily Living (ADL)

Basic activities related to everyday life (e.g. dress, feeding oneself, use the toilet) (Andreotti and Okuma 1999).

Built Environment

Human-formed, developed or structured areas (e.g. paths, sidewalks, parks) (Centers for Disease Control and Prevention, Available at http://www.cdc.gov/healthyplaces/terminology Accessed April 24, 2008).

Environmental Factors

Physical, social and attitudinal space in which people conduct their lives (WHO 2001).

Exercise

Represents planned and repetitive body movements for improving or maintaining physical fitness (Brach et al. 2004).

Functional Limitation

Reduced ability to complete specific activities (Morey et al. 1998).

Instrumental Activities of Daily Living (IADL)

Complex activities related to one's adaptation to the environment (e.g. meals preparation, shopping, financial management) (Andreotti and Okuma 1999).

Metabolic Equivalent (MET)

A measure of energy expenditure where 1 MET is equivalent to the energy expended (in kilocalories) divided by resting energy expenditure (in kilocalories) (Montoye et al. 1996).

Personal Factors

Background of the individual's life such as age, gender, race, habits, upbringing, coping styles, education, social background, past and current experience, character style, as well as other psychological assets (WHO 2001).

Physical Ability

A general term to encompass muscle strength, endurance, balance, flexibility, and neuromuscular coordination (Carlson et al. 1999).

Physical Activity

Body movement that results in increased energy expenditure (Brach et al. 2004), also considered a behaviour (Bean et al. 2004).

Physical Environment Components (attributes)

Neighbourhood aesthetics, land use-mix access, street connectivity, infrastructure for walking/cycling, traffic, and crime safety (Cerin et al. 2006).

Physical Fitness

The condition resulting from increased physical activity (Bean et al. 2004).

Physical Fitness Components

Muscle strength, endurance, flexibility, aerobic capacity, anaerobic capacity and body composition (Buchner et al. 1992).

Physical Function

The integration of physiological capacity and physical performance mediated by psychosocial factors (Cress et al. 1996).

Physically Active Lifestyle

A way of life that integrates physical activity into daily routines (Sisson 2005).

Sedentary

A person whose lifestyle is marked by much physical inactivity and relatively little physical activity (Tudor-Locke 2003).

Chapter 2 – Literature Review

2.1 Health, Function and Active Aging

Since the mid 1960`s there has been an increasing interest in finding a universal model to describe the relationships between function and health. Several conceptual models have been proposed throughout the years. Nagi's model (Nagi 1965) represented the initial framework and served as the basis for other models. In 1980 the World Health Organization (WHO) proposed the International Classification of Impairments, Disabilities and Handicaps (ICIDH) in order to clarify these concepts (WHO 1980). However, the ICIDH model presented problems in terms of study design, internal consistency and measurement feasibility (Verbrugge and Jette 1994). In order to provide a standard language for a description of health and health related factors the WHO launched the International Classification of Functioning, Disability and Health (ICF) (Figure 1). This model includes a biopsychosocial context with respect to the body, the individual and the society (WHO 2001). As described within the model, *Health* is a term used to represent disorders, diseases, trauma, injuries, aging, and congenital abnormality. *Body function* represents the physiological as well as psychological functioning of the body, while *Body structures* represent anatomical parts of the body (organs, tissues, limbs). *Activity* reflects the execution of a task by the individual, and *Participation* represents the involvement in life situations. Although not included in the model, the WHO defined decreases in each level of the model. Thus, impairments represent problems in body functions or structures, activity limitation represents difficulties in executing activities, while participation restrictions are problems that an individual may experience in life situations. Disability is used as an umbrella term to address impairments, activity limitation, and participation restrictions.

The ICF model includes 2 contextual factors: environmental and personal factors. Environmental factors include: products and technology, natural environment and human-made changes to the environment, support and relationships, attitudes and services, systems and policies. Personal factors include the background of an individual's life such as age, gender, race, health conditions, habits, upbringing, fitness, lifestyle, coping styles, social background, past and current experience, character style, psychological factors, and assets.

The great contribution of the ICF model is that the domains do not follow a linear progression (such as do the other models), but rather are all interrelated. Another unique contribution is that both environmental and personal factors are deemed to influence health. This model has been used to understand function, activity and participation in a variety of health conditions such as geriatric rehabilitation (Gladman 2008), spinal cord injuries (Biering-Sorensen et al. 2006), rheumatologic diseases (Braun et al. 2007), patellar dysfunction (Hegelson and Smith 2008), and depression (Nieto-Moreno et al. 2006). The ICF model has helped to better understand how the various levels of interaction between the person and the environment impact health. It has also demonstrated that appropriate support and intervention is a multidisciplinary process (Gladman 2008).

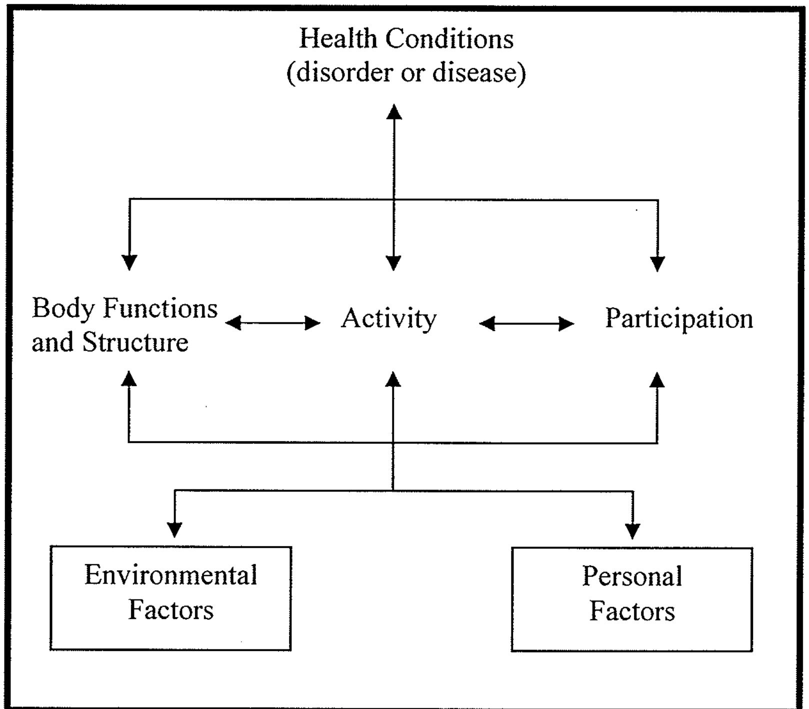


Figure 1. International Classification of Function, Disability and Health Model (ICF) (WHO 2001).

In order to optimize health for the elderly, the WHO launched the Active Aging framework, defined as: "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" (WHO 2002, page 12). The goal is to maximize resources for people, regardless of the level of functional capacity, not only to be physically active, but also to be independent, and able to participate in social, civic, cultural and spiritual activities. Recently, the WHO has acknowledged the importance of both environmental and social factors for active aging in urban settings, and has proposed a new framework called The Global Age-Friendly Cities initiative (WHO 2006). In this project, services, activities and opportunities are developed to enhance mobility and independence as people age, in a respectful environment.

As observed, both ICF and Active Aging acknowledge the influence of personal and environmental factors on activity and participation among older adults. Therefore they will constitute the conceptual basis for this study.

2.2 The Aging Process

The human body relies on a harmonious balance between organs and systems. Aging *per se* is responsible for significant physiological and cognitive changes, which may affect physical and cognitive functions, limiting the capacity to live an independent life (Carlson et al. 1999; Cançado 1999). However, the extent of this decline varies considerably from one individual to another (Hillsdon et al. 2005). This section will consider the main age-related changes and their implications.

2.2.1 Cardiovascular and Respiratory Systems

The main cardiac anatomic changes are a decrease in the number, and enlargement of the remaining myocites. As a consequence, there is a hypertrophy of the heart tissue from 1 to 1.5g per year between 30 and 90 years of age. Thickening of the left ventricle, as well as of the interventricular septum, is also observed (Pereira et al. 2002). An increasing deposition of collagen fibers, particularly in the left ventricle, may lead to ventricular stiffness, reducing the cardiac compliance and impairing diastolic function (Baldi et al. 2007; Pereira et al. 2002). In the vascular system there is a loss of elasticity in the arteries, and an increased deposit of atherosclerotic plaques especially in the coronary, aortic and carotid arteries, which can also be caused by unhealthy habits such as unbalanced diet and smoking (Wagenknecht et al. 2007). These changes lead to an increase in peripheral vascular resistance (Pereira et al. 2002). Physiological changes include an increase in blood pressure, in part because of increased vascular resistance and ventricular stiffeness (Pereira et al. 2002).There is also a significant decline in maximal heart rate and maximal cardiac output which may lead to a decline in maximal oxygen consumption, from approximately 5 to 15% per decade after the age of 25 (Mazzeo et al. 1998; Hollmann et al. 2007).

Aging is also responsible for changes in the respiratory system. Anatomical changes may occur in the chest wall such as the "barrel-shaped" deformity or augmented kyphosis. The loss of elasticity at the articulation of the spine and ribs (Shephard 1997), as well as increased abdominal adiposity (Chambers et al. 2008) can contribute significantly to reductions in pulmonary compliance and ventilation. At the micro level, aging reduces the proper function of the alveolo capillary membrane (Rouatbi et al. 2006); and although arterial oxygen tension does not decrease with advancing age (Guenard and Marthan 1996), pulmonary diffusion and total capillary lung volume presents a significant decrease. However an increase in capillary compliance with negative pressure could be a physiological adaptation for this process (Rouatbi et al. 2006).

2.2.2 Muscular System

Aging is responsible for a gradual decrease in the number, and in the average size, of muscle fibers. This gradual loss of type II (faster contraction) and type I (slow contraction) muscle fibers, known as sarcopenia, may affect muscle strength and power (Janssen et al. 2002; Mazzeo et al. 1998). It is caused by reduction in protein synthesis and an increase in muscle protein degradation, contributing to a significant reduction in muscle cross sectional area (Di lorio et al. 2006). Satellite cells, mainly responsible for muscle growth and reparation, are significantly reduced in type II fibers, perhaps being a factor that contributes to accelerated loss (Verdijk et al.2007). Changes in diameter of these fibers, particularly type II are also observed, suggesting that remaining fibers attempt to compensate muscle loss, and optimize strength (Frontera et al. 2008). A selective denervation of muscle fibers with aging occurs, most notable among the largest and fastest motor units (Brown 1972). The reinervation of these fibers happens by an axonal sprouting from an adjacent motor unit that has retained its neuromuscular supply. Fat and connective tissue also gradually infiltrate the muscle (Shephard 1997). All these anatomical changes result in a decline in muscle strength, one of the most significant factors observed during the aging process as it impacts physical function and leads to disability. Changes in muscle power with advancing age have received considerable attention because the decline in muscle power is even greater, especially later in life (Bean et al. 2004; Skelton et al. 1994), particularly in big muscles such as the quadriceps (Skelton et al. 1994).

2.2.3 Nervous System and Cognition

Aging is associated with several anatomic alterations in the nervous system. A decrease in the number and size of nerve cells, as well as the diameter of the axons is observed (Watanabe et al. 2007; Gandolfi and Skora 2001). This decrease is progressive, accounting for 10% to 20% of total reduction in cerebral mass between 20 and 90 years of age (Shephard 1997). There is a reduction in the speed of nerve conduction and demyelination of the axons, impacting not only motor, but also cognitive functions (Kovari et al. 2004). Parts of the brain present an altered function regarding the production of neurotransmitters, with significant reduction observed (Mora et al. 2007). Visual impairments are mainly observed because of age-related macular degeneration. Associated diseases such as glaucoma, cataracts and diabetic retinopathy contribute to reduction in visual field and visual acuity (Quillen 1999). Impairments are also noted in the olfactory system. One of the reasons is the neuronal distribution in the olfactory neuroepithelium (Biacabe et al. 1999). The vestibular system loses ciliar cells and nerve fibers around the semicircular canal (40% loss after the age 70) (Junior and Heckmann 2002). Proprioceptors and skin receptors experience impairments with aging that compromise sensory information (Junior and Heckmann 2002). Because aging is characterized by a decline in reaction time, and movement velocity (Borah et al. 2007), it impacts directly the maintenance of posture, balance and gait. This process in association with diseases, limits the ability to control body movements and ensure proper balance control, especially in situations of conflicting sensory information (Buatois et al. 2007; Matsumura and Ambrose 2006). The decrease in balance control is directly associated with an increased risk for falls (Buatois et al. 2007). These neurological changes may also compromise important intellectual functions such as cognition and learning capacity (Kliegel et al. 2007).

2.2.4 Osteoarticular System

During one's lifetime, the mechanical stress placed on the bones, ingestion of calcium, and sex hormones are factors that significantly contribute to peak bone mass (Pereira et al. 2002). Aging greatly impacts bone health. There is a decrease of bone mineral content (BMC) that occurs faster in women (36g/decade) than in men (30g/decade) (Shephard 1997). Women are more vulnerable because of processes related to menopause that lead to an accelerated loss of calcium (Freitas et al. 2002(b); Kohrt et al. 2004). In early old age, bone loss is greater in trabecular than in cortical bone. Bone loss is directly related to an increased risk of osteoporosis (Davis et al. 2006; Eastell 2007), however it may be just a consequence of advancing age, known as senile osteoporosis or type II (Vieira et al. 2002), or a consequence of decline in estrogen (osteoporosis type I). Early bone health intervention in older adults is necessary, as the risk of fractures increases with advancing age (Davis et al. 2006).

Tendons and ligaments are structures that differ in composition and shape, however they are mainly composed of type I collagen. Changes in the structure of collagen that occur during aging are loss of fiber orientation, inactivity, and decrease in vascular nourishment, which compromise the elasticity of tendons and the stability of ligaments (Freitas et al. 2002(b)). Such changes lead to a reduced capacity to respond properly to mechanical forces and stress resistance (Zschabitz 2005). Aging of the osteoarticular system also affects posture. The most reported change is an increase in thoracic kyphosis, sometimes followed by an increase in lumbar lordosis (Gandolfi and Skora 2001).

2.2.5 Body Composition and Metabolism

Body mass usually increases from age 25 to age 45, but after that there is a progressive decline. Lean body mass, which has a protective effect on bone mass (Travison et al. 2008), normally is preserved to about 40 years of age, with a high rate of loss thereafter (Chen et al. 2008). Fat mass and lean mass have been associated with bone mineral content. Although an increased lean mass has a greater association with increased bone mineral content than fat mass, among women, fat mass is a stronger predictor for bone mineral content than lean mass (Gjesdal et al. 2008). Body composition and metabolism have a significant gender difference. An age-related increase in body fat is also observed, and men accumulate more fat predominantly around the abdomen, whereas women normally accumulate fat in the hips and thighs (Shephard 1997). Men have reduced fat oxidation compared to women (Horber et al. 1997). Women have increased oxidative status and increased fat mass (Pansini et al. 2008) because of changes in the ovarian function regarding secretion of FSH (Sowers et al. 2007) that occur during menopause. Post menopausal women are also more likely to accumulate central fat compared to young women (Koskova et al. 2007). The content of corporal water also has a significant decrease from 13% to 15% between the ages of 25 and 75 (Freitas et al. 2002(b)). Dyslipidemia and reduced insulin sensitivity are also reported with aging (Mazzeo et al. 1998; Hunter et al. 2004).

2.3 Measurement of Physical Activity

Increasing physical activity participation among older adults is a major priority of public health practitioners. A physically active lifestyle confers a wide variety of physical and cognitive benefits, maintains levels of functional capacity, and lowers the dependence on the health care system (Bean et al. 2004; Martin et al. 2006). However, in order to report benefits, physical activity levels need to be measured and quantified through standard, valid, and reliable methods, suitable for different groups and populations. Several methods and instruments have been proposed to measure physical activity behaviour. Some of them have been specifically proposed for an older adult population, taking into consideration common physical activities, time to complete, suitable response format, and avoidance of physical stress in order to ensure safety. This section will consider both self-reported and objective measurements of physical activity.

2.3.1 Self-Reported Measurements

Self reported measurements are commonly used in observational studies, or to measure the effect of an intervention program. They generally have a questionnaire format, which requires participants to report their activities over a particular time. The questionnaires can be self administered, or be completed through an interview, or by telephone or mail. Depending on the type, respondents may list frequency, duration, and intensity of the activity, as well as leisure and/or occupational activities (Sallis and Owen 1999).

In the Seven Day Recall Physical Activity Questionnaire (Blair et al. 1985), participants are asked to estimate the number of hours spent during the last seven days and the total amount of time spent in each activity. Activities are classified as light, moderate, hard, and very hard. Metabolic equivalents (MET's), multiples of resting energy expenditure, are assigned to the activities based on values existing in the literature. This questionnaire has recently been used to assess the relationship among physical activity levels, obesity and health related quality of life in community-dwelling older adults, and has shown acceptable validity among this population (Kostka and Bogus 2007). The Seven Day Recall Physical Activity Questionnaire has shown significant correlations with objective measurements of physical activity (Motl et al. 2006).

The Physical Activity Scale for the Elderly (PASE) (Washburn et al. 1993) was designed for assessing physical activity in older adults. It includes 12 types of sport and recreational activities in which the elderly commonly participate, classified as light, moderate, and heavy. The score is obtained by multiplying each activity engaged in by a weighting factor, and summing the product for all 12 items. Test-retest reliability was administered by mail and telephone interviews, and correlation coefficients of 0.84 and 0.68 respectively were reported. The validity of this test was examined using an accelerometer, and the PASE scores were correlated with the accelerometer readings for the total sample ($r= 0.49$) and for those over 70 years of age ($r= 0.64$) (Washburn and Ficker 1999). This instrument has been used to assess physical activity level, (Cohen-Mansfield et al. 2003), and to examine relationships between sociodemographic, health-related, and environmental factors with physical activity in older adults (Chad et al. 2005). It also has been used to investigate relationships between physical activity and functional limitations (McAuley et al. 2006; McAuley et al. 2007).

In the Physical Activity Questionnaire for the Elderly (PAQE) (Voorips et al. 1991), participants are asked to report their habitual physical activity over the past one year. The questions include household activities, sports, and leisure activities. Items related to household activities use a 4 to 5 point rating scale, while sports and leisure activities include type of activity and frequency. Relative validity was tested using a questionnaire and pedometer recordings, and correlations coefficients of 0.78 and 0.72 were reported. Test-retest reliability had a correlation coefficient of 0.89. It has been used to compare physical activity levels, functional ability, and physical characteristics in older adults living in different settings (Schroeder et al. 1998); however it has not been used as frequently as the other instruments.

The International Physical Activity Questionnaire (IPAQ) (Craig et al. 2003) is one of the most recent instruments proposed to measure physical activity. It contains a long version which collects detailed information about household, yard work activities, occupational activities, self powered transport, leisure and sedentary activities. The short version gathers information about the time spent walking, in vigorous and moderate intensity activities, and in sedentary activities. Total weekly physical activity is estimated by weighting the reported minutes per week in each category by a MET value. Test-retest reliability ranged from 0.96 to 0.46, as it was administered in different countries. Concurrent validity between the short and long versions had a pooled Spearman's correlation coefficient of 0.67. Criterion validity was tested against accelerometers and a pooled spearman's correlation coefficient of 0.33 was reported. This instrument has been translated, and used worldwide from the United States to Japan, China, Brazil, and South Africa. It has been used to examine relationships between physical activity and mental health (Benedetti et al 2008), falls incidence (Mazo et al. 2007), health related quality of life (Shibata et al. 2007), physical environment (Hoehner et al. 2005), and walking transportation (Cerin et al. 2007). This questionnaire is normally acceptable for measuring physical activity levels in people between 18 and 65 years of age, but recently its reliability and validity were confirmed among older adults, providing a reasonably reliable estimate of physical activity (Deng et al. 2008; Kolbe-Alexander et al. 2006). Other authors have developed their own questionnaires to address physical activity (Aslan et al. 2008; Sumic et al. 2007; Foster et al. 2004; Michael et al. 2006).

