Canada's Physical Activity Guide for Older Adults: Effect of an intervention on functional fitness and daily energy expenditure

By

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A Thesis
Submitted to the Faculty of Graduate Studies
In Partial Fulfillment of the Requirements
For the Degree of

Master of Science

Faculty of Physical Education and Recreation Studies,
University of Manitoba, Winnipeg.

September 2001

THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES

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CANADA'S PHYSICAL ACTIVITY GUIDE FOR OLDER ADULTS: EFFECT OF AN INTERVENTION ON FUNCTIONAL FITNESS AND DAILY ENERGY EXPENDITURE

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ACKNOWLEDGEMENTS

There are several people that I would like to thank for their contributions to the completion of this thesis. First of all, my advisor, Dr. Elizabeth Ready, for her supports, guidance, encouragement during the past three years. She made not only a significant contribution towards my knowledge base, but also an invaluable research help and countless other kindness. Secondly, thanks to Dr. Michelle Porter for her advice and encouragement for the whole process of the Master's program as a committee member. Thirdly, to external committee member Dr. Juliette Cooper from the School of Medical Rehabilitation. She provided me with insight towards the development of my study.

I would also like to acknowledge St. James/ Assiniboia Senior Centre and the Manitoba Housing Authority for giving me the opportunity to do the research and providing me access to their facilities. A special thank you to Mrs. Karen Pirnie for your help and kindness during the study.

The Centre on Aging of University of Manitoba provided me financial support for my thesis study.

On a personal note, thanks to my parents and my brother, who have given me the greatest support throughout my study in Canada. And finally, thanks to all of the participants who kindly volunteered to participate in the study. Thank you all for making this work a reality.

ABSTRACT

The purpose of the study was to investigate whether a behaviour change program based on Canada's Physical Activity Guide for Older Adults would elicit greater benefits than adoption of the Physical Activity Guide alone. Fifteen older adults completed the eight week intervention (Intervention group, mean age = 73±5y years), while fourteen others received only the Physical Activity Guide (Comparison group, mean age = 77±10 years). Strength, flexibility, balance (Rikli & Jones, 1999) and estimated energy expenditure (DiPietro et al., 1993) were measured at zero and eight weeks. Strength and balance were significantly greater in the Intervention group at baseline ($p < 0.05$), and improved in both groups over time ($p<0.01$). Flexibility also increased significantly in both groups over time ($p<0.01$). The estimated energy expenditure increased in both groups over time ($p<0.05$), however the increase was significantly greater in the Intervention group (group*time, $p<0.05$). Increased estimated total energy expenditure in the Intervention group was due to increases in all sub-components of physical activity over time (exercise, recreational physical activity and work). A significant group*time interaction was also noted for increased energy expenditure due to work activities ($p<0.05$). The increase in energy expenditure in the Comparison group was due to increase in exercise and recreational physical activity only. These results suggest that adoption of the Physical Activity Guide results in benefits. However, the addition of a behaviour change intervention induced a greater increase in estimated energy expenditure primarily through daily work activities, and may therefore ultimately lead to greater health benefits than distribution of the Physical Activity Guide alone.

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Chapter 1: Introduction and Overview

The 20th century has seen a population revolution, with the number of older people increasing at a rate unprecedented in human history. The global net balance of older people is increasing by about one million persons a month (WHO, 1998). Today, the estimated global population of persons sixty years and over is 540 million; by the year 2020, the number is forecast to rise to more than one billion, a 100% increase in only twenty years. In Canada, a quarter of the population will be in the elderly age bracket by that time (MacDonald, 1999).

According to the experts, aging results in a gradual loss of adaptability, and increased functional impairment. This process occurs in living organisms, throughout the life span, resulting eventually in death (Shephard, 1997), and is affected by many factors, including genetics, lifestyle influences, chronic diseases and socio-economic status. The interaction of these factors greatly influences the aging process. Theoretically, old age refers to the immediate post-retirement period, extending from 65 to 75 years (Shephard, 1997). People at this age usually experience some further loss of function or physiologic deconditioning.

Many studies have addressed the age related decline in physiologic function, which includes deconditioning of the cardiopulmonary system, the musculoskeletal system, and the nervous-sensory system, as well as deleterious changes in aerobic capacity, strength, flexibility, balance, and independent living. As physical function is lost with age, the need for caregiver and community services increases (Narain et al., 1988). Quality of life is often negatively affected, because individuals are no longer able to perform the activities that they enjoy.