Although commonly utilized, self-reported measures of physical activity may lack accuracy. They are useful in demonstrating whether people are more or less active but they fail in providing the absolute level of physical activity (Sallis and Owen 1999). According to Tudor-Locke and Myers (2001(a)), few methods address spontaneous or routine physical activity such as household chores, family care, or capture intermittent physical activity.

2.3.2 Objective Measurements

Accelerometers and pedometers are the most commonly utilized objective measures of physical activity. These motion sensors are able to identify gradation of walking behaviour and to present unrestricted baseline values because they can capture the least amount of physical activity (Tudor-Locke and Myers 2001(a)).

Accelerometers record the frequency and intensity of trunk movement. They can also estimate energy expenditure based on personal characteristics such as age, height, weight and gender. Results are displayed on a screen, or can be downloaded for computer analysis (Tudor-Locke and Myers 2001(a); Sallis and Owen 1999). Some models can determine time spent performing various activities at different intensities, however the cost and technical requirements for use represent a considerable disadvantage (Tudor-Locke et al 2002(a)). For their higher sensitivity, accelerometers are more likely to detect trunk movements that are not considered steps, such as during vehicle travelling conditions (Le Masurier and Tudor-Locke 2003). Recently, accelerometers have been shown to be reliable instruments, providing credible results to measure levels of physical activity, even among individuals at old and very old ages (Orsini et al. 2008(a); Gerdhen et al. 2008; Yasunaga et al. 2008). Accelerometers have also been used to report levels of physical activity among residents in different neighbourhoods (Saelens et al. 2003(a); Frank et al. 2005).

Pedometers are instruments designed primarily to detect number of steps taken (Tudor-Locke and Myers 2001(a)). Depending on the type accelerometer used (uniaxial), pedometers have been shown to have acceptable accuracy and validity (Tudor-Locke et al 2002(b)) and are believed to be a suitable method for quantifying physical activity when the predominant behaviour is walking (Tudor-Locke and Myers 2001(a)). However some problems and disadvantages have been reported. At slower walking speed (Crouter et al. 2003; Cyarto et al. 2004; Rowlands et al. 2007; Storki et al 2008;Tudor-Locke et al. 2002(a); Tudor-Locke et al. 2002(b)), or among older adults with gait disorders (Cyarto et al. 2004), pedometers have been shown to lack of accuracy, underestimating steps taken. This could represent a problem in assessing frail older adults (Cyarto et al. 2004).Pedometers also have been shown to lack of accuracy for estimating distance taken, or for detecting energy cost (Crouter et al. 2003).

When pedometers are compared to subjective measurements of physical activity (questionnaires), some studies have shown an acceptable degree of agreement. De Cocker et al. (2008) compared pedometer data in an adult sample with four physical activity questionnaires, including the long and short version of IPAQ. Correlations ranged from 0.32 to 0.37. According to the authors, the low correlation may be explained by the fact that these questionnaires consider many different activities, other than walking in particular. However higher number of steps taken, were associated with increased levels of physical activity in the IPAQ (De Cocker et al. 2007). Ewald et al. 2008 reported a correlation of 0.33 between the PASE and pedometry data. Authors acknowledged that the two instruments may measure different aspects of physical activity. Mestek et al. 2008 reported that pedometers had higher agreement with the self reported questionnaire (IPAQ, short version) among younger men (r= 0.33) than among young women. Bassett et al. 2000 used a daily walking distance questionnaire and pedometers. Results showed that participants underestimated walking distance compared to pedometers.

Indices have been proposed to classify levels of physical activity based on steps walked per day. Tudor-Locke and Bassett (2004) presented the following criteria for healthy adults: less than 5,000 steps/day is considered 'sedentary'; between 5,000–7,499 steps/day is considered 'low active'; between 7,500–9,999 is considered 'somewhat active' as it may include occupational activity; 10,000 steps/day is considered 'active'; and over 12,500 steps/day is considered 'highly active'. Another classification (Tudor-Locke and Myers 2001(b)) based on age ranges suggest that for young adults, the expected number of steps per day is between 7,000 and 13,000. For healthy older adults the proposed range is between 6,000 and 8,500 steps/day.

Although pedometers have been shown to be a reliable instrument to estimate physical activity, a minimum number of days have been suggested in order to achieve reliability. Togo et al (2008) suggested that among older adults, in order to predict annual activity with a reliability of 90%, 105 days are required for men and 37 days for women, for consecutive days of observation. For days sampled on random basis, 11 days are required for men and 9 days for women. If days are sampled on a random basis, but considering season effects, the number of days reduced to 8 for men and 4 days for women. Clemes and Griffiths (2008) recommended 7 days of pedometer recording in order to get a reliable estimate of monthly physical activity in adults. Strycker et al. (2007) reported coefficients of 0.80 or greater were obtained with 5 or more days of pedometer recording in a youth sample and 2 or more days in a sample of older women (type 2 diabetes).

Pedometers have been used for a variety of purposes, such as to increase physical activity among middle aged adults (Bravata et al. 2007), and among older adults (Croteau et al. 2007; Yasunaga et al. 2008) living in the community. They also have been used to quantify physical activity under a variety of health conditions such as individuals with multiple sclerosis (Motl et al 2006), diabetes (Tudor-Locke et al (2002(c)), Parkinson's disease (Dijkstra et al. 2008) and vascular disease (Gardner and Poehlman 1998). Other health-related benefits were also studied such as a decrease in body mass index and systolic blood pressure (Bravata et al. 2007). Pedometers have also been used to study relationships between the neighbourhood environment and physical activity levels in older adults (King et al. 2005).

2.4 Benefits of Physical Activity and Exercise for Older Adults

Studies show that regular physical activity is related to decreased morbidity and mortality (Bean et al. 2004; Boyle et al. 2007). Older adults account for a significant proportion of those with chronic diseases, which often lead to a decrease in physical ability (Carlson et al. 1999). A physically active lifestyle may reduce the risk for, or the severity of, chronic diseases (Van der Bij et al. 2002), including coronary heart disease, and cancer of the colon (Blain et al. 2000). Physical activity also reduces functional impairments (Lang et al. 2007), thus leading to decreased utilization of the health care system (Martin et al. 2006). Alternatively, older adults who do not engage in regular physical activity are more likely to report pain, mobility limitation, and emotional problems (Sawatzky et al. 2007), and chronic conditions such as metabolic syndrome (Strath et al. 2007(a)).

A physically activity lifestyle is a predictor of mortality (Talbot et al. 2007; Orsini et al. 2008(b)), particularly for cardiovascular diseases (Blair et al. 1995; Haapanen-Miemi et al. 2000). Increased physical activity is also a predictor for reduced premature death (Inoue et al. 2008). Even routine physical activity, those activities related to getting around the house, is a predictor of mortality (Chipperfield 2008).

Despite this, many older adults do not participate in physical activity at recommended levels (Orsini et al. 2008(a); Brach et al. 2004; Nied and Franklin 2002). In addition to benefits such as reduced mortality and morbidity, physical activity has many other physiological, psychological, and functional benefits which will be discussed in this section.

2.4.1 Cardiovascular System

When compared to a sedentary person, an older adult who exercises regularly at a moderate intensity has increased oxygen uptake, better aerobic capacity (Deley et al. 2007), and a lower heart rate (Ogawa et al. 1992). An early diastolic filling is observed, which may facilitate increased stroke volume and cardiac output (Levy et al. 1993).

Lower resting blood pressure has also been reported (Bean et al. 2004). However, improvements in maximal oxygen consumption may occur depending on the intensity of the exercise program undertaken. Light-intensity programs elicit minimal or no changes in VO2 max (Mazzeo et al. 1998), whereas high-intensity endurance training has been found beneficial in older adults (Osteras et al. 2005). Lower heart rate is observed in different modalities of exercise such as resistance training (Wood et al. 2001), endurance training (Huang et al. 2005), and eccentric traning (Melo et al. 2008). Resistance training is also beneficial for reducing systolic (Wood et al. 2001) and diastolic blood pressure in older adults (Taaffe et al.2007). Even habitual walking has shown improvements in cardiorespiratory fitness and systolic blood pressure (Lee et al. 2007(a); Wong et al. 2003).

2.4.2 Muscle Strength and Muscle Power

Regular physical activity has been shown to improve muscle strength (Van der Bij et al. 2002; Carlson et al. 1999; Hunter et al. 2004; Holviala et al. 2006). Resistance-training programs have shown great benefits on muscle strength in older adults, however the results are maximized at higher intensities (Rabelo et al. 2004). High intensity resistance training at low velocity has shown to be more beneficial than low intensity training for increasing strength (Beneka et al. 2005). In the long term, resistance-training may be beneficial for older adults, as it increases and maintains the strength and functionality of big muscle groups, such as the quadriceps, benefits which may remain even if the exercise is discontinued (Porter et al. 2002). Strength training in older adults is also beneficial not only for muscle function itself, but also for functional capacity, contributing to an independent lifestyle (Capodaglio et al. 2007). Walking training on a regular basis has also presented positive benefits on muscle strength (Simons and Andel 2006).

Regular physical activity and exercise has also shown improvements in muscle power (Van der Bij et al. 2002; Carlson et al. 1999). Resistance training not only produces improvement in muscle strength but also in muscle power (Henwood et al. 2008), however high velocity training programs are associated with higher improvements in power (Bean et al. 2004; Henwood et al. 2008). Power training has also shown to be more beneficial for physical function than strength training among older adults (Misko et al. 2003; Bottaro et al. 2007; Hazell et al. 2007), The relationship between power achievement and higher function is associated with better quality of life (Katula et al. 2008).

2.4.3 Flexibility and Balance

Improvements in flexibility and balance are also related to regular participation in physical activity (Carlson et al. 1999; Buchner et al. 1992). Flexibility training and stretching on a regular and long term basis, has been shown to significantly improve flexibility, and to reduce overall body pain in community-dwelling older adults (King et al. 2000). Resistance-training has also been shown to increase flexibility; however improvements were only observed during moderate-intensity training and were lost when training was discontinued (Fatouros et al. 2006). Both static stretching with weights (Swank et al. 2003), or proprioceptive neuromuscular facilitation (PNF), have led to improvements in flexibility in older adults. However, caution should be considered in using PNF techniques, as older adults have decreased elastic tissue compared to young adults (Ferber et al. 2002).

Regular physical activity, even when started later in life, is beneficial for balance. Improved balance and posture have been observed in older adults who have participated in physical activity for a long time. However, in one study, even those who became active after retirement, had better balance performance compared to those who stopped for many years or who never participated in physical activity programs (Buatois et al. 2007). Studies have shown improvements in balance with various types of physical activity and exercise programs. Strength and power training have shown to be beneficial for dynamic balance in older adults (Holviala et al. 2006). Instability resistance training, for example using an instable platform has been shown to be an effective modality to improve balance and postural stability especially among athletes, but research is needed to confirm positive results for older adults (Anderson and Behm 2005). Even group-exercise training using traditional home exercise can improve balance (Barnet 2003). According to Orr et al. (2006) the decline in balance associated with aging may be affected by the decline in muscle power. They examined the effect of power training at different intensities on balance performance, and found that low intensity training had the greatest impact. Tai Chi Chuan has also shown improvements in balance and has been shown to prevent falls among older adults (Lin et al. 2006; Voukelatos et al. 2008).

2.4.4 Bone Health

Mechanical stress on bone is responsible for electric potentials that affect the balance between osteoblasts and osteoclasts, therefore increasing bone mineral density (Freitas et al. 2002(b)). Regular physical activity contributes to maximizing peak bone mass in the young, and to minimizing age-related bone loss (Bloomfield 2005). Past participation in physical activity has shown to be associated with higher bone mass density among women (Ford et al. 2004). Different types of physical activity have contributed to maintenance of bone mass. Strength and power training for example, have been shown to be beneficial to bone mineral density in postmenopausal women; however, power training has been shown to be more effective at preserving bone density among this group (Stengel et al. 2005). Moderate to vigorous activities have also shown a positive effect on bone health (Havill et al. 2007). Kohrt et al. (2004) presented a position stand from the American College of Sports Medicine confirming the importance of physical activity for bone health and prescribing recommended exercises. In order to preserve bone mass in adulthood, weight-bearing activities involving jumping, resistance training, and/or weight-bearing endurance are recommended. For older adults, weight–bearing exercises and resistance training are the most recommended. Recently, Tai Chi Chuan practice has shown to be effective among physically active older adults for retarding bone mass decline and promoting overall health (Lui et al. 2008).

2.4.5 Body Composition and Metabolism

Physical activity has a protective role on body composition, as it prevents age-associated changes in metabolism (Horber et al. 1996) and reduces weight gain (Jenkins and Fultz 2008). Increased physical activity has shown a protective role against metabolic diseases (Ekelund et al. 2007). Obesity among older adults not only limits physical activity participation but also reduces physical function and mobility (Koster et al. 2008; Woo et al. 2007). Physical activity can improve insulin sensitivity (Gill et al. 2007; Kirwan et al. 1993), especially among older adults with impaired glucose tolerance (Bloem and Chang 2008). It can also reduce body fat and improve the lipid profile (Gandolfi and Skora 2001). Resistance training may have a positive effect on metabolism in older adults, as it can increase muscle strength and fat free mass (Hartman et al. 2007), enhances energy expenditure (Hunter et al. 2004). Even among frail older adults, progressive resistance training can increase fat free mass (Binder et al. 2005). Although physical activity cannot prevent body fat accumulation, a regular active lifestyle is associated with less total fat and less trunk fat (Raguso et al. 2006).

2.4.6 Psychological and Cognitive Benefits

Many psychological and cognitive benefits such as improved self-esteem, decreased levels of stress and anxiety, improved cognitive function, and better sleep quality are related to regular physical activity (Gandolfi and Skora 2001; Sallis and Owen 1999). Depression has been shown to have a considerable impact on the well-being of older adults (Beekman et al. 2002), and a physically active lifestyle, may reduce the symptoms of this disease (Juarbe et al. 2006; Lim and Taylor 2005). Lindwall et al.

(2007) investigated the practice of light and strenuous exercise to alleviate depression in older adults, and found that inactive older adults had higher depression scores than active individuals engaged in either light or strenuous exercise; however light exercise led to somewhat better results in women. Physical activity has also been shown to positively affect cognitive function among older adults. The intensity as well as variety of physical activity taken was significantly associated with cognitive benefits in one study, which also found that intensity was more strongly related to benefits than was duration of the activity (Angevaren et al. 2007). Among healthy older adults, physical activity engagement presents important benefits against cognitive impairments, such as dementia (Sumic et al. 2007; Ravaglia et al. 2008).

2.4.7 Benefits of Walking Among Older Adults

Walking is the most common physical activity engaged in by older adults (Berke et al. 2007; Michael et al. 2006; Lim and Taylor 2005; Walsh et al. 2001; Booth et al. 1997), accounting for a significant portion of total daily physical activity (Humpel et al. 2004(a)). It is associated with higher adherence than more vigorous activities (Lamb et al. 2002). Different purposes are reported for walking including exercise (Walsh et al. 2001; Booth et al. 1997), pleasure (Humpel et al. 2004(c)), leisure (Ball et al. 2007) and transportation (Suminski et al. 2005). Walking is convenient, safe, sociable, and does not involve financial costs, and is thus an appropriate type of activity for community settings (Ekkekakis et al. 2008).

Walking is associated with many health benefits such as better cognitive function (Weuve et al. 2004), better self reported pleasure (Ekkekekis et al. 2008), and with prevention of physical disability (Wong et al. 2003). Depending on the intensity, walking provides a range of effects. When performed at low intensity it is associated with improvements in neuromotor performance (Rooks et al. 1997) and recovery of independence among older adults with disabilities (Hardy and Gill 2005). At moderate intensity, walking may improve cardio respiratory fitness, and increase levels of energy (Ekkekekis et al 2008; Wong et al. 2003). Despite the many benefits of walking, many people do not meet the recommended levels of physical activity. Researchers have acknowledged the affect of several factors on walking behaviour (Alfonzo 2005).

2.5 Factors that Influence Physical Activity Participation in Older Adults

As with all human behaviours, a wide spectrum of factors influences participation in physical activity, including personal, psychological, cultural, psychosocial, cognitive, and emotional factors, and environmental influences (Sallis and Owen 1999).

2.5.1 Personal Factors

The influence on physical activity participation of several factors related directly to the individual will be presented in this section.

2.5.1.1 Age and Gender

In general, advancing age in conjunction with increased functional limitations impacts the decision to engage in regular physical activity (Janke et al. 2006). The proportion of the adult population who participate in physical activity is small (Sallis and Owen 1999). Sports, exercise, and leisure activities are normally associated with younger age (Manitoba *in motion* 2006; Gagliardi et al. 2007). According to the 2002/03 Canadian Community Health Survey, 59% of Canadians aged 65 years and over are classified as inactive, compared to 52% of those aged 45 to 64, 50% of those aged 25 to 44, and 40% of those aged 20 to 24. Fewer older adults are classified as moderately active (23%) or active (19%) than their younger counterparts (CCHS Cycle 2.1 2002/03, as cited by CFLRI 2004). Walking is considered to be a low intensity type of physical activity and has shown to be more accepted among older adults (Canadian Fitness and Lifestyle Research Institute (CFLRI 1998). However, despite the health benefits, studies have shown that advancing age has been associated with less participation in physical activity (Johannsen et al. 2008; Gagliardi et al. 2007; Eyler et al. 2003), or walking in particular (Payn et al. 2008; Davis and Fox 2007; Michael et al. 2006).

There are also gender differences in physical activity participation. Men are more likely to engage in physical activity and exercise than are women (Chad et al. 2005; Poortinga 2006; Brach et al. 2004), not only among younger adults, but also among older adults (Lim and Taylor, 2005; Aslan et al. 2008; Yasunaga et al. 2008). In a Swedish study of older women, the percentage who met the physical activity recommendation was only 31% (Orsini et al 2008(a)). Older women also reported more barriers to exercise compared to older men, including health concerns (Cohen-Mansfield et al. 2003).

2.5.1.2 Educational Level and Socioeconomic Status

Educational level has shown a positive association with physical activity participation. People with more years of education are more likely to participate in physical activity (Addy et al. 2004) and exercise programs (Becker et al. 2007), including walking (Addy et al. 2004; Ball et al. 2007; Owen et al. 2007) compared to those with lower levels of education. This relationship is also observed among older adults (Gagliardi et al. 2007; Chad et al. 2005; Lim and Taylor 2005; Walsh et al. 2001; Brach et al. 2004). More years of education are also associated with more leisure participation (Camoes and Lopes 2008).

The contribution of socioeconomic status to physical activity engagement has been inconsistent. Older adults with higher income are more likely to engage in physical activity, exercise and formal leisure such as clubs and organizations, compared to those with lower incomes (Rutt and Coleman 2005(b); Chad et al. 2005; Janke et al. 2006), as there is less concern about program costs (Cohen-Mansfield et al. 2004). However some studies have shown the opposite relationship, in which physical activity is associated with low socioeconomic status (King et al. 2005; Poortinga et al. 2006). Neighbourhood socio-economic status has also been shown to play an important role in people's decision for physical activity. Living in a lower socio-economic neighbourhood has been associated with less engagement in moderate to vigorous physical activity, and with more energy expenditure in activities of daily life (Lee et al. 2007(b)).

2.5.1.3 Physical Health Status

Health status is normally described as the number of health conditions, or as self rated health (which consists of a simple question asking people to rate their health on a scale ranging from poor to excellent). Self rated health in particular has been related to functional status (Cohen-Mansfield et al. 2003; Hu et al. 2007), and mortality (Mason et al. 2007). Health problems have frequently been reported by older adults as a barrier, restricting their engagement in physical activity or exercise (Gagliardi et al. 2007; Aslan et al. 2007; Eyler et al. 2003; Cohen-Mansfield et al. 2003; Lim and Taylor 2005; Booth et al. 1997). A recent study showed that older Canadians are not physically active enough, and that this is accentuated if a chronic disease is present (Ashe et al. 2008). A preventive care approach has been targeted as one possibility to promote healthy behaviours among older adults, and increase quality of life (Spalding and Sebesta 2008). However, in Canada, a population-based survey showed that a large number of older adults did not meet the recommendations for preventive care, did not make changes to improve their health, and reported that it was not necessary to make efforts towards health improvements (Newsom et al. 2004).

Health status has also been significantly associated with walking, as those who report better overall health are more likely to walk frequently. (Rutt and Coleman 2005 (b)). Long term association of health status with physical activity has also been observed. Over the years, older adults who remained physically active in sports and moderate to vigorous physical activities were less likely to report a decline in their health status (Malmberg et al. 2005).

Perception of health has been related not only to physical activity participation, but also to the perception of the neighbourhood. In longitudinal studies, poor health status was associated with higher number of external barriers in the neighbourhood environment, and this association increased over the months (Dawson et al. 2007, Poortinga 2006).

2.5.1.4 Physical Function

The aging process by itself is somewhat responsible for decline in physical ability. To be able to perform basic activities of daily living (such as preparing meals, cleaning a house and bathing), and activities related to social and civic life (such as buying groceries, volunteering in community services, driving or using public transportation), an individual needs an acceptable level of physical function (Gandolfi and Skora 2001). Muscle strength and power, endurance, flexibility, balance, agility and coordination contribute to physical function and influence one's ability to cope with activities such as these (Andreotti and Okuma 1999).

Strength is one of the most important factors related to physical function, as it is necessary to perform activities like walking moderate distances, lifting objects and climbing stairs, thus facilitating overall mobility (Nied and Franklin 2002; Rikli and Jones 1999). Reductions in strength and endurance may affect quality of life in older adults by contributing to a less active lifestyle (Hunter et al. 2004). Muscle power positively impacts activities such as stair climbing, lifting heavy objects, and brisk walking. Among older adults living in the community, power training has been shown to be more effective to improve physical function than simply strength training (Misko et al. 2003; Porter 2006). Other important components associated with physical function are flexibility and balance because they impact activities such as dressing, reaching objects, stooping, driving and gait ability (Carlson et al 1999).

Physical function is strongly associated with physical activity and leisure participation, especially among older adults. Normally, people who participate in those activities, or who have increased participation, have higher levels of physical function

(Lim and Taylor 2005; Di Francesco et al. 2005; McAuley et al. 2007; Gagliardi et al. 2007). Even when initiated in middle age, physical activity may contribute to better physical function among older adults, compared to those who are sedentary (Hillsdon et al. 2005; Patel et al. 2006). Any type of physical activity, including habitual walking, done on a regular basis may help to prevent functional decline and maintain mobility, (Boyle et al. 2007; Visser et al. 2005; Wong et al. 2003). However, when done at the recommended levels, greater achievements in functional capacity are observed (Brach et al. 2004).

The literature reports a consistent and positive relationship between physical activity and physical function. Better levels of physical function are achieved as a result of increased physical activity (Buchner et al. 1992; Hillsdon et al. 2005; Carlson et al. 1999; Patel et al. 2006). Although it is clear that physical activity enhances physical function, the opposite relationship has not been consistently studied. Gretebek et al. (2007) used the Theory of Planned Behaviour model in order to explain physical activity in older adults. According to the authors, physical function decreases with advancing age and may impact physical activity behavior. Among older adults, better levels of physical function have shown to be an important predictor of the intention to perform physical activity, and to remain physically active (Lim and Taylor 2005).

2.5.1.4.1 Measurement of Physical Function

Much of the decline in physical function observed during the aging process, may be prevented through an effective early assessment of functional capacity and planned intervention (Rikli and Jones 1999). The role of physical functional tests is to provide effective measurements of functional status in order to prevent or minimize disability in older adults. They can also provide information about prognosis, and guidance for health providers regarding appropriate interventions (Reuben and Siu 1990). The literature presents two different formats of function tests: self-reported and performance-based.

2.5.1.4.1.1 Self-Reported Tests

Self reported tests in general assess activities of daily living and instrumental activities of daily living. Used in questionnaire format, they measure one's ability to perform a specific task (Fries et al. 1980; Coman and Richardson 2006). This section will discuss some of the most commonly utilized tests and procedures, as well as their potential advantages and disadvantages.

The Health Assessment Questionnaire (HAQ) (Fries et al. 1980) was first intended to assess patients affected by arthritis. It considers dimensions like discomfort, disability, drug toxicity, and financial costs. In the disability section of the questionnaire, physical function can be measured as ability related to dressing and grooming, arising, eating, walking, hygiene, reaching, gripping, doing outside activities and sexual activity. Each activity is scored from zero (0) to three (3) and high scores represent decreased functional ability. This test is largely utilized in older adults with rheumatoid arthritis (Baskan et al. 2007; Husted et al. 2007; Bostrom et al. 1991; Eberhardt et al. 2007; Bjork et al. 2007; Wells et al. 2007). Recent studies used this test to evaluate the disease activity (Baskan et al. 2007; Husted et al. 2007), to measure the level of activity limitation over time in rheumatic patients (Bjork et al. 2007; Eberhardt et al. 2007), or to measure disability in response to medication treatment (Llonch et al. 2008; Kremer et al. 2008).

The HAQ has also been used as an instrument of validation for other proposed tests (Daltroy et al. 1995).

The Modified Health Assessment Questionnaire (MHAQ) (Pincus et al. 1983) is an updated version of the Health Assessment Questionnaire, and essentially covers the same categories as the HAQ (Martin et al. 2007). This test has been used with rheumatic patients to assess functional ability (Benitha and Tikly 2007; Dadoniene et al. 2007), to measure the severity of the disease (Baddoura et al. 2006), and to measure functional status in different types of drug treatments for rheumatoid arthritis (Kawai et al. 2006). MHAQ also has been used to measure quality of life in patients with knee and hip replacement (Ackerman et al. 2006), and to assess the relationship between disability and pain (Taylor et al. 2006).

The Short-Form Health Survey (SF-36) (Ware and Sherbourne 1992) contains 36 items categorized in eight dimensions such as social function, mental health, and pain. One of these dimensions relates to physical function and has been used to assess functional capacity (Lim and Taylor 2005). Some of the activities, including dressing and bathing, are also observed in the HAQ and the MHAQ. For the SF-36, walking was expanded to address specific situations (walking one block, several blocks, more than one mile). Other components such as bending, kneeling, stooping, climbing stairs, moderate and vigorous activities are included. The scores range from 1 to 3 with higher scores indicating better health. Because this test has other domains included, it has not only been used as a physical function assessment but, as a health survey of quality of life (Patel et al. 2007). The recent literature has confirmed this purpose, and the SF-36 has been utilized as a measurement of quality of life in patients with rheumatoid arthritis (Benitha and Tikly 2007), lymphedema (Franks et al. 2006), fibromyalgia (Uhlemann et al. 2007), coronary heart disease (Christian et al. 2007), cardiac rehabilitation (Asbury et al. 2008), orthopedic surgery (Obremskey et al. 2007), and caregivers of patients with rheumatism (Bruns et al. 2008). Some studies have used the SF-36 in combination with other self reported measurement to assess physical function (Llonch et al. 2008; Kremer et al. 2008). A recent study used Item Response Theory (IRT) methods to analyze the measurement properties of the MHAQ and the SF-36 (the physical function dimension). The results showed that both scales were not precise, but that combining the best components of each questionnaire resulted in a powerful and sensitive instrument for clinical change (Martin et al. 2007).

Self-reported tests are in general low in cost and easy to administer. They also facilitate the logistics of some studies as they can be administered in a research center, sent by mail, or through home visits. The disadvantages are that they are based on perceptions of one's own ability, and require much time to be completed (Coman and Richardson 2006).The time factor may reduce participants' adherence in the study, lowering the response rate (Martin et al. 2007).

2.5.1.4.1.2 Performance-Based Tests

In these tests, physical function is assessed by one's ability to perform a specific task. Normally, they measure the time taken to execute an activity, or the number of repetitions in a given time (Coman and Richardson 2006). Some tests provide a direct measure of the activity such as dressing, writing, or simulated eating, while others assess the necessary dimensions (strength, flexibility, endurance, balance) to achieve a specific activity of daily living. For example, upper body strength is necessary for household chores, and carrying groceries (Rikli and Jones 1999). This section will discuss some performance-based tests, dimensions and procedures.

The Physical Performance Test (PPT) (Reuben and Siu 1990) was developed to screen for functional impairments, to monitor changes in functional status, or to predict subsequent functional decline. It contains 9-items such as writing a sentence, simulated eating, lifting a book and putting it on a shelf, picking up a penny from the floor, turning 360 degrees, putting on and removing a jacket, walking 50 feet and climbing one flight of stairs, or the numbers of flights of stairs climbed. A shortened version with a 7-item measure was also created and climbing stairs was removed, as it might not be safe for some people. Additionally, not all facilities have stairs. The dimensions assessed include balance, coordination, endurance, mobility, and upper body fine motor function. The PPT takes 5 to 10 minutes to complete. Construct and concurrent validity of the 9-item and 7-item scale were compared to other self reported measures of physical function, and correlations of 0.65 and 0.50 respectively were found using Katz Activities of Daily Living. For the Rosow-Breslau scale correlations of 0.80 and 0.69 respectively were found. The reliability of the 9-item and 7-item scale had Cronbach's alpha coefficients of 0.87 and 0.79 respectively. This instrument has recently been used for many different purposes such as to assess functional capacity in patients after stroke (Glymour et al. 2007), cerebral aneurysm (King et al. 2006(a)) or knee replacement (Harnirattisai and Jonhson 2005), and to predict disability in patients with vascular disease (Landgraft et al. 2006). It has also been used to evaluate exercise programs and functional ability among older adults (Nelson et al. 2004; Schroeder et al. 1998).

The Physical Capacity Evaluation (PCE) (Daltroy et al. 1995) was developed to cover the main domains of physical function necessary to perform the activities of daily living. This test has some similarities with the PPT regarding the type of activities. Writing a sentence, putting on a shirt, walking, and footsteps were also included. Hand function was expanded to include grip strength, hand fine control (pegboard), and hand skill (key turning and card turning). Shoulder range of motion was also included. The mean time for administration was 36 minutes, the internal reliability was 0.90, and the retest reliability was 0.95. One of the practical applications is to assess functional performance and pain among workers in order to return to the work place after rehabilitation treatment (Scheman et al. 2000).

The Functional Fitness Test (FFT) (Rikli and Jones 1999) was developed to address the components of physical fitness in older adults necessary to perform the ADL. According to the authors, most tests assess function only for basic activities such as bathing, dressing, and walking. These tests fail to effectively evaluate elderly living in the community because some of the activities are too easy to perform for those who are fit.

The components of the FFT are upper body strength (arm curl), lower body strength (30 second chair stand), upper body flexibility (back scratch), lower body flexibility (chair sit and reach), aerobic endurance (6 minute walking or the 2 minute step as an alternative test), and motor agility and dynamic balance (8 feet up and go). The test focuses on physiological performance measured in a continuous scale. For example, the 30-second chair stand, which measures lower body strength, represents the fitness component necessary to climb stairs or raise from a chair. The objective of the test is to assess older adults at different levels of fitness. It is intended to reflect normal age-related changes in physical performance and to detect changes resulting from training or exercise. It takes from 30 to 45 minutes to be completed. Intraclass reliability values (R) ranged from 0.81 to 0.96. The criterion validity ranged from r= 0.73 to r= 0.83. It has proved to be a valid and reliable test for older adults across various levels of physical fitness (Miotto et al. 1999). This test has been used to determine the effectiveness of different exercise programs for older adults, such as high and low intensity resistance training (Bottaro et al. 2007; Cavani et al. 2002), and to evaluate levels of functional fitness among older adults who adopted Canada's Physical Activity Guide and Handbook for Older Adults (Jiang et al. 2004). The FFT has also been used older adults with chronic conditions, in order to plan for most appropriate exercise intervention (Reeder et al. 2008).

The great advantage of using performance-based tests is the sensitivity of measurements. These tests focus on the measured, not the perceived, capacity (Coman and Richardson 2006). Another advantage is that baseline and ceiling effects, very low or very high scores achieved respectively, can be better controlled on these tests (Sherman and Reuben 1998). Disadvantages include the length of time to complete the test, the need for specialized equipment, and the high cost for administration (Coman and Richardson 2006).

Some studies have shown that when performance based measurements are compared to self reported measurements, little agreement has been reported. Brach et al. (2002) used the 7-item measure of the PPT to identify early decline of physical function in community-dwelling older women. They also compared this instrument with a self-reported test. Older women had more limitations in the performance-based test, than in the self-performance reported one. Reuben et al. (1995) and Sherman & Reuben (1998) tested physical function comparing different performance-based and self-reported tests in community-dweller older adults. Results showed that performance-based tests were highly correlated with each other, but moderately correlated with self-reported measurements. The order in which the tests are administered also influences the levels of agreement between the two types of measurements (Daltroy et al. 1999).

Although each has its advantages and disadvantages, both self-reported and performance based tests are widely utilized. Therefore the choice of method depends on which domains the researcher wants to assess, the number of participants available for credible results, space, time and financial resources.

2.5.2 Environmental Factors

The environment, one of the least understood factors influencing physical activity, has recently gained considerable interest in the research field (Humpel et al. 2002; Owen et al. 2000). Several models have been used to explain the role of the environment on physical activity participation. Social Cognitive Theory (Bandura 1986) emphasizes the dynamic interaction between environmental, personal and behavioural factors and highlights that these factors have a different interaction among individuals and circumstances. For example, an interpretation of one's own behaviour, can alter a person's environment and personal factors, and subsequently inform and alter behaviour in a dynamic manner. This model has been useful in designing physical activity interventions (Rogers et al. 2004)

Ecological models acknowledge the influence of the environment on a wide variety of areas related to well being such as public health promotion, community health, and urban planning (Stokols 1992). This model also has been used to explain physical activity engagement. From an ecological perspective, the increasing rates of television viewing, car ownership, computer use and other technological innovations encourage people to have sedentary lifestyles (Sallis and Owen 1999; Owen et al. 2000). These habits increase the likelihood of not meeting the minimum recommendation of thirty minutes of moderate-intensity physical activity five days of the week, recently proposed by the American College of Sports Medicine and the American Heart Association (Haskell et al. 2007). In an ecological approach, not only the physical environment such as geography or architecture but also the sociocultural environments such as culture, economy, and public policies play an important role in the decision to be physically active. There is a direct influence from the environment on a person's behaviour (Stokols 1992). For example, a person may be encouraged to be more physically active when services such as parks and recreation centers are available and accessible, friends or neighbours are physically active, the surrounding area is safe and clean, and services are financially reasonable. Ecological models bring together many different areas of knowledge such as social sciences, medicine, ergonomy, psychology and public health, and acknowledge that physical activity behaviour is influenced by multiple factors (Sallis et al. 2006, Stokols 1992).

Recent research has shown that the environment where people live is particularly influential on physical activity level, especially walking behaviour around the neighbourhood (King et al. 2005; Leslie et al. 2005; Michael et al. 2006). Many different categories have been proposed to describe the physical environment, including aesthetics, availability of sidewalks, parks and playgrounds, street connectivity, land use patterns which includes the mix between business and residential areas, proximity of facilities such as grocery stores, golf courses, and post offices (King et al. 2005; Saelens et al. 2003 (b); Sisson 2005). Recently, the social environment such as safety, trusted neighbours, perceiving neighbours as being physically active, and crime rate has been associated with physical activity including walking (Addy et al. 2004; Granner et al. 2007).

Describing the components of the environment that may influence walking behaviour in older adults has been challenging. First, the majority of studies have used non-standardized methods, as the authors developed their own questionnaires. Second, some studies combined several categories into an overall measure of the physical environment, making it difficult to analyze the influence of each category (Humpel et al. 2002). Third, some studies have monitored physical activity in general, and others have combined overall physical activity and walking (Berke et al. 2007; Hoehner et al. 2005; McGin et al. 2007 (b); Ruth and Coleman 2005 (a)). This section will describe the influence of different attributes of the environment on physical activity.

2.5.2.1The Physical Environment

2.5.2.1.1Accessibility and Availability of Services

It has been shown that people living in a certain neighbourhood with a diversity of services ranging from business to leisure are more likely to be physically active. Parks, sports fields, playgrounds, shopping stores, and food stores for example, may contribute to a physically active lifestyle (Fisher and Li 2004; Addy et al. 2004; Foster et al. 2004; Hohener et al. 2005; Lee and Moudon 2006; Owen et al. 2007; Poortinga 2006; Rutt and Coleman 2005 (a); Rutt and Coleman 2005 (b); Suminski et al. 2005; Frank et al. 2005; Atkinson et al. 2005; Wendel-Vos et al. 2007; Humpel et al. 2002). In some studies, particularly from urban planning, land use mix has been used instead of accessibility of services. It is defined by the variety between residential and commercial buildings in the same neighbourhood (Handy et al. 2002).

Having a leisure centre, supermarket and post office available in the neighbourhood has been associated with better reports about health (Poortinga 2006). For older adults, living within walking distance from a golf course and a post office is associated with more walking (King et al. 2005; Poortinga 2006). Having increased services available contributes significantly to greater levels of functional independence, particularly lower body function among older adults (Clark et al. 2005). For young adults, shops within walking distance, bike lanes, and available places for walking are associated with more walking or other types of physical activity (Foster et al. 2004; Hoehner et al. 2005; Suminski et al. 2005). Living within walking distance to the work place is also a factor that may contribute to increased walking among this population (Cerin et al. 2007). The accessibility of services has a direct impact on the purpose of walking, as women in particular are more likely to walk for transportation or recreation when services are nearby (Owen et al. 2007; Suminski et al. 2005; Humpel et al. 2004(a); Humpel et al. 2004 (b)). As observed, the extent to which places and services influence physical activity is associated with age, gender, type of physical activity taken, and even health status. In a longitudinal study, positives changes in the availability of services have been associated with increased physical activity, including walking (Humpel et al. 2004 (b)).

2.5.2.1.2 Aesthetics

Aesthetics describes the attractiveness, beauty and pleasantness of a certain place. Some characteristics include the land scape (green space, including gardens and trees), design of houses and buildings, and ornamentation (Handy et al. 2002). This is particularly influential for pedestrians, as they walk or bike at slow speed compared to vehicles, and are able to perceive the beauty and attractiveness of the environment (Frank and Engelke 2001). Aesthetics has been associated with increased physical activity (King et al. 2006(b)), especially walking behavior around the neighbourhood (Giles-Corti and Donovan 2003). Some gender differences have been reported, as men are more likely than women to perceive the aesthetics of the environment (Humpel et al. 2002; Humpel et al. 2004(a); Wendel vos et al. 2007). Positive changes in the perceptions of the aesthetics have been associated with increased physical activity (Humpel et al. 2004 (b); Koval and Fortier 2007). Even health status has shown an important association with aesthetics. Those who perceive the aesthetics negatively, are more likely to report poor health (Poortinga 2006). Greater neighbourhood aesthetics has also been associated with different purposes of walking such as transportation or recreation (Suminski et al. 2005; Hoehner et al. 2005).