Lifestyle factors, for example smoking, stress, diet, and especially a sedentary lifestyle, have been identified as the most significant independent cause of cardiovascular disease, decreased functional performance, risk of injury and loss of independent living (Dunn et al., 1999; Lowenthal, et al., 1994). Longitudinal cohort studies report that physically active older adults have less risk of falls and functional impairment (Campbell et al., 1989; Nevitt et al.,1989; Sorock et al., 1988). Exercise and other forms of physical activity are known to provide many specific physiologic and psychosocial benefits to older adults (Pescatello and DiPietro, 1993; Stewart and King, 1991). Exercise physiologists unanimously agree that regular exercise is essential for optimal function of the human body at all ages (Astrand, 1986). Bassey (1978) and Bortz (1982) noted the similarities between the structural and functional declines associated with aging, and the effects of enforced inactivity such as bed rest or space flight. They also noted the ability of activity interventions, like exercise programs, to slow the rate of decline. Haskell (1994) reported that the greatest health benefits from increased physical activity occur when very sedentary persons begin a regular program of moderate aerobic and muscular endurance exercise. Since older adults who are sedentary and inactive have a greater risk of injury, disease, and death, adequate physical activity is highly recommended to this age group, in order to increase the probability of maintaining better health and a higher quality of life (Orban, 1994).

Despite ample evidence to show the benefits of physical activity in the elderly, 43% of a U.S sample aged 65 years and older, were categorized as sedentary in 1986 (Caspersen et al.). According to the more recent 1996-97 Canadian National Population Health Survey, only 34% of men and 29% of women, aged 55 years and over, are

physically active, and among adults aged 74 years and over, only 29% of men and 19% of women are physically active (cited by ALCOA, 1999). Furthermore, according to the 1997 Physical Activity Monitor, as many as one-third of older adults report participating in some form of physical activity less than twice weekly. This means that one-third of older adults are facing an increased risk of losing mobility and functional capacity, which could eventually decrease their functional independence (CFLRI, 1998).

The traditional approach, whereby structured exercise is prescribed, is a useful technique to maintain health. However, it may fall short of meeting the needs of older adults who dislike or fear structured exercise, who have difficulty reaching facilities, or who are low income, or who have age-related medical conditions. There are a vast of number of reasons why older adults are not as physically active as they could and should be. According to the Physical Activity Monitor (CFLRI, 1995), some of the principal reasons offered by adults aged 55 or over for not becoming physically active include lack of energy, lack of motivation, feeling ill at ease, long-term illness or injury, fear of injury, lack of available facilities, perceived excessive cost, lack of skill, and lack of a safe place in which to be active. All of these reasons reflect barriers that act to discourage older people from involvement in physical activity.

Both public health and individual strategies are needed to encourage older people to become more active, in order to delay the decline in physical function and to promote successful aging. It is imperative to determine the most suitable types of physical activity to improve health in the senior population. The main concern should be motivating and increasing physical activity participation of those with very low physical activity levels.

Many studies support the shift in emphasis from traditional individual exercise

"prescription" to a broader construct of moderate physical activity for public health. Studies have examined ways to maximize the health and well-being of older adults via adoption of a more physically active lifestyle. Epidemiological evidence clearly indicates that 30 minutes of daily moderate physical activity yields substantial health benefits (Dunn, et al., 1998). Physical activity recommendations in Healthy People 2000 are to increase to at least 30 percent, the proportion of people aged 6 and older, who engage in light or moderate physical activity for at least 30 minutes daily (US Dept of Health and Human Services, 1991). Haskell (1994) showed that thirty minutes of moderate intensity exercise once or twice a week, or 10 minutes of jogging three times a week, will significantly improve aerobic capacity and body composition in previously sedentary persons.

Studies to date have focused primarily on the effects of experimental or community-based physical activity programs, or on the benefits of physical activity as reported by large sample population surveys. There has been little research conducted which integrates an active educational program, self-management skill training, and lifestyle physical activities. Exercise and behavioural-scientists suggest that public health organizations, educational institutions, health care providers, communities, and individuals can more effectively promote physical activity through educational programs, and the creation of programs and facilities that make it easier for people to become, and remain, more active (Pate et al., 1995). Research suggests that a focus on the lifestyle physical activity approach is effective in producing changes in physical activity level and healthy lifestyle behaviors (Prochaska et al., 1992). More recent studies have demonstrated that a combination of cognitive and behavioural strategies (including

lifestyle activity) are effective for increasing physical activity and cardiovascular fitness levels (Dunn et al., 1999), as well as for decreasing weight and risk factors for heart disease (Andersen et al., 1999).

In Canada, a number of public health strategies and initiatives have been developed at the national level to provide education and to disseminate information. The Physical Activity Guide to Healthy Active Living, and a companion document for older adults, are valuable educational materials developed for the public (Health Canada, 1999). The theory behind these guides is to increase the overall physical activity level, especially in the elderly, through lifestyle physical activity behaviour change. It is believed that, this, in turn, will promote a number of health benefits and a higher quality of daily life to older Canadians (Wheeler, 2000).

1.1 Statement of the Purpose

To investigate whether a behaviour change program based on Canada's Physical Activity Guide to Healthy Activity Living for Older Adults (PAG) would elicit greater physical benefits than adoption of the PAG alone in community-residing older adults. Outcome variables to be measured would include functional fitness and estimated daily energy expenditure.