2.5.2.1.3. Street Connectivity and Presence of Sidewalks

Street connectivity has been considered either part of the physical environment, as it is built in the neighbourhood, or part of the transportation environment, as it facilitates pedestrian traffic and flow (Hoehner et al. 2005). It can be described by the availability of different routes connecting two points (Handy et al. 2002), or measured by the presence of cul-de sacs, walkways, short distances between intersections, and alternative routes or four-way intersections (Leslie et al. 2005). However the association of this attribute with physical activity, including walking is less consistent than accessibility of services. Some studies have shown a positive association between the connection of the streets sidewalks, trails, and bike lanes with increased physical activity (Giles Corti and Donovan 2002; De Bourdeaudhuij et al. 2003; Eyler et al. 2003; Sharpe et al. 2004; Frank et al. 2005; Atkinson et al. 2005; Mcgin et al. 2007(b); Berke et al. 2007; Strath et al. 2007(b); Michael et al. 2006). In one study, those who perceived more tracks, trails, routes, and pathways were more likely to meet physical activity recommendations (Sharpe et al. 2004). Some studies have shown no association with this attribute and walking, either for transportation or for recreation (Hoehner et al. 2005; Ruth and Coleman 2005 (b)).

2.5.2.2. The Social Environment

2.5.2.2.1 Safety

Safety may be considered to be either part of the physical environment (street lighting) (Humpel et al. 2002), or the social environment, as it can be related to trusted neighbours, traffic flow (cars and bikes), crime rate, and unattended animals. Safety has a significant impact on physical activity outdoors and on walking. Studies have shown that those residing in places with more street lights, more trusted neighbours, and better overall perception of safety were more likely to walk, particularly women (Fisher and Li 2004; Addy et al. 2004; Foster et al. 2004; Suminski et al. 2005; Lees et al. 2007; Taylor et al. 2007). Time of day has also been identified as a significant safety factor, as those with positive perceptions about safety were more likely to walk during the day (Foster et al. 2004). When attributes of the social environment were included together with the physical environment, the social environment, especially safety, had a higher level of importance for physical activity engagement, than did the physical environment (King 2008; Lees et al. 2007).

2.5.2.2.2 Social Support

Social support may be understood by the individual's connections in the community, including interpersonal relationships and interactions. It refers to the perceived resources and beneficial support, including emotional or informational that are available to an individual in social networks (Ferreira and Sherman 2007). For older adults, the support coming from family members and friends may be a significant factor influencing physical activity participation (Cousins 1995).

Some studies have considered items such as perceiving neighbours as active, and having a companion for physical activity as part of the social environment. People who perceived their neighbours as physically active, who trusted their neighbours (Addy et al. 2004), who have higher social support (Lees et al. 2007; Wendel-Vos et al. 2007) and who have a companion for physical activity (Wendel-Vos et al. 2007) are more like to be physically active. Alternatively, those who have less social support are less likely to walk regularly (Eyler et al. 2003). Recently, items such as self efficacy and motivation, which are considered to be part of the individual environment, as they relate to one's behaviour, have also been associated with physical activity (McNeill et al. 2006). When the influences of the physical, individual and social environments are studied together, there is no agreement as to which would be most influential for physical activity. Studies have considered them to be equally important (Giles-Corti and Donovan 2003), or have found the social environment to be the most influential (Granner et al. 2007).

2.5.3 Measuring the Attributes of the Physical Environment

The physical environment can be measured using objective or perceived measures. Objective measures include Geographic Information Systems (GIS), a computerized map of a given environment. Researchers can set geographic boundaries and objectively assess items such as businesses and services available, street connectivity and number of intersections, number of sidewalks, distance to facilities, presence of hills, and weather, among others. This has shown to be a reliable and useful method, (Leslie et al. 2005) and has been used in a number of studies (Leslie et al. 2005; Cerin et al. 2007; Hoehner et al. 2005; Michael et al. 2006; Frank et al. 2005; King et al. 2005; Owen et al. 2007; Berke et al. 2007; Fisher et al. 2004; Giles-Corti and Donovan 2003; Wendel-Vos et al. 2004). However, GIS methods normally make no attempt to value people's perception of their environment, reducing the subjectivity of the measurements (Michael et al. 2006).

Self reported measures are based on people's perception of their environment. Normally, these measures take a questionnaire format, requesting people to provide information about the components of their physical environment. Answers may be expressed in different formats, such as yes/no, present/absent, or rated frequency according to the question content. The attributes measured are the same as those objectively measured, however self report measures also include features from the social environment (safety, crime rate, social support). Another advantage is the possibility of investigating how levels of education (Ball et al. 2007), and socioeconomic status (Giles Corti and Donovan 2002), influence environmental perceptions. A number of studies have used this type of measurement (Saelens et al. 2003; Addy et al. 2004; Suminski et al. 2005; Humpel et al. 2004(a); Fisher et al. 2004; Foster et al. 2004; Miles and Panton 2006; Poortinga 2006; Dawson et al. 2007; Granner et al. 2007).

Recently, the Neighbourhood Environment Walkability Scale (NEWS) was proposed to measure the participants' perceptions of their local environment (Saelens et al 2003 (a). It assesses the following environmental characteristics: constructs of residential density, proximity to stores and facilities, street connectivity, facilities for walking and cycling, aesthetics, and safety from crime and traffic. The test-retest reliability of the items was tested using two neighbourhoods that differed in GIS database, and correlations coefficients ranged from 0.62 to 0.88 (Leslie et al. 2005). The authors recently developed an abbreviated version containing fewer questions (Neighborhood Environment Walkability Scale – Abbreviated Version (NEWS-A), and confirmatory factor analysis between NEWS and NEWS-A scores ranged from 0.82 to 0.97 at the group level and from 0.83 to 0.97 at the individual level (Cerin et al. 2006).

While objective measures are taken in a standardized way (using computer software), self reported measurements are inconsistent. In most studies, the authors developed their own questionnaires, sometimes grouping attributes, making it difficult to establish comparisons (Humpel et al. 2002). When objective measures are compared to peoples' perceptions about their environment for physical activity, significant differences are observed. Studies that have used both measurements show a low degree of agreement. Street connectivity and land-use mix have been reported to have a high degree of agreement between the two types of measurements, however, aesthetics has had controversial results (Leslie et al. 2005; Cerin et al. 2007; Hoehner et al. 2005; Micheal et al. 2006). Study settings and different populations might have influenced the degree of agreement between the measurements. People's perception of their environment might have a greater influence on behaviour than the actual or objective environment, however, it is important to address both types of measurements as they allow different interpretations (McGinn et al. 2007 (a); McGinn et al. 2007(b)).

As observed, physical activity and walking may be influenced by a variety of environmental factors; furthermore, the various attributes of the environment contribute differently for different purposes of walking such as recreation, transportation, or health. Demographic factors such as age, gender, socioeconomic level, and culture play an important role mediating this process. The type of measurement chosen, performance based or self reported, may also present different associations among the environment attributes with physical activity.

Chapter 3: Methods

3.1 Introduction

This section will be presented in five sub sections: ethics, participant recruitment and screening, study design, procedures, and statistical analyses.

3.2 Ethics

This study had ethics approval from the Education/Nursing Research Ethics Board (ENREB) of the University of Manitoba and from the Winnipeg Regional Health Authority. Prior to participation, informed consent was obtained from each participant (Appendix 1). Informed consent also included an explanation about the study, risks, benefits, anonymity and confidentiality of the results as well as participant/researcher responsibilities. All participants were assigned an identification number which was used to record and store all data. No identifying information was linked with any participant data. Only the investigator and her advisor had access to the list linking names and identification numbers. Results of the study will be made available for those interested in a report that will be sent to each seniors' apartment building.

3.3 Participant Recruitment and Screening

Participants were sixty volunteers recruited from five seniors' apartment buildings in the downtown neighbourhood of Winnipeg. Nursing staff from the WRHA Seniors' Health Resource Teams identified contact persons and the manager in each building. To recruit participants, the investigator set up a display stand in the lobby of each building.

Posters explaining the purpose of the study were fixed on announcements board. The purpose of the study was explained to interested residents, and those who wished to participate received the informed consent and screening forms (Physical Activity Readiness Questionnaire PAR-Q) (Appendix 2). Participants were recruited if they met the inclusion criteria for this study. To be included, participants had to be 65 years of age or above, and reside in the downtown neighbourhood for one year or more. They were excluded if they used any walking devices such as walkers, canes or wheelchairs. Each participant completed the PAR-Q prior to participating in the study. In the case of "yes" responses to the PAR-Q, physicians' approval was required (Physical Activity Readiness Examination - PARmed-X) (Appendix 3) to ensure the participant's safety to perform the Functional Fitness Test. The researcher was certified in Cardiopulmonary Resuscitation (CPR) (level C), (Canadian Red Cross).

3.4 Study Design

This project was a cross-sectional study that was conducted during the fall of 2007 and the spring of 2008. Data collection was stopped from November to April in order to minimize biased pedometer results due to winter weather.

3.4.1 Data Collection

Data collection consisted of two sessions arranged on an individual basis according to the participant's convenience. In the first session (scheduled between Monday and Wednesday), subjects performed the FFT in a private room (exercise room, library or recreation room in each building) reserved for this purpose. For safety reasons, each room was checked prior to testing for adequate space, and to ensure the presence of a telephone line to contact emergency services in case of need. A CSEP Certified Exercise Physiologist was present for the tests where required by the physician who completed the PARmed-X. After the FFT, participants received a package containing the scales and questionnaires used in the study, as well as the necessary information and guidance for their completion. They also received a pedometer and a pedometer recording form to record the number of steps taken per day, and instructions for their use (Appendix 4). Participants could ask questions about the study questionnaires and procedures at this time.

At the second session, which was held in a reserved space in each building, participants brought back the completed questionnaires and the pedometer recording form. They also received feedback from the test, physical activity counseling, and a small gift for their participation in the study (*in Motion* shopping bags, pedometer, and the Physical Activity Guide for Older Adults).

Weather was recorded on a daily basis between September and November (2007), and April and June (2008), (temperature, amounts of rain, and snow) through the Weather Office (Environment Canada, http://www.weatheroffice.gc.ca). Details of each session and the schedule *per* week are presented in Tables 1 and 2, respectively.

Table 3.1 Purpose of the sessions

Session	Purpose
Session number 1	To perform the FFT, measure height and weight.
	To provide package with written material
	To provide pedometers/recording forms
	To answer any questions
Session number 2	To collect and review completed forms
	To collect pedometer recordings
	To provide feedback from the FFT

Monday	Tuesday	Wednesday	Thursday/Friday/ Saturday	Monday
Session number one	Session number one	Session number one	Pedometer recording	Session number two

Table 3.2 Weekly data collection schedule

3.5 Procedures

3.5.1 Physical Function

The Functional Fitness Test (Rikli and Jones 1999) was utilized to assess the level of physical function. The test was chosen because it is designed for older adults, requires minimal equipment, is easy to score, and takes 30 to 45 minutes for each person to complete (test-retest reliability $\leq$0.80). Prior to the test, participants received instruction and a demonstration of each item, and were instructed to do the best they could, but not to go beyond their physical limit. Ten minutes of warm up exercises were done. Height and weight were also measured. The Functional Fitness Test has six fitness parameters administered in the following order:

<u>30-Second Chair Stand (lower body strength)</u>

Seated in the middle of a chair, the participant had their feet touching the floor entirely and their back straight. Arms were crossed against the chest. The participant was instructed to rise to a full stand and return to a full seated position as many times as possible within 30 seconds. The score was the total number of correct stands within 30 seconds. If the person needed assistance to rise, the score given was zero.

<u>Arm Curl (upper body strength)</u>

Seated with the dominant side of the body close to the side edge of the chair, the participant had the feet touching the floor entirely, and their back straight. Hand weights were used for this test (5lb for women and 8lb for men). The dominant arm was placed close to the body with the elbow in complete extension. The hand was in a handshake grip position, when the weight was given to the subject. The participant was instructed to perform a full flexion of the elbow (turning the palm of the hand up) without moving the shoulder, and to return to a full-extended position of the elbow as many times as possible within 30 seconds. The score was the total number of correct elbow flexions within 30 seconds.

2-Minute Step-in-Place (aerobic endurance)

The participant stood beside a wall. Knee-stepping height was determined for each participant, as the halfway point between the patella and the iliac crest. This was determined by stretching a piece of cord from the patella to the iliac crest, then folding in half to determine the halfway point. In order to mark the height, coloured masking tape was attached to the wall. Participants were instructed to begin stepping in place (without running) as many times as possible within 2 minutes. The score was the total number of times that the right knee reached the minimum height. If needed, participants were allowed to place one hand on a table or a chair to maintain balance. After completing the test, participants walked around the testing room slowly for about a minute to cool down.

Chair Sit and Reach (lower body flexibility)

In a sitting position, the participant moved forward to the front edge of the chair. One leg was kept bent with the foot touching the floor entirely, and the other leg was extended in front of the hip with the heel touching the floor and the ankle in dorsal flexion. The participant was instructed to bend forward slowly with the spine as straight as possible in an attempt to touch the toes. The score was determined using a ruler to record the remaining number of centimeters to reach the toe (minus score) or the reach beyond the toe (plus score). In this test, participants were asked to indicate the preferred leg (the leg that gives the best score).

Back Scratch (upper body flexibility)

In a standing position, the participant was instructed to place one hand behind the shoulder with the elbow in flexion, and palm of the hand touching the back with fingers extended. The hand was moved down as far as possible. The other hand was placed behind the back, palm out and fingers extended, and the participant moved the hand up as far as possible in an attempt to reach or overlap both hands. Using a ruler, the score represented the remaining distance (in centimeters) to reach the middle fingers (minus score) or the overlap between the middle fingers (plus score). In this test, participants were asked to indicate the preferred hand (the hand that gives the best score on one of the sides).

8-foot Up-and-Go (agility and dynamic balance)

Participants were seated on a chair with hands on thighs and feet touching the floor entirely. A cone was placed 4-feet (1.22 meters) away from the chair (Figure 3). Participants were instructed on the signal "go" to get up from the chair and walk as quickly as possible (without running) around the cone and back to the seated position on the chair. The score represented the time, in seconds, taken to perform this task. This test included two trials with each participant, and the best score (lowest time) was used.

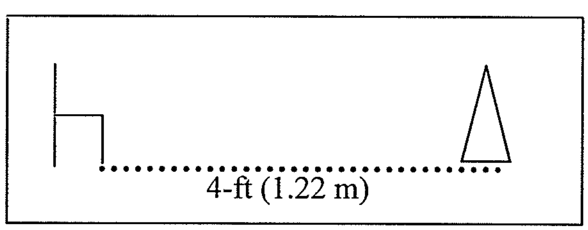


Figure 3.1 Measurements for the 8-foot Up and Go test

Figure 3.2 illustrates each part of the Functional Fitness Test. (The participant granted permission to exhibit these pictures).

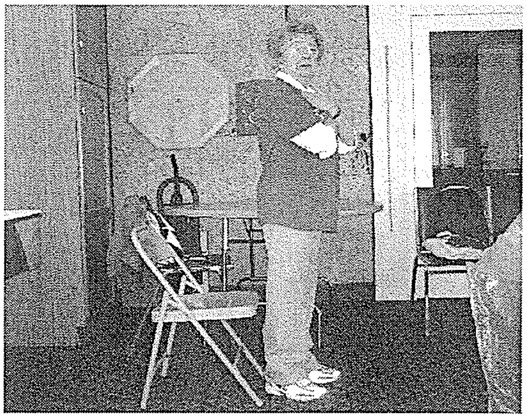


Figure 3.2.1 Lower body strength

Figure 3.2.2 Upper body strength

Figure 3.2.3 endurance

Figure 3.2.4 Lower body flexibility

Figure 3.2.5 Upper body flexibility

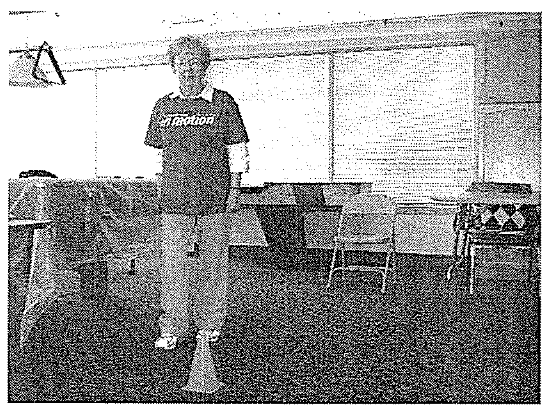


Figure 3.2.6 Agility and balance

Figure 3.2 Functional Fitness Test (illustrative pictures)

3.5.2 Perceived Environment Scale

Each participant received instructions to assist them to complete a modified version of the Abbreviated Neighbourhood Environment Walkability Scale (NEWS-A) (Cerin et al. 2006). This scale measures the resident's perception of their neighbourhood environment. NEWS-A has 6 sections: access to services, street connectivity, infrastructure for walking/cycling, aesthetics, traffic safety, and crime safety. The answers to questions have a 4-point scale ranging from 1 (strongly disagree) to 4 (strongly agree) with higher values corresponding to a more walkable neighborhood (Appendix 5).

3.5.3 Demographic and Health Assessment

Each participant received instructions to assist them to complete a questionnaire requesting demographic data: age, gender, household income, educational level and number of health conditions. Self-rated health was assessed using the following question: "How would you rate your health compared to others of your age?" Answers ranged from 1 (excellent) to 5 (poor) (See Appendix 6).

3.5.4 Social Support

Social support was assessed using the following sentence: "Write the number of close friends and close relatives that you have (people you feel at ease with and can talk to about what is on your mind)". Higher values mean higher social support.

3.5.5 Walking Behaviour

Each participant received a pedometer (StepsCount SC-01, Ontario, Canada. Information available at: http://www.stepscount.com/organizations) and was shown how to use the instrument and to record data. Pedometers were attached on the participant's hip and used for 3 consecutive days (Thursday to Saturday).

3.6 Statistical Analysis

Data was analyzed using SPSS version 16 for windows. Bivariate correlations were used to determine any significant association between the neighbourhood environment, level of physical function, other personal factors, and walking behaviour. Multiple regression was utilized to verify the significance of each personal explanatory variable (hypotheses number one to four) and environmental explanatory variable (hypotheses number five and six) on walking, controlling for the effect of confounder variables.

3.7 Research Variables

Dependent Variable

The main outcome variable was walking behaviour, assessed via a three-day pedometer recording and a walking questionnaire developed by the authors. Specific walking data included:

- Average steps per day (pedometer)
- How often usually walk 10 minutes or more outside the building during summer/winter time (Never, 1 - 2 times per week, 3 – 5 times per week, almost every day).
- Where usually walk (on the local streets/sidewalks in my neighborhood, in a nearby park or other outdoor recreational area (e.g. a trail), at a mall, on a track, other).
- Main reason for walk (to go somewhere (e.g. store, post office, hair dresser), for fun or recreation, to stay healthy, other).
- Walk (by myself, with a friend, with my spouse or other relative)
- If belong to a walking club (yes/no)
- What type of motor transportation use (drive own car, a relative or friend usually drives, city bus, take a taxi, transportation service (shuttle bus, handi transit), other).

Explanatory variables

I. Personal Factors

- Age
- Gender
- Socio economic status (SES)
- Educational level
- Number of health conditions
- Self rated health
- Social Support

Physical Function

- Upper body strength
- Lower body strength
- Upper body flexibility
- Lower body flexibility
- Endurance
- Motor agility and dynamic balance
- Body Mass Index (BMI)

II. Environmental Factors

- Access to services
- Street connectivity
- Infrastructure for walking/cycling
- Aesthetics
- Safety

Chapter 4 – Results

This section will be presented in three sub-sections: demographic characteristics of subjects and the neighbourhood, and the impact of personal factors and of environmental factors on walking behaviour.

4.1 Demographic Characteristics and Walking Patterns

4.1.1 Subject Characteristics

A total of 70 subjects agreed to participate in this study, however because some of them required physicans' approval to perform the FFT, some subjects were not able to participate within the schedule set for data collection. A total of 60 subjects participated in the study. The mean age for the total sample (N=60) was 77.0 years (SD= 7.3, ranging from 65 to 92 years), and the mean number of steps per day was 5289 steps (SD= 4029, ranging from 854 steps to 22091steps). Steps per day taken for each participant is shown in Figure 4.1. Characteristics of the participants are shown in Table 4.1. The majority were female, retired, and with an annual income above $30,000. The majority reported very good or excellent health status; however one half reported having two or more health conditions.

All continuous explanatory variables were plotted with average number of steps and a linear relationship was found, thus multiple regression was the appropriate analysis. However, 5% of the sample (3 participants) had an average number of steps that were two standard deviations above the average for the total sample (≥13,347 steps). The mean age for these 3 participants was 66 years and the average number of steps was 17,855 steps. They were all highly educated, had an annual income above $30,000, and reported excellent health. Two of them were female. These subjects were characterized as influential observations. These observations, although valid, did not have enough representatives across the sample, and could potentially affect the strength of the relationship of each explanatory variable with average number of steps. Thus, two regression models were run in order to explain the association of each explanatory variable on walking behaviour with and without these extreme observations. The first model included the total sample, and the second one excluded the influential points from the analyses. After removing the influential observations, the average number of steps per day decreased to 4627 (SD= 2763) steps, however the mean age remained unchanged.

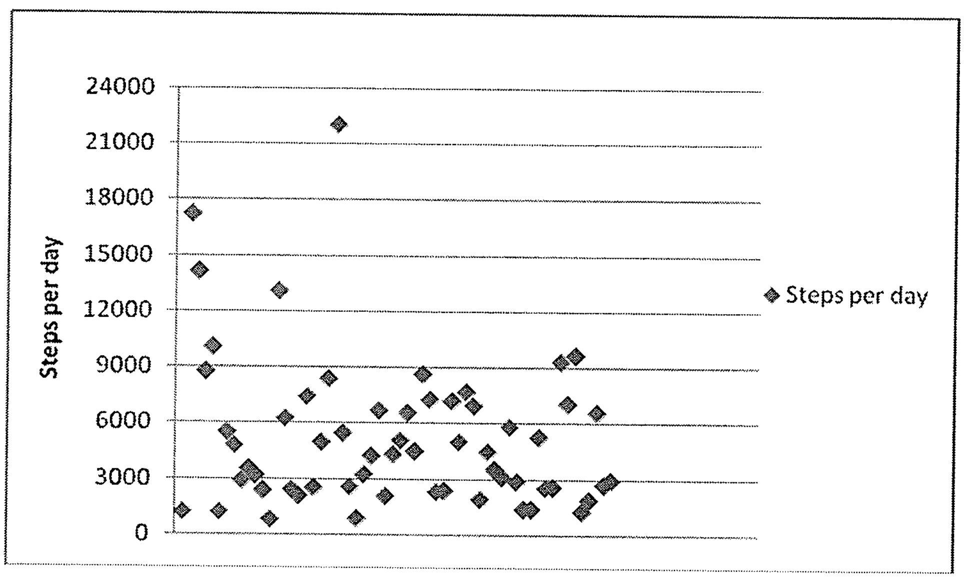


Figure 4.1 Steps per day taken by each participant

Table 4.1 Demographic characteristics of participants

Characteristic	Percentage of participants Total Sample (n= 60)	Percentage of participants Influential observations (n=3)
Female	75.0	66.6
Have college/university degree completed	21.0	100.0
Living in relationship (married or common law partner)	43.3	66.6
Income level:		
Annual income from $ 0,000 to 29,999	38.3	
Annual income above $ 30,000	61.7	100.0
Retired	93.3	66.6
Self rated health:		
Excellent	23.3	100.0
Very Good	43.3	
Good	30	
Have two or more health conditions	50.1	0.0
Have more than ten close friends	51.7	0.0

4.1.2 Neighbourhood Characteristics

This study was done in five seniors' apartment buildings, all located in the downtown neighbourhood as described by the WRHA community area map. Table 4.2 shows the characteristic of each building, as well as the number of participants in each. The majority of buildings had rents competitive with similar buildings in the area, however, in one building rent was subsidized by Manitoba Housing.

Table 4.2 Characteristics of the five downtown apartment buildings

	Senior's Buildings (N=60)				
Characteristic	**Fred Douglas Place N= 17**	**Betelstadur Place N= 4**	**Fort Garry Place N= 17**	**Villa Heidelberg* N= 5**	**Kiwanis Chateau N=17**
Number of suites	120	72	294	97	122
Approximate number of occupants	160	85	325	97	150
Average cost ($)	490- 1,013	522- 650	700	275	470-850

* Subsidized by Manitoba Housing; cost is based on 25% of income

4.1.3 Walking Patterns

Walking behaviour is shown in Table 4.3. Most participants walk outside almost every day regardless of the summer or winter season. They prefer to walk outdoors, and give the main reason for walking as for health or for transportation, not for recreation. The majority usually walk alone. Only 50% of respondents drive a car. All of the three subjects with influential observations walk almost every day in the summer, preferred to walk outdoors, and drive a car. They walk either for recreation or for health.

Table 4.3 Walking behaviour

Topic	Percentage of participants (n=60)	Percentage of participants (n=3)
Walk outside almost every day in the summer	96.7	100.0
Walk outside almost every day in the winter	85.0	66.6
Locations differ between summer and winter	50.0	66.6
Walk outdoors (streets or parks)	63.3	100.0
Main reason for walking:		
Transportation	35.0	0.0
Recreation	6.7	66.6
Health	58.3	33.4
Walk alone	70.0	33.4
Belong to a walking club	6.7	0.0
Drive a car	50.0	100.0

Of the total sample, only 4 participants reported walking for recreation, making it impractical to enter in the regression model. Thus for further analyses, the variable main reason for walk was grouped as walk for transportation or not walk for transportation. Forty per cent of the total sample (24) were tested during the fall and sixty per cent (36) were tested during the spring. Although those who were tested in the spring had fewer steps (4533 steps, SD= 2467) compared to those who were tested in the fall (6422 steps, SD= 5491), the difference was not significant ($t= 1.81$, $p> 0.05$). Consequently, both groups were combined for future analyses.

4.2 Relationships between Personal Factors and Average Number of Steps

Considering the total sample, average number of steps had moderately significant correlations with several personal variables (Table 4.4). Advancing age, poor self rated health, and poor balance performance were associated with fewer steps per day. Alternatively, higher education and income, and higher levels of physical function (strength, endurance and flexibility) were associated with more steps per day. After removing the three influential observations from the sample, the relationship remained, but weaker correlations were found, and education was not significantly correlated with number of steps per day. However, these correlations did not take into account the influence of other personal variables.

Table 4.4 Personal variables significantly correlated with number of steps/day

Variable (total sample)	**Pearson correlation coefficient (r)**	**Variable (three influential observations removed)**	**Pearson correlation coefficient (r)**
Age	- 0.496**	Age	-0.403**
Education	0.342**	Education	Non significant
Annual income	0.359**	Annual income	0.347*
Self rated health	- 0.289*	Self rated health	-0.261*
Lower body strength	0.549**	Lower body strength	0.473**
Upper body strength	0.482**	Upper body strength	0.330*
Endurance	0.476**	Endurance	0.393**
Lower body flexibility	0.291**	Lower body flexibility	0.275*
Agility/ balance	-0.518**	Agility/ balance	-0.478**

* Correlation is significant at 0.05 level (2-tailed)
** Correlation is significant at 0.01 level (2-tailed)

4.2.1 Collinearity among Personal Variables

Some personal variables were significantly correlated with each other, as shown in Table 4.5. In order to explain as much of the variation in the outcome measure with the least number of explanatory variables, only one variable was considered when collinear relationships were found. After removing influential observations, the same collinearity among variables was observed. The variable with the highest correlation with steps per day was used for further analyses. Annual income represented a measure of socioeconomic status. Self rated health represented a measure of health status, using only two categories, 1- excellent/very good health and 2-good/fair health. This combination of categories was chosen in order to minimize the number of explanatory variables entering in the regression model. Level of physical function was characterized by lower body strength.

Table 4.5 Collinearity among personal variables

Collinear Variables	Pearson correlation coefficient (r) (total sample)	Pearson correlation coefficient (r) (three influential points removed)	Explanatory variable utilized in the regression model
Education and annual income	0.291*	0.280*	Annual income
Self rated health and number of health conditions	0.462**	0.452**	Self rated health
Lower body strength and:			
upper body strength	0.529**	0.438**	Lower body strength
endurance	0.568**	0.505**	
agility and balance	-0.603**	-0.550**	

* Correlation is significant at 0.05 level (2-tailed)
** Correlation is significant at 0.01 level (2-tailed)

The following subsections will address the first hypothesis, that younger age, male, higher education and income, better health, higher levels of physical function, and better social support will be related to more steps walked per day.

4.2.2 Age

Figure 4.2 shows a decrease in average number of steps taken with increasing age. The age groups differed significantly ($F= 5.147$, $p< 0.01$). Post Hoc test showed that the old age group differed significantly from the very old age group ($p< 0.05$) and the oldest old age group ($p< 0.05$), however the very old and oldest old age group did not differ. Age had a significant negative association on average number of steps ($R^2= 0.25$; $B= -275.22$; $\beta= -0.496$; $t= -4.353$; $p< 0.01$), even when the three influential observations were removed from the analyses ($R^2 =0.16$; $B= -159.63$; $\beta= -0.403$; $t= -3.269$; $p< 0.01$), as shown in the Figure 4.3.

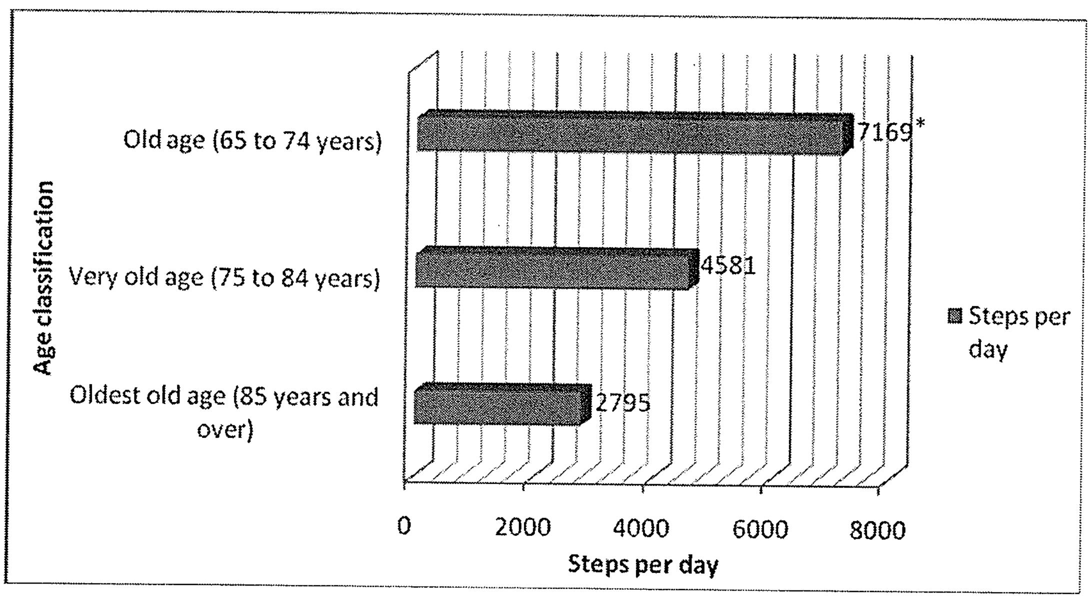


Figure 4.2. Average number of steps per day taken per age group.

Note: * Significant at < 0.05 level from the two groups

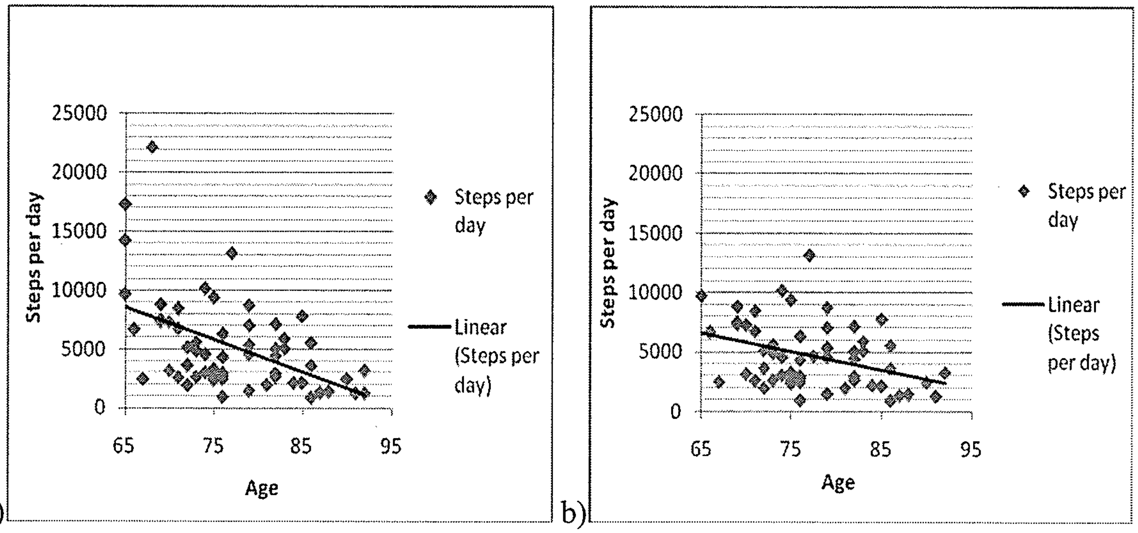
a) b)


Figure 4.3 Relationship between age walking for the total sample (a) and after removing the three influential observations (b).

However, after controlling for other personal factors such as health status, income and physical function, age was not associated with walking for the total sample (B= -135.34; β= -0.244; t= -1.799, p> 0.05), and after removing the three influential observations (B= -76.91; β= -0.194; t= -1.383, p> 0.05).

4.2.3 Gender

Gender had no association with walking even after removing the three influential observations. After controlling for age, health status and physical function, no association was found.

4.2.4 Income

Annual income had a significant positive association with walking. Compared to those with lower income, those with higher income had an average of almost three thousand more steps (R^2=0.13; B= 2948.82; β= 0.359; t= 2.928, $p<0.01$). After removing the three influential observations this association still remained significant (R^2= 0.12; B= 1939.77; β= 0.347; t= 2.748, $p<0.01$) (Figure 4.4). After adjusting for age, health status and physical function, annual income still exhibited a significant positive influence on walking. The difference in the number of steps between the two income groups was almost 2000 steps when the total sample was analysed (B= 1966.94; β= 0.239; t= 2.260, $p<0.05$). After removing influential points, this difference decreased to 1530 steps, but still remained significant (B= 1530.67; β= 0.274; t= 2.403, $p<0.05$).

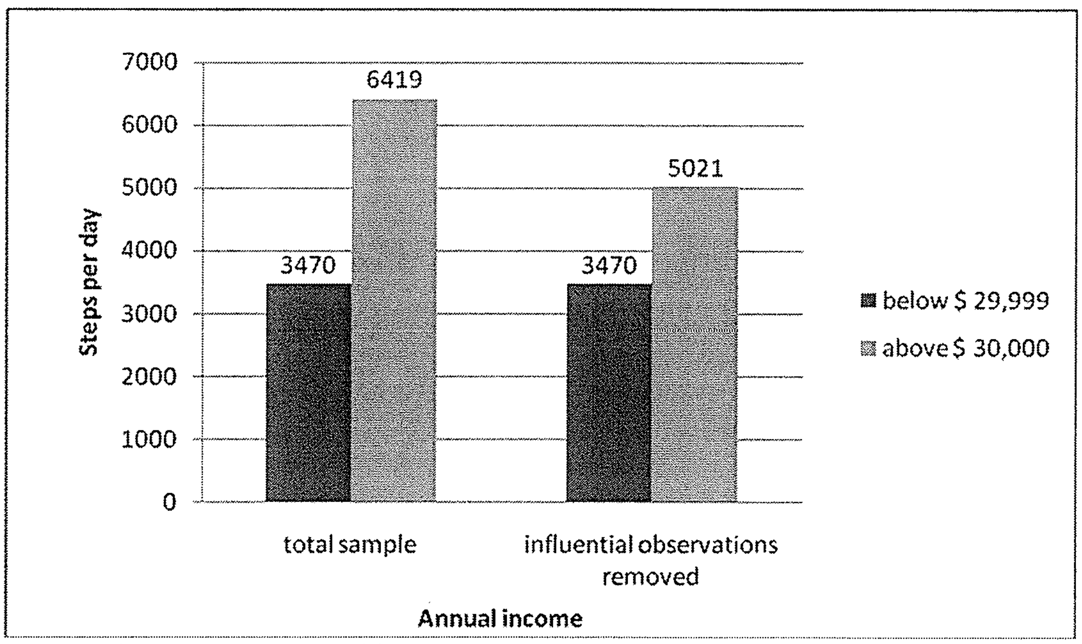


Figure 4.4 Relationship between annual income and walking.

4.2.5 Health Status

Self rated health had a significant negative association with walking even when the three influential observations were removed from the total sample. Those who rated their health as excellent/very good had considerably more steps compared to those who rated their health as good/fair. However, after adjusting for age, annual income and physical function, self rated health had no association with walking. Table 4.6 shows the association of health status with walking for the total sample and after removing the three influential observations.

Table 4.6 Association of health status with walking

Model and variable	R^2	Unstandardized coefficient (B)	Standardized coefficient (β)	t value	Significance level (p)
Total sample (unadjusted)	0.08	-2452.7	- 0.289	-2.302	0.025
Adjusted †		-1406.60†	- 0.166†	-1.489†	0.142†
Influential observations removed (unadjusted)	0.07	-1500.11	-0.261	-2.008	0.05
Adjusted		-979.98†	-0.171	-1.419†	0.162†

Note: †after adjustments for age, annual income and physical function

Better self rated health also had significant associations with higher levels of physical function in this sample, as shown in Table 4.7

Table 4.7 Variables related to physical function significantly correlated with self rated health

Variable	Pearson correlation coefficient (r)
Lower body strength	-0.314*
Upper body strength	-0.350**
Endurance	-0.339**
Lower body flexibility	0.399**
Agility/ balance	0.441**

* Correlation is significant at 0.05 level (2-tailed)
** Correlation is significant at 0.01 level (2-tailed)

4.2.6 Physical Function

Table 4.8 shows descriptive analyses for the Functional Fitness Test. Those with higher scores for lower body strength walked significantly more compared to those with lower scores on both models, as shown in Figure 4.5. After controlling for age, health status and income, physical function remained associated with walking, both for the total sample or after removing the three influential observations, as shown in Table 4.9.