1.2 Hypotheses

1) It was hypothesized that that an eight- week behaviour change intervention based on the Physical Activity Guide as compare to the PAG alone, would significantly increase functional fitness, including lower body strength, lower body flexibility and motor agility/dynamic balance in community-residing older adults.

2) The second hypothesis was that the above intervention would also result in higher daily energy expenditure in behaviour change program due to increase in lifestyle physical activity behaviours.

1.3 Definitions

Active Living

A way of life in which individuals make meaningful and satisfying physical activities an integral part of daily living (CSEP, 1998).

Age Classification

Middle age (40 to 64yr); old age (65-75yr); very old age (75-85yr); oldest old age (over 85yr) (Shephard, 1997).

Aging

Process (es) occurring in living organisms that with the passage of time lead to a loss of adaptability, functional impairment, and eventually death (Shephard, 1997).

Exercise

A form of leisure-time physical activity that is planned, structured, and repetitive. Its main objective is to improve or maintain physical fitness (CSEP, 1998).

Functional performance

The ability to perform activities of daily living (Peel et al, 1999).

Lifestyle Physical Activity

The daily accumulation of at least 30 minutes of self-selected activities, which includes all leisure, occupational, or household activities that are at least moderate to vigorous in their intensity and could be planned or unplanned activities that are part of everyday life (CSEP, 1998).

Physical Activity

All leisure and non-leisure body movement produced by the skeletal muscles and resulting in a substantial increase in resting energy expenditure (CSEP, 1998).

Sedentary

Those individuals who expend less than approximately 10% of their daily energy expenditure in performance of exercise of at least four metabolic equivalents, or who expend less than 2000 kcal/week, (less than 150 kcal/day) doing physical activity (Ainsworth et al., 1993; Bernstein et al., 1999; Pate et al., 1995).

Successful Aging

Maintaining independence, and a high quality of life throughout life or

compressing morbidity into a shorter time period (Fries, 1980).

1.4 Assumptions

1. Participants in the Intervention group and the Comparison group had similar initial daily physical activity levels.
2. Participants in the two groups had no contact with each other during the study.
3. Participants followed the prescribed interventions throughout the study.
4. All tests were conducted following standardized procedures.

1.5 Delimitation

1. The study participants were not representative of the entire population aged 55 years or older, but were a self-selected group who passed the pre-screening, and who maintained participation for eight weeks.
2. A socio-economic bias may have existed, as the Intervention group participants were more likely to be of middle to high socio-economic status.

1.6 Limitations

It is important to identify and address possible confounding factors that may have impacted the results of the study, to prevent their occurrence in future studies.

1. Due to the practical difficulties of participant recruitment and management, and to avoid interaction between groups, the study employed a non-randomized design.
2. The sample size was limited due to practical and logistical constraints.
3. Volunteers in the Intervention group may have been more motivated and

active than those in the Comparison group, as they had convenient and frequent access to the events and facilities of the community centre.

4. Measures of functional fitness may have been influenced by practice and familiarity. The extent of effort made to perform the tasks at each test session may have been affected by current mood and health condition. As both groups received the Physical Activity Guide, there is no way to differentiate practice effects from the effect of the Physical Activity Guide.

5. Evaluation of energy expenditure was estimated using a recall questionnaire. Memory difficulties and cognitive problems are common sources of bias, especially for older adults, and may have affected these results.

6. The eight week study may have been too brief to accurately reflect the impact of each intervention.

Chapter 2: Literature Review

2.1 Physiologic and Functional Changes with Aging

2.2.1 Changes in the Cardiovascular System with Aging

It is difficult to determine whether cardiovascular changes associated with aging are due to the effects of age-related decreases in physical activity, or to the diseases and chronic conditions associated with advancing years (Shephard, 1997). For example, coronary heart disease (CHD), currently one of the leading causes of death in North America, increases with age, and may be on the rise in elderly populations (Bild et al., 1993). One previous study reported that as many as 60% to 70% of older individuals had some evidence of coronary vascular disease (Elveback and Lie, 1984).

Cardiac performance undergoes direct and indirect age-associated changes. With increasing age, there is a small reduction in the contractility of the myocardium, probably due to a decrease in myocardial catecholamine concentration and/or response (Becklake et al., 1965; Dock, 1966; Gerstenblith et al., 1976). Plasma norepinephrine concentrations are increased, but the cardiovascular responses of the elderly are diminished (Palmer et al., 1978; Templeton et al., 1979). The myocardium increases in stiffness (Templeton et al., 1979; Weisfeldt, 1980), impairing ventricular diastolic relaxation and increasing end-diastolic pressure (Lowenthal et al., 1994).

Older age is associated with both an increased prevalence of episodes of low blood pressure (hypotension), and a progressive increase in systolic pressures (hypertension) at rest as well as during exercise (Shephard, 1997; Hurley and Roth, 2000). Between 10% and 30% of community-dwelling seniors show a drop in pressure of 20 mmHg or more with a change of posture (Lipsitz, 1989). Postural hypotension, caused

by a reduced tolerance to changes in the circulatory system, occurs when the elderly move suddenly from a supine to an upright position, or rise from a sitting position in a hot environment. The sudden drop in systemic blood pressure in older adults may cause dizziness, confusion, weakness, and fainting, which directly contribute to the prevalence of falls in the elderly (Fagard et al., 1993; Halter, 1985). Furthermore, myocardial infarction or cardiac arrest, which happens soon after short bout of exercise may also result from the sudden drop of blood pressure (Shephard, 1997). On the other hand, aging is associated with both increases in average systolic blood pressures and an increased prevalence of clinical hypertension. Specifically, studies have shown that systolic blood pressure is elevated at rest due to increases in systemic vascular resistance, which hinders the flow of blood through the cardiovascular system and forces the heart to work harder to eject blood (Robergs and Roberts, 1997). Berne et al. (1998) demonstrated that with the increases in collagen content elastic tissue atrophies, and the aorta becomes progressively larger. The rigid artery then expands to accept less cardiac stroke volume.

Because of an increase in end-diastolic volume and increased systolic pressures, the left ventricular wall is increased in the thickness and mass in older than in younger persons (DiBello et al., 1993). The decrease of the total numbers of cardiac myocytes is also compensated through the hypertrophy of the remaining tissue (Olivetti et al., 1991). Moreover, Lakatta (1987) discovered that the fibrous component of the heart wall may double over the span of an adult's life.

Aging is also associated with a natural decline in other cardiovascular functions. Maximum heart rate decreases due to neural, hormonal and functional changes; stroke volume is reduced mainly due to a decrease in myocardial contractility; and blood flow to

a variety of tissues including the heart is reduced. This latter finding is due to a general atherosclerotic condition that includes a decrease in vessel elasticity and cross-sectional area of the lumen of the coronary arteries and other vessels (O'Brien Cousins et al.,1995). The most notable change in cardiovascular function with advancing age is the decline in maximal oxygen consumption (VO2 max) (a 10% decrease per decade after 30 year old) (Robergs and Roberts, 1997; Hurley and Roth, 2000).

2.1.2 Changes in the Muscloskeletal System with Aging

The age-related decline in muscle mass is well documented, and studies have shown that advanced age is a significant factor accounting for this decline (Imamura et al., 1983). Computed tomography of individual muscles shows that after age 30, there is a decrease in cross-sectional area of the thigh, as well as in muscle density, and an increase in intramuscular fat. These changes are most pronounced in women (Imamura et al., 1983). Total muscle mass decreases with age, and the greatest decrease occurs after 50 years of age. The reduction of muscle mass has been estimated at approximately 33% between the ages of 30 and 80 years of age. This loss accelerates to approximately 1% per year after the age of 70 (Heislein et al., 1994; Rantanen et al., 1992). The muscle atrophy that accounts for so much of the decreased muscle mass with aging reflects both a decrease in average fiber size, and a decrease in the number of muscle fibers (Aoyagi and Shephard, 1992). The number of muscle fibers in the midsection of the vastus lateralis of autopsy specimens is significantly lower in older men (age 70-73yr) compared with younger men (age 19-37 yr) (Lexell et al., 1983). Moreover, the decline is more marked in Type II muscle fibers, which decrease from an average of 60% in sedentary

young men to below 30% after the age of 80 yr (Larsson, 1983), and is directly related to age-related decreases in strength.

A significant decline in muscular strength is probably the most prominent effect of aging. Losses in muscular strength occur at a rate of approximately 12 to 14 percent per decade after age 50 (Hurley and Roth, 2000). The changes in muscular function associated with aging are most likely secondary to losses in muscle mass and total cross-sectional area (ACSM, 2000; Robergs and Roberts, 1997). As mentioned above, loss of muscle mass is accompanied by a loss of muscle strength and is thought to be comparable for the upper and lower extremities (Grimby, 1990). Typical cross-sectional data reflect a 30%-40% loss of back, leg, and arm strength between 30 to 80 years of age, with the most dramatic losses occurring after the age of 70 yr (Grimby et al., 1983). Data from the Framingham (Jette and Branch, 1981) study indicated that 40% of the female population aged 55-64 yr, 45% of women age 65-74 yr and 65% of women age 75-84 yr were unable to lift 4.5 kg. In addition, similarly high percentages of women in this population reported that they were unable to perform some aspects of normal household work. Longitudinal studies show a 60% loss in grip strength between ages 30 and 80 (Clement, 1974), and among healthy older adults a loss of 10-25% of quadriceps strength (Aniansson et al., 1986; Aniansson et al., 1983). Thus, cross-sectional as well as longitudinal data indicate that muscle strength declines by approximately 15% per decade in the 6^{th} and 7^{th} decade, and by about 30% thereafter (Harries and Bassey, 1990; Larsson, 1983). While there is some indication that the quality of muscle tissue is reduced with advancing age, the overwhelming majority of the loss in strength results from an age-related decrease in muscle mass (Mazzeo et al., 1998).