Table 4.8 Descriptive analyses of the Functional Fitness Test

Category	**Median**	**Mean (SD)**	**Minimum**	**Maximum**	**Range**
Lower body strength (number of repetitions)	11	10.4 (5.38)	0	23	23
Upper body strength (number of repetitions)	15	15.2 (3.7)	7	27	20
Endurance (number of repetitions)	100.5	94.5 (31)	0	165	165
Lower body flexibility (centimeters)	0	-0.533 (10.2)	0	26	48.0
Upper body flexibility (centimeters)	-9.25	-8.62 (11.2)	-22	13.5	49.5
Agility and balance (number of seconds)	6.21	6.4 (1.4)	-36	10.8	6.96
BMI	26.1	26.9 (4.4)	18	40.9	22.9

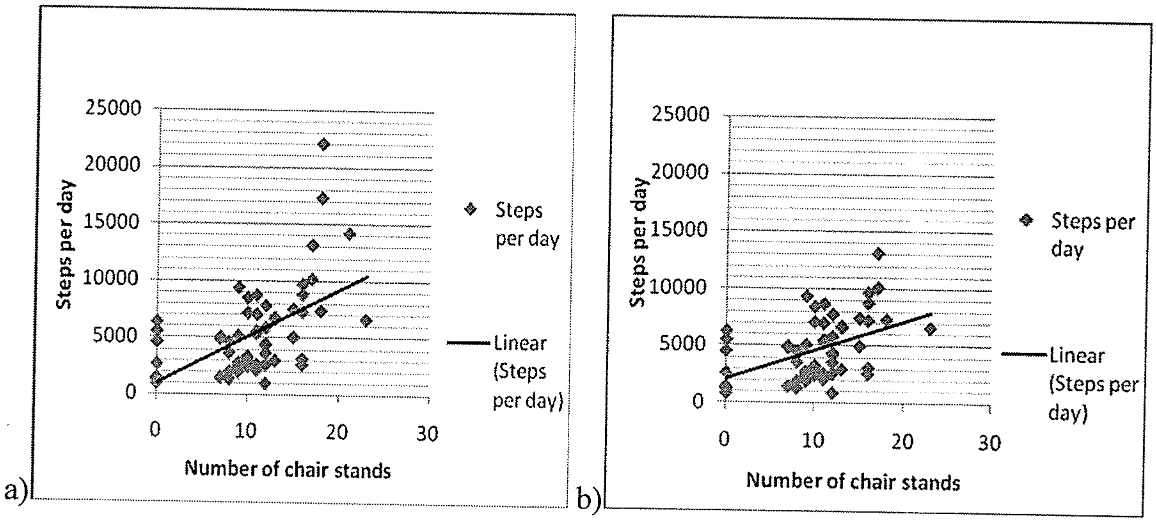


Figure 4.5 Relationship between lower body strength and walking for the total sample (a) and after removing the influential observations (b)

Table 4.9 Association of physical function with walking

Model	R^2	Unstandardized coefficient (B)	Standardized coefficient (β)	t value	Significance level (p)
Total sample (unadjusted)	0.30	411.39	0.549	5.009	0.000
Adjusted †		238.32†	0.318†	2.288†	0.026†
Influential observations removed (unadjusted)	0.22	254.85	0.473	3.981	0.000
Adjusted†		161.37†	0.300†	2.094†	0.041†

Note: † after adjustments for age, health status and income

4.2.7 Social Support

Although those with fewer close friends walked more compared to those with more friends, social support had no association with average number of steps taken (B= -20.72; β= -0.067; t= - 0.515, p>0.05). Even after adjusting for age, physical function, and health status, no association was observed either for the total sample or after removing the three outliers.

4.2.8 Driving Behaviour

This subsection addresses the second hypothesis. Of the total sample, only 50% drove a car (13 males and 17 females). Those who drove had significantly more steps compared to those who do not drive ($R^2 = 0.07$; B= -2200.06; β= -0.275; t= -2.181, $p<0.05$). However this association became non significant after controlling for age, annual income and health status (B= -218.56; β= -0.027; t= -0.240, $p> 0.05$). When the three influential observations were removed from the total sample, driving behaviour had no association with number of steps per day.

4.2.9 Preferred Place and Main Reason for Walking

This subsection addresses the third and fourth hypotheses. The place where subjects usually walk (indoors/outdoors), and their main reason for walking (for transportation / not for transportation) had no association with average number of steps per day. After controlling for age, health status and physical function this association remained non significant for the total sample and after removing the three influential observations.

4.3 Relationships between Environmental Factors and Average Number of Steps

This subsection addresses hypotheses number five and six. Table 4.10 shows descriptive analyses for each component of the environment for the total sample. For the total sample, only access to services and the total score for NEWS-A were correlated with walking, as shown in Table 4.11. Without accounting for the association with personal factors, accessibility of services and an overall friendly environment were associated with more walking. When the three influential observations were removed from the total sample, none of the environmental variables were correlated with walking. Street connectivity, places for walking, neighbourhood aesthetics, and safety were not significantly correlated with walking even after removing the three influential observations (Table 4.12).

Table 4.10 Descriptive analyses of the environmental components for the total sample

Component	**Mean (SD)**	**Median**	**Minimum**	**Maximum**	**Range**	**Reference values**
Access to services	20.8 (2.3)	21	13	24	11	6 – NF 24 – F
Street connectivity	10.7 (1.3)	11	7	13	6	3 –NF 12 – F
Places for walking	9.9 (1.7)	10	6	12	6	3 –NF 12 – F
Aesthetics	12.6 (2.6)	13	4	16	12	4 – NF 16 – F
Safety	24.9 (4.1)	25	17	35	18	9 – NF 36 – F
Total score for NEWS-A	79 (7.7)	80	61	98	37	25 – NF 100 – F

Note: NF – Non- friendly neighbourhood
F – Friendly neighbourhood

Table 4.11 Environmental variables significantly correlated with number of steps/day

Variable (total sample)	Pearson correlation coefficient (r)
Access to services (NEWS-A)	0.266*
Total score (NEWS-A)	0.275*

* Correlation is significant at 0.05 level (2-tailed)

Table 4.12 Environmental variables not significantly correlated with steps/day

Variable (total sample)	Pearson correlation coefficient (r)
Street connectivity (NEWS-A)	0.065
Places for walking (NEWS-A)	0.064
Aesthetics (NEWS-A)	0.179
Safety (NEWS-A)	0.202

4.3.1 Access to Services

Accessibility of services had a significant positive association with average number of steps; however, after controlling for personal factors, no association was found. After removing the influential observations from the total sample, access to services was no longer associated with average number of steps. Table 4.13 shows this association before and after controlling for personal factors.

Table 4.13 Association of access to services with walking

Variable	Unstandardized coefficient (B)	Standardized coefficient (β)	t value	Significance level (p)
Access to services (NEWS-A) (unadjusted)	455.29	0.266	2.099	0.04
Adjusted †	-303.689†	0.177†	1.722†	0.09†
Explained by income (after adjustments)	1992.53	0.242	2.312	0.025
Explained by physical function (after adjustments)	273.22	0.365	2.839	0.006

Note: †after adjustments for age, income, and physical function

4.3.2 Total Score for NEWS-A

The total friendliness of the neighbourhood had a significant positive association with average number of steps even after adjusting for age, annual income and physical function (Table 4.14). However as the total score of NEWS-A was also correlated with accessibility of services ($r= 0.509$, $p< 0.01$), a second regression model was run adjusting for age, physical function and access to services. The association of the total NEWS-A score with number of steps remained significant (Table 4.15).

Table 4.14 Association of the total score for NEWS-A with walking

Variable	Unstandardized coefficient (B)	Standardized coefficient (β)	t value	Significance level (p)
Total score (NEWS-A) (Unadjusted)	144.042	0.275	2.178	0.034
Adjusted†	130.61†	0.249†	2.432†	0.018†
Explained by physical function (after adjustments)	299.80	0.400	3.235	0.002

Note: † after adjustments for age, annual income and physical function

Table 4.15 Association of the total score for NEWS-A with walking controlling for access to services

Variable	Unstandardized coefficient (B)	Standardized coefficient (β)	t value	Significance level (p)
Total score (NEWS-A) †	141.27	0.384	2.273	0.027
Explained by physical function (after adjustments)	287.69	0.384	2.971	0.004
Explained by age (after adjustments)	-151.40	-0.273	-2.145	0.036

Note: † after adjustments for age, physical function and access to services

However, after removing the three influential observations from the total sample, total score for NEWS-A had no association with the outcome variable. The other environmental variables, either individually or after controlling for personal factors effects, did not have any significant association with the outcome variable, either for the total sample or after removal of the influential observations.

4.3.3 Influence of the Weather on Walking

Mean temperature, snow and total rain had no significant association with average number of steps as shown in Table 4.16. Average daily minimum and maximum temperatures and average total daily precipitation did not differ between the fall and spring data collection periods. Weather recording for each subject during the time while wearing the pedometers are listed in Appendix 7.

Table 4.16 Influence of the weather on walking

Variable	**Unstandardized coefficient (B)**	**Standardized coefficient (β)**	**t value**	**Significance level (p)**
Mean temperature	-58.7	-0.10	-0.793	0.431
Snow on the ground	1494	0.143	1.103	0.275
Total Rain	-33.7	-0.104	-0.793	-.431

Chapter 5 – Discussion

The purpose of this study was to investigate the association between walking behaviour and the following variables: personal factors (age, gender, income, education, number of health conditions and self-rated health, social support, and physical function) and perceived neighbourhood environment (access to services, neighbourhood aesthetics, street connectivity, infrastructure and safety), in older adults residing in a downtown neighbourhood. Results partially supported the study hypotheses as several personal factors (younger age, better health status and levels of physical function were significantly associated with more walking). Hypotheses related to the association between the perceived local environment and walking behaviour were not supported.

5.1 Sample Characteristics

The sample consisted of 60 volunteers from five buildings all located in a downtown neighbourhood. The majority of the sample (75%) was female. Among women in this study, 71.1% live alone, which included widow, divorced, or single status. Perhaps this high proportion of women in the study may be explained because among older adults, women are more predominant compared to men. In Manitoba, in 2006, there were 134 women aged 65 years for every 100 men, and this trend increased with increasing age. Among the very old age group (75 to 84 years of age), there were 143 women for every 100 men while in the oldest old group (over 85 years) there were 219 women for every 100 men. The proportion of women living alone in Manitoba was 46% including widow, divorced or single status. The proportion of widowed women aged 85 and over was 78.9% (Statistics Canada 2007). In the downtown neighbourhood, in 2006, 6% of the population were women aged 65 years and above, and 5% were men aged 65 years and above. The proportion of older adults that live alone is 48.4%, which is considered the highest among all Winnipeg communities (Community Health Assessment 2004).

From the total sample, only 21% had college/university degree completed. In the downtown neighbourhood, 12.0% of the population has less than grade nine (12.0%), and 32.8% has high school as the highest educational level attained (Community Health Assessment, WRHA 2004). The majority of subjects in this study reported an annual income level above $ 30,000. The average income for the downtown neighbourhood is $33,229 (Community Health Assessment, WRHA 2004). Perhaps a relatively higher annual income was found for this sample because the majority live in seniors' apartments where the cost of living is relatively high.

Despite the fact that half of the sample had two or more health conditions, most reported excellent or very good health (66.6%). The community health assessment from the Winnipeg Regional Health Authority showed that downtown is one of the less healthy communities among WRHA communities. Health issues including diabetes, cardiovascular diseases, and cancer among others were reported. However they were not reported by age categories. Perhaps other issues such as high immigration and high minority rates, as well as ethnic diversity impacts the health status at downtown neighbourhood (Community Health Assessment, WRHA 2004).

Although the older adults in this study were still living in the community, and reported very good health status, and frequent walks, the average number of steps taken per day was 5289, below the minimum of 6,000 steps suggested for health by Tudor-Locke and Myers (2001)(b) or the minimum 6565 steps suggested by Bohannon et al. (2007). However the mean age of the present sample was higher in comparison with other studies done with older adults that used pedometers to assess walking behaviour (Croteau et al. 2007; Tudor Locke et al. 2002(c); King et al. 2005). In the present study, three subjects had an average of 17,855 steps per day, considerably greater than two standard deviations above the average for the total sample (i.e., > 13,347 steps). These subjects were all healthy, highly educated, and relatively wealthy. Although a small proportion of the total sample, the results of these three subjects significantly changed some of the relationships observed, particularly related to driving behaviour and the relationship of walking with the perceived environment. Perhaps if the sample size was larger, with a broader range of data, consistent relationships could have been found.

When the influential observations were not considered, the average number of steps for the sample decreased to 4627 steps, which is considerably less than recommended. This apparent discrepancy may be explained in several ways. The above recommendations may not have considered different age categories, as the number of recommended steps for the oldest old age group may differ from the old group. Bohannon (2007) presented a confidence interval ranging from 4897 to 8233. Perhaps this range should be stratified into different age categories in order to better understand walking behaviour, particularly among the oldest old age group. Croteau et al. (2007) used pedometers in a community dwelling older adult sample in order to increase physical activity (mean age, 72.9 years). At baseline, without any intervention, the average number of steps was about 4860, which was similar to our results. Tudor Locke et al.

(2002 d), examined exercise class participation to increase daily activity in older adults (mean age, 69 years). She showed that without class participation, an average of less than 4000 steps was achieved. However among those who participated in the exercise classes, an average of 8,119 steps was found. King et al (2005) used pedometers to quantify physical activity in older women, and an average of 6518 steps was reported. However the mean age for the sample was only 57.3 years.

Difficulties regarding proper management of the equipment must be considered. If pedometers are not kept in a vertical position, steps are not counted properly, as the equipment detects vertical accelerations (up and down motion) (Tudor Locke and Myers 2001 a). It is possible that some of the subjects had walked at a slow pace reducing the accuracy of the equipment to detect the total number of steps taken (Tudor-Locke et al. 2002 a; Tudor-Locke et al. 2002 b). Also, as half of our sample drives, pedometers could have erroneously counted vehicle movements (such as potholes) as steps taken. Another possibility is that some did not attach the equipment as soon as they got up in the morning, consequently some steps were missed. Pedometers were chosen for its suitability to measure walking behaviour (steps per day) (Tudor-Locke and Myers 2001(a)) rather than questionnaires that measure physical activity considering a variety of activities such household or leisure activities. Also, it is a performance based instrument, and walking can be measured rather than self reported. There are no published studies available about the validity and reliability of the SC-01 StepsCount pedometer. The supplier provided a study (not published) done with the purpose of evaluate the accuracy of the equipment at various speeds and walking surfaces. Results showed that the most accurate position was in the right mid-thigh position, which was the position used to record the steps in the study

5.2 Personal Factors

5.2.1 Walking Behaviour

Most participants reported themselves to be frequent walkers, regardless of the summer or winter season. Preferred places for walking were local streets, parks or at a mall. Influential observations, although representing a small portion of the total sample, were younger, and reported themselves as outdoor walkers, who walked primarily for recreation compared to the total sample. Perhaps an age effect was present, that led the older subjects to walk more for health reasons or transportation; alternatively, the younger age and better reported health of the three influential observations contributed to more enjoyable walking, compared to the total sample, as noted earlier in the Results section.

Literature supports our findings related to walking location and purpose of walking, as local streets (Eyler et al. 2003; Giles-Corti and Donovan 2002), parks and malls are the most preferred places for walking (Eyler et al. 2003). Reported reasons for walking have been either for transportation or for recreation (McGinn et al. 2007(a); Hoehner 2005; Owen et al. 2007). However, unlike the present study, these studies were done with younger adults, and specifically examined the relationship between the purpose of walking and the physical environment. Kolt et al. (2004) reported that walking was one of the most common types of physical activity among older adults, who reported walking mainly to stay healthy. Age was found to affect the purpose of walking by

Humpel et al. (2004)(a), who found that the proportion of those aged 60 years or more who walked for recreation was significantly smaller than those aged less than 60 years.

5.2.2 Age and Gender

Age was associated with taking fewer steps per day, as those who were older walked significantly less, compared with those who were younger. These results are supported by the literature, as levels of physical activity (Lim and Taylor 2005; Poortinga 2006; Eyler et al. 2007; Granner et al. 2007; Panagiotakos et al. 2008), and of walking in particular (Michael et al. 2006) decrease with advancing age. However, in the present study, after controlling for personal factors such as physical function, health status and income, age was no longer associated with the amount of walking, suggesting that increasing age alone was not a major determinant of walking behaviour.

No gender differences in walking behaviour were found. Perhaps if the sample had more males, gender differences could have been reported. The literature is controversial regarding gender differences in walking. Some studies report gender differences for physical activity participation (Lim and Taylor 2005), and leisure time physical activity (Hughes et al. 2008; Steffen et al. 2006), as men were more likely to engage in those activities than women. Some studies do not report any difference between gender and walking (Ruth and Coleman 2005(b); Michael et al. 2006). Perhaps different types of physical activity measurement, as well as the population studied (younger adults or older adults) might have influenced the variability of results.

5.2.3 Annual Income

In this study we found a strong significant association between higher income and higher number of steps taken, even after accounting for age, health status and levels of physical function. For the three influential observations, the markedly higher number of steps and higher education level compared to the total sample could have led to a stronger association between income and average number of steps taken. However, even after accounting for this, the relationship between income and average number of steps taken remained highly significant. This suggests that older adults with higher income walked significantly more than those with lower income. Previous studies also found a significant association between higher income (Eyler et al. 2003; Ruth and Coleman 2005 (b), or higher SES neighbourhoods (Hoehner et al. 2005) and increased physical activity. Alternatively, lower income, or residents of lower SES neighbourhoods are less likely to engage in moderate physical activity than those living in higher SES neighbourhoods (Ball et al. 2007; Lee et al. 2007(b)).

In this study socioeconomic status was represented as income level, as income and educational level had collinear results. However, studies that considered education as a measure of socioeconomic status also showed a significant association with increased physical activity (Camoes and Lopes 2008; Steffen et al. 2006) or walking (Ruth and Coleman 2005(b). Kolt et al. 2004 showed that among older adults, those with more years of education reported fitness as the most important reason to engage in physical activity and exercise, unlike those with less years of education.

Some studies have found no association between income or educational level and walking. Perhaps because these studies used self reported measurements for walking, and the sample was predominantly young adults (Granner et al. 2007; Foster et al. 2004).

Other studies have found the opposite relationship between income and walking. King et al. (2005) reported that among older women, those living in a low SES neighbourhood were more likely to walk. Authors acknowledged fewer transportation options, and some had to rely on walking to access places and services. Owen et al. (2007) showed a significant association between higher income and less minutes of walking for transportation among adults. The authors acknowledged the high availability of motorized transport in the neighbourhood studied.

5.2.4 Health- Status

In this study there was a significant association between higher self rated health and more steps taken per day. Older adults who reported their health as excellent or very good walked significantly more compared to those who reported their health as good or fair. These findings are supported by the literature, as better self rated health has been associated with increased physical activity among older adults (Gregg et al. 1996; Abu-Omar et al. 2004). Alternatively, poor self rated health has been associated with less exercise (Lorraine et al. 2005). Health problems among older adults, particularly among the very old and oldest old populations (Newson and Kemps 2007), have been the most important cited barrier for physical activity engagement (Lim and Taylor 2005).

There were also significant associations in the present study between higher self rated health, fewer health conditions, and higher physical function such as strength, endurance, flexibility and balance, suggesting that self rated health is strongly linked with higher overall mobility and greater physical health. Given the cross-sectional nature of this study, it was not possible to establish predictions, or causal relationships. However, increased functional limitations, such as increased walking difficulty, and slower walking speed (Jylha et al. 2001) have been associated with poor self rated health.

5.2.5 Physical Function

A significant association was found between higher physical function, particularly chair rising as a functional measure of lower strength, and more walking in the present study. Even after controlling for variables such as age, income and health status this relationship remained highly significant, suggesting that higher physical function was one of the most important factors associated with walking capacity. In fact, higher lower body strength was one of the variables that most explained the total variation in walking for this sample. Lim and Taylor (2005) also showed that better physical function was significantly associated with higher physical activity among older adults.

The relationship between physical function and physical activity including walking behaviour has been reported in the literature, in both cross-sectional and longitudinal studies. Cross-sectional studies show that lower physical activity is associated with lower physical function among older adults (Frisard et al. 2007). Similarly, older adults who are physically active or do exercise have higher levels of physical function (Brach et al. 2004). Longitudinal studies indicate that increased physical function in older adults is achieved as a consequence of increased physical activity (McAuley et al. 2007), or that a physically active life style during mid-life contributes to higher levels of physical function (Hillsdon et al. 2005). Focusing on walking behaviour in particular for physical function, walking itself (Wong et al. 2003) had a positive impact for maintenance of physical function among older adults. Walking associated with a physically active lifestyle also contributed for maintenance of physical funtion (Visser et al. 2005).

5.2.6 Driving Behaviour

Driving was significantly associated with walking behaviour in this study. It was hypothesised that those who do not drive would walk more, as they would be more likely to use public transportation or even walk for errands, or community services. Contrary to what was hypothesised, those who drove had significantly more steps compared to those who did not drive. This suggests that driving behaviour contributed to increased mobility. However this association became non-significant after controlling for age, annual income and health status; suggesting that driving behaviour was not a strong determinant of walking among older adults.