Reduced muscle strength is associated with reduced gait speed (Studenski et al., 1991), loss of balance (Whipple et al., 1987), and increased disability (Phillips and Haskell, 1995). This loss of strength, particularly in the lower extremities, is highly associated with reductions in functional status and increased risk of falling (Buchner and deLateur, 1991; Tinetti et al., 1994). In a study of 26 institutionalized individuals, Bassey and colleagues (1992) found that individuals using a walker had less than half of the leg strength of those walking without assistance. They also found significant positive correlations between leg strength and chair-rising speed, walking speed, and stair-climbing speed. Later, Fleg and Lakatta (1988) reported that muscle loss may also account for a substantial proportion of the age-related decline in aerobic capacity.

2.1.3 Physical Activity Level and Functional Limitation in the Elderly

Sedentary living among older people has become a significant public health issue that adds to the burden of unnecessary illness and premature death (McPherson, 1994). Inactivity doubles health risks and adds a disease burden to society comparable to smoking (Pate et al., 1995). Studies show that years of inactivity during middle age shortens the human life span by as much as 2 years (Paffenbarger et al., 1986).

While physical activity levels in all age groups are improving, a majority of older people are inadequately active to maintain or promote their health (O'Brien Cousins et al., 1995). A 1995 national sample of individual 65 years and older categorized 43% of this population as sedentary (Caspersen et al., 1986). Canadian studies have found that only 10% of women aged more than 45 years have optimal activity levels (Statistics Canada, 1990), and only 20-30% are active enough to promote their health with some degree of

life quality (Stephens and Craig, 1990). Men at all ages pursue significantly more weekly hours of moderate, hard and very hard activity compared to women (Sallis et al., 1985; Stephens and Craig, 1990), and are more involved and capable in vigorous physical tasks which require upper body strength and increased exertion (Coroni-Huntley et al. 1986). In 1994, the National Advisory Council on Aging reported that approximately one-half of Canadian seniors claim they exercise daily or frequently. However, in the same study, 36% say they never exercise. The proportion of older persons who are inactive varies with the definition of physical activity or exercise used, and with the population studied (Wagner et al., 1992).

Inactivity and low levels of physical activity in the elderly accelerate the rates of decline of the major physiologic systems, and therefore increase the risks of cardiovascular disease, diabetes, obesity, falls and fractures. Also, the ability to prevent or recover form acute stresses is impaired (Wagner et al., 1992). Branch (1985) found that men and women aged 65 and older, who reported having slowed down their physical activities, were twice as likely to have functional disabilities after five years. Many studies have also addressed the negative effects of lower physical activity levels on gait, balance, and increased risk of a fall (Buchner et al., 1997). It is increasingly evident that physical activity level is a major factor in maintaining physiologic function, physical performance, and functional ability in the elderly.

2.2 Physiologic and Functional Benefits of Physical Activity in the Elderly

Physical activity is shown to positively affect physical functioning and to prevent

functional limitation, or the inability to carry out normal daily tasks and roles, among the elderly (Berkman et al., 1993; Camacho et al., 1993; Hubert et al., 1993). It is associated with optimal function and low incidence of functional limitation among relatively healthy persons (Fries et al., 1994; Mor et al., 1989), and among those with chronic conditions (Santiago et al., 1993). These benefits are due to a reduction in the incidence of chronic disease, the major cause of functional limitation (Helmrich et al., 1994), and to maintenance of the physiologic capacity to enable normal functional performance (Wagner et al., 1992). An adequately functioning musculoskeletal system is a key factor for functional capacity, independence, and good quality of life. Impaired functional capacity and degenerative diseases of the musculoskeletal organs are one of the most prevalent and increasing sources of morbidity and suffering (Puggaard et al., 2000).

2.2.1 The Effects of Physical Activity on the Cardiovascular System

Because cardiovascular disease (CVD) is the major cause of death in older men and women, the effects of exercise training on CVD risk factors is highly important. In older healthy men and women, cross sectional and intervention studies consistently indicate that endurance exercise training is associated with lower fasting and glucose-stimulated plasma insulin levels, as well as improved glucose tolerance (if initially impaired) and insulin sensitivity (Hersey et al., 1994; Seals et al., 1984b). Available data also generally supports the conclusion that plasma lipoprotein lipid profiles are improved in older adults with endurance exercise training, although these changes may be secondary to training-induced reductions in body fat stores (Katzel et al., 1995; Seals et al., 1984a; Seals et al., 1984b). Recent studies show that regular aerobic-endurance

exercise decreases the age-related reductions in central arterial compliance in previously sedentary healthy middle-aged and older men. This may be the mechanism by which habitual exercise lowers the risk of cardiovascular disease in this population (Tanaka et al., 2000).