The higher number of steps observed among the three "high walkers" in this study compared to the total sample, could potentially have directed the relationship between greater number of steps taken and driving behaviour to a highly significant association. In fact, when these influential observations were removed from the total sample, driving behaviour had no association with number of steps taken per day. Perhaps this relationship could have been significant if the sample had had more "high walking" representatives, heterogenizing the results. Lim and Taylor et al. (2005) reported that physical activity among older adults was strongly associated with independent travel by car, bus or train. Crombie et al. (2004) showed that not having access to a car was one of the most cited reasons why older people do not participate in leisure time physical activity. However Miles and Panton et al. (2006) used pedometers to increase physical activity among women, and showed that having a car had no association with number of steps taken.

5.2.7 Social Support

This study considered number of close friends, including family members as a measure of social support. Although a higher number of steps were observed among those with fewer close friends, than among those with more friends, social support had no association with walking among older adults. The majority of subjects also walked alone and did not belong to any walking club. This finding contradicts the literature, as social support has been significantly associated with physical activity engagement (Poortinga 2006, Phongsavan et al. 2007) and leisure (Orsega-Smith et al. 2007). Petee et al. (2006) showed that among older adults, married status or having an active spouse was significantly associated with more physical activity engagement. Eyler et al. (2003) reported that regular walkers had more social support than occasional or never walkers. A reason for this disagreement may be because social support was measured using only a single question with an opened answer (to write down the number of close friends including family members) rather than a standard questionnaire.

5.3 Environmental Factors

Higher accessibility of services and an overall supportive neighbourhood (total score for NEWS-A) were significantly associated with more walking among older adults. These findings were supported by the literature. That suggests that those who have access to places and services such as parks (Miles and Panton et al. 2006; Foster et al. 2004), streets, and malls (Addy et al. 2004; Michael et al. 2006), open spaces (Giles-Corti and Donovan 2003), and recreational areas (Granner et al. 2007), are more likely to walk or to meet minimum physical activity recommendations (Hoehner et al. 2007). Living close to industrial/commercial areas, as well as higher land use mix and residential density (Frank et al. 2005) are also associated with more walking, particularly for transport (Hoehner et al. 2005; Cerin et al. 2007). Accessibility of places has also been associated with walking for recreation, and gender differences were reported, as women with moderate perception of accessibility of places were more likely to walk for recreation than were men (Humpel et al. 2004(c)). However in the majority of these studies, the sample was primarily young adults and walking was self reported measurement. Specifically for older adults, Li et al. 2005 showed that those living in neighbourhoods with more accessibility of services, particularly physical activity facilities, and with higher safety are less likely to decrease walking levels overtime.

After adjusting for personal factors, income and physical function explained most of the variation and accessibility of services had no association with walking in this study. Although overall friendliness of the neighbourhood remained significantly associated with walking, this association was no longer present when the three influential observations were removed. These three subjects had an average number of steps even higher than what was recommended for a high active person. They were considerably younger, and had excellent levels of physical function. They also reported frequent walks, particularly outdoors. This suggests that the association with the environment may be present among those who walk more, as they may interact with the environment where they live. However, when they were removed from the sample, the average number of steps decreased considerably and no association with the environment was found, suggesting that for older adults in the older age category, the perceived environment was not a strong determinant for walking, and this behaviour was significantly more related to personal and intrinsic physical capabilities, particularly physical function and income level, than the environment where they live.

The literature also supports this finding. Frank et al. (2005) showed that personal factors such as age, gender, and education accounted for most of the variation in walking, and environmental variables only added a small proportion to the explanation. Giles Corti and Donovan 2003 showed that among physical environmental, personal and social factors, personal factors were the ones that mostly influenced walking. King et al. (2008) studied the association between physical, personal and social environment for walking in older adults. Although aesthetics, not access to services was associated with more walking, social variables such as social cohesion and safety had greater association with walking and moderated the association between walking and the physical environment. Foster et al. (2004) showed that for women, among nine environmental categories only access to services and safety were related to more walking among those who categorized themselves as low walkers. Even overtime, Dawson et al. (2007) showed that reported barriers to neighbourhood walking did not change walking habits among younger and older adults. Perhaps personal and social factors are more important for keeping overall mobility and independence around the neighbourhood than environmental factors. Perhaps if more "high walkers" representatives were present in this study, stronger association could be found between walking and the perceived environment. However, the probability of a strong association between more steps per day taken and higher levels of physical function would also be high, indicating that physical function could moderate the relationship between walking and the perceived environment.

In this study, after controlling for personal variables such as income, the association with accessibility of services was no longer present. This is in agreement with the literature, as Wendel-Vos et al. (2004) found a significant association between access to a sport ground and more walking in a crude analysis, but after controlling for factors such as age, gender and SES, this association was no longer present. Differences in socioeconomic status (education and income) have also been shown to predict physical activity participation and walking. Those living in low SES areas were less likely to perceive the environment as supportive for walking, less attractive and were less likely to use recreational facilities, and to engage in physical activity (Giles Corti and Donovan 2002). This reflects the multi levels of association between socioeconomic status, not only with physical activity participation but also with perceptions of the environment.

Other than access to services, none of the other environmental attributes were associated with walking in this study. This is in disagreement with the literature, as studies found significant associations between aesthetics (Hoehner et al. 2005; Giles Corti and Donovan 2003; Sallis et al. 2007; Humpel et al. 2004(b); Humpel et al. 2004(c)), and safety (Sallis et al. 2007; Granner et al. 2007; Suminski et al. 2005) with physical activity, or between aesthetics and leisure time (McGinn et al. 2007(a)). Aesthetics and land use mix were also factors that encourage physical activity among older adults (Strath et al. 2007). Perhaps if more than one neighbourhood had been assessed, significant differences among the attributes could have been observed. Some studies that considered this type of setting reported significant differences between the two neighbourhoods. Saelens et al. (2003) showed that residents from a highly walkable neighbourhood reported higher residential density, land use mix, street connectivity, aesthetics, and safety compared than did the residents in a low walkable neighbourhood. Lesliet et al. (2005) showed that residents of highly a walkable neighbourhood reported higher residential density, land use mix access, and street connectivity than did residents of a low walkable neighbourhood. Traffic safety and safety from crime did not differ. However these studies considered a young adult sample. Strath et al. (2007) used a similar setting, with an older adult sample, and no differences were reported between the two neighbourhoods. Other studies reported that among different categories of the environment, only access to services was associated with more walking in adults (King et al. 2005) and older adults (Michael et al. 2006).

The present study showed that those with younger age, higher income, better health status, higher physical function, who drove, and had more accessibility of services and an overall friendly neighbourhood took more steps taken per day. Gender and social support had no associations with walking. Studies that used various explanatory variables reported that those from older age groups, from lower socio-economic backgrounds (Poortinga 2006), and with chronic disease (Aslan et al. 2007) are less likely to engage in physical activity. Accordingly, among older adults, younger age, ability to drive or use public transportation, better physical function (Lim and Taylor 2005; Gagliardi et al. 2007), higher education and income, and access to facilities such as walking trails, are factors associated with increased physical activity (Chad et al. 2005). However after adjustments, only higher income and physical function were associated with increased walking.

This study had several limitations. The physical environment was not objectively measured through Geographic Information Systems, but rather through a self reported measurement; therefore it was documented according to people's opinion about their neighbourhood environment. When both methods were used, little agreement was found (McGinn et al. 2007(a)) even among the elderly (Michael et al. 2006), however authors acknowledged the importance of self reported measurements for a more directed physical activity intervention. This study had a cross-sectional design, thus causality, as well as influences on walking could not be established. Another limitation was the small sample size. This not only impacted the strength of the relationships but also limited the number of representative data across the sample.

This study also had some strengths. Physical function was measured using performance based measurement, increasing the reliability of the results. This study was the first to address relationships between physical activity and neighbourhood environment accounting for levels of physical function. None of the prior studies cited considered this relationship. This study also was one of few studies to investigate several personal and environmental variables for walking among older adults.

Conclusion

Several personal factors were associated with physical activity among this sample. Younger age, higher income, better self reported health status and higher physical function were significantly associated with walking. Gender and social support had no associations with walking. However, higher income and better physical function, particularly chair rising as a functional measure of lower body strength, were the main factors associated with walking after removing the influential observations. Among environmental factors, access to services and the overall friendliness of the neighbourhood were associated with more walking. However, after accounting for personal factors, this relationship was no longer observed. Additionally, when influential observations were removed from the sample, no associations were found between walking and the perceived environment.

Recommendations for Future Research

Based on the findings of this study, the following recommendations are made for future research:

- More studies focusing on older adults in order to better understand the role of personal and environmental factors on walking or on physical activity in general, as most studies focused on young adult population.
- More studies, particularly using a longitudinal design, to explore how changes in physical function affect the relationship with neighbourhood environment.
- Studies to include not only independent ambulatory, but also dependent ambulatory older adults, to investigate possible different perceptions of the physical and social environments.
- More studies investigating the role of different cultures on physical activity engagement and environmental perceptions.

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Appendices List

1 - Informed Consent

Research Project Title: Associations between Personal and Environmental Factors on Walking Practices of Older Adults Residing in a Downtown Neighbourhood

Researcher: Lucelia Luna de Melo

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

1. The purpose of this study is to examine the influence of neighborhood characteristics and personal factors (such as age, gender, health status, etc.) on walking practices of older adults who live in a downtown neighbourhood.

2. Your participation in this study will take place over an approximate one-week period, and will include three parts:

i) You will be given two questionnaires to take home and complete at your convenience. The first questionnaire contains simple questions about your age, gender, health status, education level, degree of social support and your walking habits. The second questionnaire will ask you to agree or disagree with several characteristics about your neighborhood. It should take you less than 30 minutes to complete both questionnaires.

ii) Your height and weight will be measured, and you will perform a functional fitness test. This assessment is specifically designed for older adults, and will take about 45 minutes to complete. It will be done in a private area in your apartment building. The functional fitness assessment contains six parts:

- Upper body strength

  Sitting on a chair you will do elbow flexions while holding a light weight (as many as you can in 30 seconds).

- Lower body strength

  Sitting on a chair, you will stand up and return to a seated position as many times as you can within 30 seconds.

- Upper body flexibility

In a standing position you will place your hands behind your back (one over your shoulder, one from below), and attempt to touch your hands together.

- Lower body flexibility

Sitting on a chair, you will place one leg straight in front of you, while the other one will be bent at the knee. You will bend forward slowly in an attempt to touch your toes.

- Endurance

In a standing position, you will "walk in place" for 2 minutes.

- Balance and Agility

On the signal "go" you will stand up from your position seated in a chair, WALK as quickly as you can around a mark placed a short distance in front of you, come back, and sit down on the chair.

Prior to the functional fitness assessment you will do a 10-minute warm up. You will receive appropriate instructions and will be individually monitored, and instructed not to go beyond your limit.

iii) On the same day as your functional fitness assessment, you will be shown how to use a pedometer to measure the number of steps you walk each day. A pedometer is a small portable instrument that you will strap onto your hip over your clothes. You will be asked to wear the pedometer for three days (Thursday, Friday, Saturday), and at the end of each day, to write down the number of steps on a recording form that you will be given. You will meet with the researcher the following week to hand in your recording form. At this meeting you will also be given your personal fitness assessment scores, a physical activity guide, and have the option of consulting with the researcher about your personal physical activity level. This meeting will take approximately 30 minutes, and will also occur in your apartment building.

3. This study does not involve any high risks. There is a small chance that symptoms such as dizziness, "feeling tired", or joint discomfort might occur during or after the fitness assessment. The assessment will be stopped immediately at any discomfort reported to the principal researcher.

4. Any personal information and data obtained during this study will be treated as privileged and confidential. Data collected during the study will be recorded in association with a subject number that only the principal researcher, her advisor, and you will know. The data collected during this study will be used for statistical analyses and scientific purposes only. Only grouped data will be published, and no personal information will be released to any individual without your prior written consent.

5. You will receive your personal fitness assessment results during your final appointment with the principal researcher. After the study completion, if you so choose, the general results will be mailed to you. Copies of the general results will also be available in your apartment building lobby, and the principal researcher will make a presentation about the study findings in the Spring of 2008.

6. Participants who complete the study will be eligible for several small draw prizes (e.g. Winnipeg *in motion* tee-shirts, water bottles, hats).

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Lucelia Luna	Telephone:
Dr. Elizabeth Ready (advisor)	Telephone:

This research has been approved by the *Education/Nursing Ethics Board.* If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

____________________________ ____________________

Participant's Signature Date

____________________________ ____________________

Researcher and/or Delegate's Signature Date

2 PAR-Q

Physical Activity Readiness Questionnaire - PAR-Q (revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	**Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?**
☐	☐	2.	**Do you feel pain in your chest when you do physical activity?**
☐	☐	3.	**In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	4.	**Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	5.	**Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	6.	**Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	7.	**Do you know of <u>any other reason</u> why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to <u>all</u> PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

<u>Informed Use of the PAR-Q</u>: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME ____

SIGNATURE ________________________________ DATE ____________________

SIGNATURE OF PARENT ________________________ WITNESS ____________________
or GUARDIAN (for participants under the age of majority)

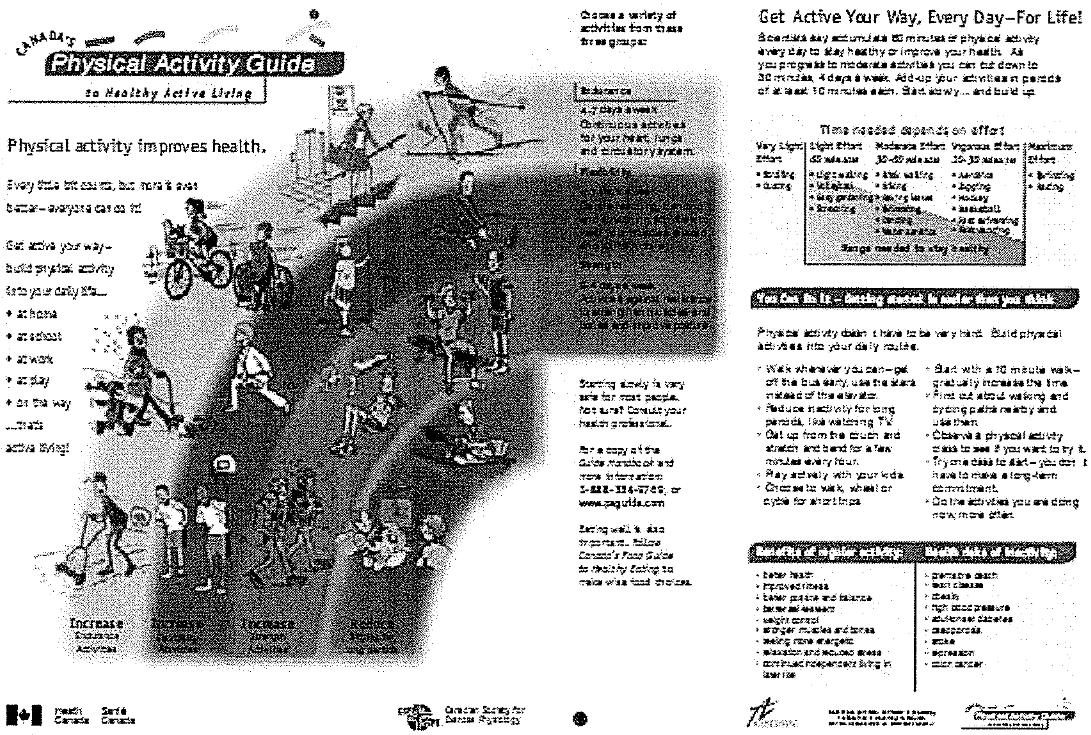
Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

CSEP SCPE Supported by: Health Canada Santé Canada continued on other side...

...continued from other side

PAR-Q & YOU

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 2002)



Source: Canada's Physical Activity Guide to Healthy Active Living, Health Canada, 1998 http://www.hc-sc.gc.ca/hppb/paguide/pdf/guideEng.pdf

FITNESS AND HEALTH PROFESSIONALS MAY BE INTERESTED IN THE INFORMATION BELOW:

The following companion forms are available for doctors' use by contacting the Canadian Society for Exercise Physiology (address below):

The **Physical Activity Readiness Medical Examination (PARmed-X)** – to be used by doctors with people who answer YES to one or more questions on the PAR-Q.

The **Physical Activity Readiness Medical Examination for Pregnancy (PARmed-X for Pregnancy)** – to be used by doctors with pregnant patients who wish to become more active.

References:

Arraix, G.A., Wigle, D.T., Mao, Y. (1992). Risk Assessment of Physical Activity and Physical Fitness in the Canada Health Survey Follow-Up Study. **J. Clin. Epidemiol.** 45:4 419-428.

Mottola, M., Wolfe, L.A. (1994). Active Living and Pregnancy, In: A. Quinney, L. Gauvin, T. Wall (eds.), **Toward Active Living: Proceedings of the International Conference on Physical Activity, Fitness and Health.** Champaign, IL: Human Kinetics.

PAR-Q Validation Report, British Columbia Ministry of Health, 1978.

Thomas, S., Reading, J., Shephard, R.J. (1992). Revision of the Physical Activity Readiness Questionnaire (PAR-Q). **Can. J. Spt. Sci.** 17:4 338-345.

For more information, please contact the:

Canadian Society for Exercise Physiology
202-185 Somerset Street West
Ottawa, ON K2P 0J2
Tel. 1-877-651-3755 • FAX (613) 234-3565
Online: www.csep.ca

The original PAR-Q was developed by the British Columbia Ministry of Health. It has been revised by an Expert Advisory Committee of the Canadian Society for Exercise Physiology chaired by Dr. N. Gledhill (2002).

Disponible en français sous le titre «Questionnaire sur l'aptitude à l'activité physique - Q-AAP (revisé 2002)».

3 PARmed-X

Physical Activity Readiness
Medical Examination
(revised 2002)

PARmed-X PHYSICAL ACTIVITY READINESS MEDICAL EXAMINATION

The PARmed-X is a physical activity-specific checklist to be used by a physician with patients who have had positive responses to the Physical Activity Readiness Questionnaire (PAR-Q). In addition, the Conveyance/Referral Form in the PARmed-X can be used to convey clearance for physical activity participation, or to make a referral to a medically-supervised exercise program.

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. The PAR-Q by itself provides adequate screening for the majority of people. However, some individuals may require a medical evaluation and specific advice (exercise prescription) due to one or more positive responses to the PAR-Q.

Following the participant's evaluation by a physician, a physical activity plan should be devised in consultation with a physical activity professional (CSEP-Professional Fitness & Lifestyle Consultant or CSEP-Exercise Therapist™). To assist in this, the following instructions are provided:

PAGE 1: • Sections A, B, C, and D should be completed by the participant BEFORE the examination by the physician. The bottom section is to be completed by the examining physician.

PAGES 2 & 3: • A checklist of medical conditions requiring special consideration and management.

PAGE 4: • Physical Activity & Lifestyle Advice for people who do not require specific instructions or prescribed exercise.

• Physical Activity Readiness Conveyance/Referral Form - an optional tear-off tab for the physician to convey clearance for physical activity participation, or to make a referral to a medically-supervised exercise program.

This section to be completed by the participant

A PERSONAL INFORMATION:

NAME ______________________

ADDRESS ______________________

____

TELEPHONE ______________________

BIRTHDATE ______________ GENDER ________

MEDICAL No. ______________________

B PAR-Q: Please indicate the PAR-Q questions to which you answered YES

- ❑ Q 1 Heart condition
- ❑ Q 2 Chest pain during activity
- ❑ Q 3 Chest pain at rest
- ❑ Q 4 Loss of balance, dizziness
- ❑ Q 5 Bone or joint problem
- ❑ Q 6 Blood pressure or heart drugs
- ❑ Q 7 Other reason: ______________

C RISK FACTORS FOR CARDIOVASCULAR DISEASE:
Check all that apply

- ❑ Less than 30 minutes of moderate physical activity most days of the week.
- ❑ Currently smoker (tobacco smoking 1 or more times per week).
- ❑ High blood pressure reported by physician after repeated measurements.
- ❑ High cholesterol level reported by physician.
- ❑ Excessive accumulation of fat around waist.
- ❑ Family history of heart disease.

Please note: Many of these risk factors are modifiable. Please refer to page 4 and discuss with your physician.

D PHYSICAL ACTIVITY INTENTIONS:

What physical activity do you intend to do?

____

____

____

This section to be completed by the examining physician

Physical Exam:

Ht	Wt	BP i) /
		BP ii) /

Conditions limiting physical activity:

- ❑ Cardiovascular ❑ Respiratory ❑ Other
- ❑ Musculoskeletal ❑ Abdominal

Tests required:

- ❑ ECG ❑ Exercise Test ❑ X-Ray
- ❑ Blood ❑ Urinalysis ❑ Other

Physical Activity Readiness Conveyance/Referral:

Based upon a current review of health status, I recommend:

Further Information:
❑ Attached
❑ To be forwarded
❑ Available on request

- ❑ No physical activity
- ❑ Only a medically-supervised exercise program until further medical clearance
- ❑ Progressive physical activity:
  - ❑ with avoidance of: ______________
  - ❑ with inclusion of: ______________
  - ❑ under the supervision of a CSEP-Professional Fitness & Lifestyle Consultant or CSEP-Exercise Therapist™
- ❑ Unrestricted physical activity–start slowly and build up gradually

PARmed-X PHYSICAL ACTIVITY READINESS MEDICAL EXAMINATION

Following is a checklist of medical conditions for which a degree of precaution and/or special advice should be considered for those who answered "YES" to one or more questions on the PAR-Q, and people over the age of 69. Conditions are grouped by system. Three categories of precautions are provided. Comments under Advice are general, since details and alternatives require clinical judgement in each individual instance.

	Absolute Contraindications	**Relative Contraindications**	**Special Prescriptive Conditions**	**ADVICE**
	Permanent restriction or temporary restriction until condition is treated, stable, and/or past acute phase.	Highly variable. Value of exercise testing and/or program may exceed risk. Activity may be restricted. Desirable to maximize control of condition. Direct or indirect medical supervision of exercise program may be desirable.	Individualized prescriptive advice generally appropriate: • limitations imposed; and/or • special exercises prescribed. May require medical monitoring and/or initial supervision in exercise program.	
Cardiovascular	☐ aortic aneurysm (dissecting) ☐ aortic stenosis (severe) ☐ congestive heart failure ☐ crescendo angina ☐ myocardial infarction (acute) ☐ myocarditis (active or recent) ☐ pulmonary or systemic embolism—acute ☐ thrombophlebitis ☐ ventricular tachycardia and other dangerous dysrhythmias (e.g., multi-focal ventricular activity)	☐ aortic stenosis (moderate) ☐ subaortic stenosis (severe) ☐ marked cardiac enlargement ☐ supraventricular dysrhythmias (uncontrolled or high rate) ☐ ventricular ectopic activity (repetitive or frequent) ☐ ventricular aneurysm ☐ hypertension—untreated or uncontrolled severe (systemic or pulmonary) ☐ hypertrophic cardiomyopathy ☐ compensated congestive heart failure	☐ aortic (or pulmonary) stenosis—mild angina pectoris and other manifestations of coronary insufficiency (e.g., post-acute infarct) ☐ cyanotic heart disease ☐ shunts (intermittent or fixed) ☐ conduction disturbances • complete AV block • left BBB • Wolff-Parkinson-White syndrome ☐ dysrhythmias—controlled ☐ fixed rate pacemakers	• clinical exercise test may be warranted in selected cases, for specific determination of functional capacity and limitations and precautions (if any). • slow progression of exercise to levels based on test performance and individual tolerance. • consider individual need for initial conditioning program under medical supervision (indirect or direct).
			☐ intermittent claudication	progressive exercise to tolerance
			☐ hypertension: systolic 160-180; diastolic 105+	progressive exercise; care with medications (serum electrolytes; post-exercise syncope; etc.)
Infections	☐ acute infectious disease (regardless of etiology)	☐ subacute/chronic/recurrent infectious diseases (e.g., malaria, others)	☐ chronic infections ☐ HIV	variable as to condition
Metabolic		☐ uncontrolled metabolic disorders (diabetes mellitus, thyrotoxicosis, myxedema)	☐ renal, hepatic & other metabolic insufficiency	variable as to status
			☐ obesity ☐ single kidney	dietary moderation, and initial light exercises with slow progression (walking, swimming, cycling)
Pregnancy		☐ complicated pregnancy (e.g., toxemia, hemorrhage, incompetent cervix, etc.)	☐ advanced pregnancy (late 3rd trimester)	refer to the "PARmed-X for PREGNANCY"

References:

Arraix, G.A., Wigle, D.T., Mao, Y. (1992). Risk Assessment of Physical Activity and Physical Fitness in the Canada Health Survey Follow-Up Study. **J. Clin. Epidemiol.** 45:4 419-428.

Mottola, M., Wolfe, L.A. (1994). Active Living and Pregnancy, In: A. Quinney, L. Gauvin, T. Wall (eds.), **Toward Active Living: Proceedings of the International Conference on Physical Activity, Fitness and Health.** Champaign, IL: Human Kinetics.

PAR-Q Validation Report, British Columbia Ministry of Health, 1978.

Thomas, S., Reading, J., Shephard, R.J. (1992). Revision of the Physical Activity Readiness Questionnaire (PAR-Q). **Can. J. Spt. Sci.** 17: 4 338-345.

The PAR-Q and PARmed-X were developed by the British Columbia Ministry of Health. They have been revised by an Expert Advisory Committee of the Canadian Society for Exercise Physiology chaired by Dr. N. Gledhill (2002).

Disponible en français sous le titre «Évaluation médicale de l'aptitude à l'activité physique (X-AAP)»

Continued on page 3...

	Special Prescriptive Conditions	ADVICE
Lung	❑ chronic pulmonary disorders	special relaxation and breathing exercises
	❑ obstructive lung disease ❑ asthma	breath control during endurance exercises to tolerance; avoid polluted air
	❑ exercise-induced bronchospasm	avoid hyperventilation during exercise; avoid extremely cold conditions; warm up adequately; utilize appropriate medication.
Musculoskeletal	❑ low back conditions (pathological, functional)	avoid or minimize exercise that precipitates or exasperates e.g., forced extreme flexion, extension, and violent twisting; correct posture, proper back exercises
	❑ arthritis—acute (infective, rheumatoid; gout)	treatment, plus judicious blend of rest, splinting and gentle movement
	❑ arthritis—subacute	progressive increase of active exercise therapy
	❑ arthritis—chronic (osteoarthritis and above conditions)	maintenance of mobility and strength; non-weightbearing exercises to minimize joint trauma (e.g., cycling, aquatic activity, etc.)
	❑ orthopaedic	highly variable and individualized
	❑ hernia	minimize straining and isometrics; stregthen abdominal muscles
	❑ osteoporosis or low bone density	avoid exercise with high risk for fracture such as push-ups, curl-ups, vertical jump and trunk forward flexion; engage in low-impact weight-bearing activities and resistance training
CNS	❑ convulsive disorder not completely controlled by medication	minimize or avoid exercise in hazardous environments and/or exercising alone (e.g., swimming, mountainclimbing, etc.)
	❑ recent concussion	thorough examination if history of two concussions; review for discontinuation of contact sport if three concussions, depending on duration of unconsciousness, retrograde amnesia, persistent headaches, and other objective evidence of cerebral damage
Blood	❑ anemia—severe (< 10 Gm/dl) ❑ electrolyte disturbances	control preferred; exercise as tolerated
Medications	❑ antianginal ❑ antiarrhythmic ❑ antihypertensive ❑ anticonvulsant ❑ beta-blockers ❑ digitalis preparations ❑ diuretics ❑ ganglionic blockers ❑ others	NOTE: consider underlying condition. Potential for: exertional syncope, electrolyte imbalance, bradycardia, dysrhythmias, impaired coordination and reaction time, heat intolerance. May alter resting and exercise ECG's and exercise test performance.
Other	❑ post-exercise syncope	moderate program
	❑ heat intolerance	prolong cool-down with light activities; avoid exercise in extreme heat
	❑ temporary minor illness	postpone until recovered
	❑ cancer	if potential metastases, test by cycle ergometry, consider non-weight bearing exercises; exercise at lower end of prescriptive range (40-65% of heart rate reserve), depending on condition and recent treatment (radiation, chemotherapy); monitor hemoglobin and lymphocyte counts; add dynamic lifting exercise to strengthen muscles, using machines rather than weights.

*Refer to special publications for elaboration as required

The following companion forms are available online: http://www.csep.ca/forms.asp

The **Physical Activity Readiness Questionnaire (PAR-Q)** - a questionnaire for people aged 15-69 to complete before becoming much more physically active.

The **Physical Activity Readiness Medical Examination for Pregnancy (PARmed-X for PREGNANCY)** - to be used by physicians with pregnant patients who wish to become more physically active.

For more information, please contact the:

Canadian Society for Exercise Physiology
202 - 185 Somerset St. West
Ottawa, ON K2P 0J2
Tel. 1-877-651-3755 • FAX (613) 234-3565 • Online: www.csep.ca

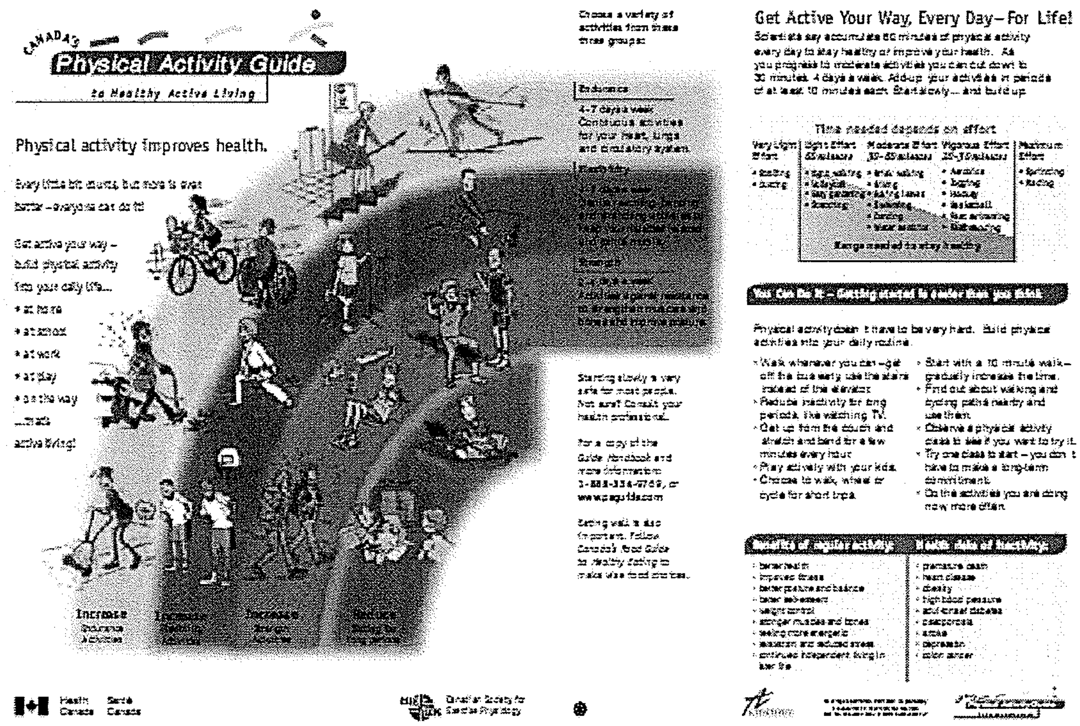
Note to physical activity professionals...

It is a prudent practice to retain the completed Physical Activity Readiness Conveyance/Referral Form in the participant's file.

Continued on page 4...

Physical Activity Readiness
Medical Examination
(revised 2002)

PARmed-X PHYSICAL ACTIVITY READINESS MEDICAL EXAMINATION



Source: Canada's Physical Activity Guide to Healthy Active Living, Health Canada, 1998 http://www.hc-sc.gc.ca/hppb/paguide/pdf/guideEng.pdf

PARmed-X Physical Activity Readiness Conveyance/Referral Form

Based upon a current review of the health status of ______________________________, I recommend:

- ❑ No physical activity
- ❑ Only a medically-supervised exercise program until further medical clearance
- ❑ Progressive physical activity
  - ❑ with avoidance of: ______________________________
  - ❑ with inclusion of: ______________________________
  - ❑ under the supervision of a CSEP-Professional Fitness & Lifestyle Consultant or CSEP-Exercise Therapist™
- ❑ Unrestricted physical activity — start slowly and build up gradually

Further Information:
- ❑ Attached
- ❑ To be forwarded
- ❑ Available on request

Physician/clinic stamp:

______________________________ M.D.

______________________________ 20______
(date)

NOTE: This physical activity clearance is valid for a maximum of six months from the date it is completed and becomes invalid if your medical condition becomes worse.

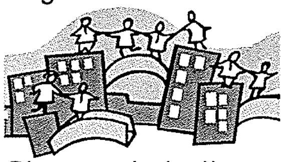
4 Pedometer Recording Form

You are being asked to wear a pedometer for three days. Attach the pedometer on your hip in the morning as soon as you wake up, and remove at night before you go to bed. At the end of each day, check the number of steps taken, and record them on the table below. Please continue to do your normal daily activities during the time you are wearing the pedometer.

	Thursday	**Friday**	**Saturday**
Number of Steps			

5 Neighborhood Environment Walkability Scale (NEWS–A) (Abbreviated Version) (Cerin et al 2006) This scale was modified from the original Original available at: http://www.drjamessallis.sdsu.edu/

We would like to find out more information about the way that you perceive or think about your neighborhood. Please answer the following questions about your neighborhood and yourself.



Access to services

Please circle the answer that best applies to you and your neighborhood. Both *local* *and* *within walking distance* *mean within a 10-15 minute walk from your home.*

1. Stores are within easy walking distance of my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. Parking is difficult in local shopping areas.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many places to go within easy walking distance of my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. It is easy to walk to a transit stop (bus, train) from my home.

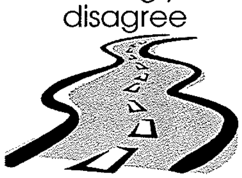
1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

5. The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

6. There are major barriers to walking in my local area that make it hard to get from place to place (for example, freeways, railway lines, rivers).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree



Streets in my neighborhood

Please circle the answer that best applies to you and your neighborhood.

1. The streets in my neighborhood <u>do not</u> have many cul-de-sacs (dead-end streets).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. The distance between intersections in my neighborhood is usually short (100 yards or less; the length of a football field or less).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many alternative routes for getting from place to place in my neighborhood. (I don't have to go the same way every time.)

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

You're making great progress......keep it up!

Places for walking and cycling

Please circle the answer that best applies to you and your neighborhood.

1. There are sidewalks on most of the streets in my neighborhood.

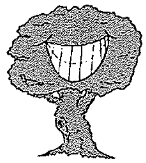
1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. Sidewalks are separated from the road/traffic in my neighborhood by parked cars.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There is a grass/dirt strip that separates the streets from the sidewalks in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree



Neighborhood surroundings

Please circle the answer that best applies to you and your neighborhood.

1. There are trees along the streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. There are many interesting things to look at while walking in my neighborhood.

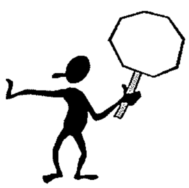
1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many attractive natural sights in my neighborhood (such as landscaping, views).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. There are attractive buildings/homes in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree



Neighborhood safety

Please circle the answer that best applies to you and your neighborhood.

1. There is so much traffic along <u>nearby</u> streets that it makes it difficult or unpleasant to walk in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. The speed of traffic on most <u>nearby</u> streets is usually slow (30 mph or less).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. Most drivers exceed the posted speed limits while driving in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. My neighborhood streets are well lit at night.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

5. Walkers and bikers on the streets in my neighborhood can be easily seen by people in their homes.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

6. There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

7. There is a high crime rate in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

8. The crime rate in my neighborhood makes it unsafe to go on walks <u>during the day</u>.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

9. The crime rate in my neighborhood makes it unsafe to go on walks <u>at night</u>.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

6 Demographic and Health Questionnaire

The following questionnaire asks you about some personal and health characteristics. Please, mark the answer that best applies to you. All responses will be kept strictly confidential and only grouped data will be reported (not individual responses). Thank you for your assistance!

Identification Number: ______________________

Apartment Building: ______________________________________

How long have you residing in this building? ______________**years**

Where did you live before you moved to this building?

( ) Also in downtown Winnipeg

( ) In another Winnipeg neighborhood

( ) Outside Winnipeg **Location:**_____________________________

What is your gender? ( ) Male ( ) Female

What is the highest educational level the you have attained?

( ) Less than high school

( ) High school graduate/or **some** college or university

( ) College diploma or university degree completed

What is your marital status?

( ) Single

( ) Widowed

( ) Married couple/ common law partner

( ) Divorced

What is your annual household income?

( ) Below or equal to $ 29,999 (0)

( ) Between $ 30,000 and $ 69,999 (1)

( ) $ 70,000 or above (2)

What is your <u>current</u> primary occupation?

( ) Homemaker

( ) Working full time (outside the home)

( ) Working part time (outside the home)

( ) Retired

( ) Other

"How would you rate your health compared to others of your age?"

( ) Excellent (0)

( ) Very Good (1)

( ) Good (2)

( ) Fair (3)

( ) Poor (4)

Write the number of close friends and close relatives that you have (people you feel at ease with and can talk to about what is on your mind):

Do you have any of these health conditions listed below? (Please, read carefully and mark only the one (ones) which your physician has diagnosed you)

( ) Muscle, bone or join problems

( ) Breathing problems

( ) Heart and circulation problems

( ) Kidney, bladder, or urinary problems

( ) Neurological problems

( ) Mental or emotional problems

( ) Cancer

( ) Blood problems

( ) Eye problems

( ) High blood pressure

( ) Diabetes

( ) Other (specify) ______________________________ if you reported a health condition, does it limit your physical activity level?

( ) Not at all

( ) A little bit

( ) A lot

Subject	Mean Temperature (˚C)	snow on the ground (cm)	Total rain (mm)
1	13.3	0	0
2	13.3	0	0
3	13.3	0	0
4	13.3	0	0
5	8.6	0	0
6	8.6	0	0
7	8.6	0	0
8	8.6	0	0
9	8.6	0	0
10	6.8	0	0
11	6.8	0	0
12	7.8	0	23

7

Weather Recording

13	4.1	0	0
14	4.1	0	0
15	4.1	0	0
16	4.1	0	0
17	1.9	0	0
18	1.6	1.5	0.5
19	1.6	1.5	0.5
20	1.6	1.5	0.5
21	-2.3	0	0
22	-8.2	1	0
23	-8.2	1	0
24	-8.2	1	0
25	-0.6	0	0
26	-0.6	0	0
27	-0.6	0	0
28	-0.6	0	0
29	-0.6	0	0
30	-0.6	0	0
31	-0.6	0	0
32	-0.6	0	0
33	3.2	0	0
34	3.2	0	0
35	3.2	0	0
36	3.2	0	0
37	2.3	0	0
38	13.1	0	0.5
39	13.1	0	0.5
40	15.2	0	4.5
41	15.2	0	4.5
42	15.2	0	4.5
43	15.2	0	4.5
44	15.2	0	4.5
45	15.2	0	4.5
46	15.2	0	4.5
47	15.2	0	4.5
48	15.2	0	4.5
49	15.2	0	4.5
50	15.2	0	4.5
51	15.2	0	4.5
52	15.2	0	4.5
53	15.2	0	4.5

54	14.1	0	38.5
55	14.1	0	38.5
56	14.1	0	38.5
57	14.1	0	38.5
58	14.1	0	38.5
59	14.1	0	38.5
60	14.1	0	38.5