It appears that the elderly obtain similar beneficial cardiovascular adaptations with exercise training as do younger patients (Ades et al., 1988). These changes include decreases in heart rate at rest and during submaximal exercise, increases in VO2max and decreases controlled hypertension. Older patients with CVD also appear to improve a number of other factors with exercise endurance training, including beneficial changes in body weight, body fat, and plasma LDL, HDL, cholesterol and triglyceride levels (Lavie et al., 1993).

2.2.2 The Effects of Physical Activity on the Musculoskeletal System

Until recently, the prime emphasis of training programs for the elderly has been upon the development of aerobic function. Nevertheless, the maintenance and increase of strength and flexibility are of at least equal importance for function and quality of life, particularly in the frail elderly.

Strength conditioning is generally defined as training in which the resistance against which a muscle generates force is progressively increased over time. Muscle strength has been shown to increase in response to training at an intensity of between 60 and 100% of 1RM (MacDougall, 1986). However, large gains in muscle strength would not be anticipated with a typical aerobic training program (Shephard, 1997). An early study of 65-year-old subjects (Sidney and Shephard, 1976) noted gains of leg strength

averaging 11% after seven weeks of aerobic conditioning, and 13% after one year. Other longitudinal studies of aerobic programs involving treadmill running (Brown and Oldridge, 1985; Stebbins et al. 1985) have also shown similar increases in leg strength. Coggan et al. (1992) trained 64-year-old subjects exercising at 80% of maximal heart rate for 45 min, four days per week, for 9 to 12 months. This relatively strenuous aerobic program yielded an increase in the percentage of type IIA fibers at the expense of type IIB; and similar increases in the cross-sectional area (11%), capillary density (20%), and the activity of mitochondrial enzymes (24% to 55%) of type I and IIA fibers.

During the last few years, there have been several well-controlled longitudinal studies of resistance training for seniors of various ages. Almost all studies report that resistance training increases the strength of older adults (Aniansson et al., 1980; Cress et al., 1999). Heislein et al. (1994) reported significant gains in the strength of the quadriceps (21%), the hamstrings (9%), and handgrip (14%) in an eight-week study conducted with women aged 50 to 64 years. Earlier studies of low and moderate intensity resistance training reported modest increases (10-25%) in strength with exercise (Aniansson et al., 1984; Liemohn, 1975; Moritani and deVries, 1980). More recent studies in healthy adults (Charette et al., 1991), and frail adults (Fiatarone et al., 1990; Fisher et al.1991) demonstrate that more vigorous exercise produces far greater gains in strength (100-200% in a three-month training program). Dupler and Cortes (1993) adopted a relatively high-intensity weight-training program, utilizing loads that increased from 45% to 75% of the individual's one-repetition maximum force. Muscle strength increased an average of 66%. Hence, there is good evidence that older people, even the frail elderly, can undertake programs of resisted exercise. Moreover, such programs can

yield substantial gains of strength, with corresponding improvements in gait, balance, and overall functional ability.

Flexibility is a general term which encompasses the range of motion of single or multiple joints and the ability to perform specific tasks. The range of motion of a given joint depends primarily on bone, muscle, and connective tissue structure and function, other factor such as pain, and the ability to generate sufficient muscle force. The effects of aging impact these tissues, thereby limiting the range of motion at the joints, and reducing physical performance. The basis for exercise interventions to improve flexibility is that the muscle or connective tissue properties can be improved, joint pain can be reduced, and/or muscle recruitment patterns can be altered (Mazzeo et al., 1998).

Studies have shown both significant positive effects, and no significant effects, of exercise on the range of motion of joints in the elderly, depending on the duration of the program, the exercise tasks, and the measurement technique. The majority of some early and more recent studies have demonstrated significant improvement in the range of motion of various joints (neck, shoulder, elbow, wrist, hip, knee, and ankle) in older adults who participated in a program of regular exercise (Lesser, 1978; Munns, 1981; Morey et al., 1991). Morey et al. (1991) found out that over a two-year program of aerobic, strength, and flexibility exercise, 65- to 75- year-old participants showed an 11% increase in flexibility. Brown and Holloszy (1991) had 65-year-old subjects perform general unsupervised exercise for three months. Significant gains were seen in the forward bend, straight leg raise, hip extension, and hip internal rotation. However, other instructors found no association between exercise and flexibility, reporting that physical activity as assessed by a questionnaire was not related to range of motion at the shoulder,

elbow, hip and knee in older adult men and women (Walker et al., 1994). To date, studies have not provided the evidence for a clear dose-response relationship between flexibility and exercise (Mazzeo et al., 1998).

2.2.3 The Effects of Physical Activity on Physical Function and Independence

Many adults experience declines in physical function as they age. As function is lost, the need for caregiver and community service increases (Narain et al., 1988). The quality of life of older persons is also potentially affected, because individuals are no longer able to perform the activities that they once enjoyed. Eventually, they may not even be able to carry out activities of basic daily living, and will therefore lose their independence.

DiPietro (1996) pointed out that there is less known about the relationship between habitual physical activity (especially that of lower- to moderate-intensity) and the maintenance of day-to-day functioning in older people. However, physical activity through all stages of life is essential to maintain quality of life and to continue independent living as people age (Dampier and Adams, 1999). Studies of successful aging should identify the modifiable factors related to enhance higher physical function. Dipetro (1996) classified physical activity as a behaviour, whereas physical function results from the ability to perform functional tasks. Physical activity can lead to an increase in balance and muscular strength that, in turn, enables older adults to live independently (Cress et al., 1999). Some other epidemiologic studies suggest that physical activity is associated with the maintenance of more basic components of physical function, as well as with higher-order tasks or goal-oriented functions in healthy

older people. Moreover, higher levels of physical activity appear to be associated with better functioning and more physical independence, even in those with already-existing chronic disease (DiPietro, 1996). Scientific evidence shows that the benefits of being active include better health, more energy, reduced stress, improved sleep and reduced risk of heart disease, high blood pressure, type 2 diabetes, and osteoporosis (Dampier and Adams, 1999).

Since maintenance of an independent lifestyle is an important concern for many older adults, Katz et al. (1993) has described life expectancy in terms of years of active life expectancy, and years of dependent living, for adults from age 65 years. For men and women combined, at age 65 years, the total life expectancy is 16.5 years, 10 years of active life and 6.5 years of dependent living. Song (1993) reported that in the elderly, mental health, physical health and activities of daily living (ADL) are closely related to independent living in older adults. In a 6-month study, Hamdorf et al. (1993) discovered that elderly women participating in a progressive weight program adopted and sustained a higher level of habitual physical activity, and concluded that favorable modification of lifestyle factors is more likely to enhance independence. A recent study (Puggaard et al., 2000) explored the effect of regular physical activity on blood pressure, maximal oxygen uptake, maximal isometric muscle strength, and walking speed in the very old, and suggested that physical reactivation of the this group may reduce the risk of acquiring age-related diseases associated with an elevated blood pressure, and may improve parameters crucial for independence. Vuori (1995) reported that physical activity positively influences most structural components of the musculoskeletal system that are related to functional capabilities and the risk of degenerative diseases. Physical activity

also has the potential to postpone or prevent prevalent musculoskeletal disorders, such as low back pain, neck and shoulder pain, and osteoporosis and related fractures. Scientific evidence is now sufficient to recommend regular lifelong physical activity as part of a healthy lifestyle for everyone, in order to enhance physical function and health for both individuals and populations. Recent ACSM health recommendations call for incorporating at least 30 minutes of any activity into the daily schedule (Dunn et al., 1998). Therefore, regular participation in activities of moderate intensity (such as walking, gardening, house/yard work) should be encouraged among the older community.

2.2.4 The Effects of Physical Activity on Daily Energy Expenditure

Energy expenditure depends on basal metabolic rate, as well as on the duration and intensity of daily physical activity. The daily energy expenditure requirement of the average adult decreases by 0.8MJ/day from age 45 to 75, with a further decrease of 1.2MJ/day in those who are even older (Shephard, 1997). In addition to the physiological changes associated with aging, this decrease is due to the prevalence of sedentary lifestyle in old age, the increased illness that often prevents older adults from engaging in regular physical activity, and/or to the low awareness of the importance of daily activity (Marcus et al., 1992; Blair et al., 1989).

The report of the US Surgeon General suggests that an increase in daily energy expenditure of approximately 150 kcal is associated with substantial health benefits, and that the activity does not need to be vigorous to produce benefits (US Department of Health and Human Services, 1996). According to Canadian Society for Exercise Physiology (1998), an increase of 500kcal/week is required to see a small increment of

health benefits. An increase of 800kcal/week is required for getting much greater benefits. However, these are all based on current physical activity level and health status. Examinations of the dose-response effect of physical activity have demonstrated that the most significant health benefits are found in individuals engaging in moderate physical activity, and that very great benefits occur when sedentary individuals begin a program of regular physical activity (Haskell, 1994). A 16-week study of a home-based walking program, conducted with healthy, elderly, community-dwelling men and women, using energy expenditure as the outcome measurement, demonstrated high adherence (95%) using this approach to promote physical activity among the elderly (Leaf and Reuben, 1996). This study also suggests that flexible and daily living activities are more suitable to the elderly, and may be more readily maintained.

2.3 The Benefits of Lifestyle Physical Activity

The history of lifestyle physical activity interventions is closely linked with the history of public health recommendations for physical activity such as those from the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM), the National Institute of Health Consensus panel, and the Surgeon General's recommendations for physical activity and health (Dunn et al., 1998).

Lifestyle physical activity is defined as the daily accumulation of at least 30 minutes of self-selected activities, which includes all leisure, occupational, or household activities that are at least moderate to vigorous in their intensity, planned or unplanned, and a part of everyday life (Dunn et al., 1998). The critical part in this definition is that these activities are individually selected and are not prescribed. Also, these self-selected

activities can be consciously planned by the individual or they can be unplanned by manipulation of the environment, such as suggesting that individuals climb stairs instead of using elevators. As illustrated in Figure 1 (Blair et al., 1992), lifestyle activities can be accumulated in short bouts during the day rather than performed in one long bout of continuous activity. Lifestyle physical activity has been facilitated through the use of various behavioural strategies or environmental cues that shape sedentary or inadequately active individuals to reduce sedentary activities and to achieve or surpass minimum public health guidelines for physical activity (Marcus et al., 1996).

2.3.1 The Limitations of Structured Exercise for the Elderly

Although the benefits of adopting regular exercise as a traditional approach to gain health are very well documented, epidemiological studies demonstrate that only 15% of the population are vigorously active at the levels prescribed by the American College of Sports Medicine (ACSM, 1990). Similarly a large majority, 60%, of the population are inadequately active, and of these 25% are completely inactive (U.S. Department of Health and Human Service, 1996). This evidence, along with important reviews of determinants and barriers to exercise (Dishman et al., 1985; King et al., 1992), indicates that many people feel that they do not have time to exercise, dislike vigorous exercise, and dislike the structure of gymnasium-based exercise. More barriers to structured exercise are reported for older adults (CFLRI, 1995), including lack of energy, lack of motivation, feeling ill at ease, long-term illness or injury, fear of injury, lack of available facilities, perceived excessive cost, lack of skill and lack of a safe place which to be

active. Older adults may hesitate to engage in physical activity because of a misperception that vigorous and structured exercise is their only alternative.

2.3.2 The Effects of Lifestyle Physical Activity on the Elderly

Most lifestyle physical activity interventions that have measured physical activity, cardiorespiratory or endurance fitness, or exercise adherence as primary outcomes have been conducted in the past ten years. These studies indicate that lifestyle interventions are effective in helping individuals meet the established public health criterion for physical activity (Pate et al., 1995). There is some preliminary evidence that a large percentage of individuals maintain activity levels for up to 2 year or longer after such interventions (Elmer et al., 1995). In addition to facilitating increased overall levels of physical activity, lifestyle studies have demonstrated improvements in cardiorespiratory fitness equal to improvements reported in studies conducted with structured exercise programs (Dunn et al., 1999). To date, only a few studies have specifically examined lifestyle physical activity in older adults (i.e., over the age of 65 years). Leaf and Reuben (1996) reported a significant improvement of sit-to-stand test performance, and a 95% adherence rate after a 16-week walking program which aimed to increase total kilocalorie (kcal) expenditure from 300 kcal/week to 1,200kcal/week in a sedentary senior group. In this study, energy expenditure did not significantly increase from baseline to 16 weeks.

Although there are relatively few lifestyle physical activity studies conducted with elderly people, long-term benefits have been demonstrated including an increase in moderate-intensity physical activity, and reduction of sedentary activity (Dunn et al., 1998). Also, lifestyle physical activity interventions may be expected to have a more long

lasting effect on physical activity behaviour. Moreover, based on the definition of lifestyle physical activity, it is apparent that the large variety of self-selected activities, and accumulated short bouts, will provide older people with more choice to arrange their own physical activity plan, unlimited by time, physical ability, specific facility requirements, and cost.

2.3.3 Interventions to Promote Physical Activity in Communities and Populations

The many benefits of participation in regular moderate- or vigorous-intensity physical activity are well documented. The advantages of adopting lifestyle physical activity on a daily basis are also established. However, the sedentary or insufficiently active population remains large. Research has shown that without intervention, most people remain sedentary (Marcus et al., 2000b). It is important that large scale physical activity interventions be disseminated to the large population of sedentary individuals. This requires that physical-activity interventions move beyond strictly face-to-face modes, and begin to use newer behaviour change methodologies (Marcus et al., 2000a). Strategies must not be directed only at individuals or small groups, but to entire populations, if they are to successfully promote physical activity (Sallis and Owen, 1998).

Published studies have revealed that behaviour modification, and cognitive-behaviour modification can be successfully used to assist patients and healthy adults in the adoption of physically active lifestyles (Marcus et al., 2000b). Media and mass communication are more effective at influencing the knowledge and attitudes of people who are at the earlier stage of the exercise adoption process (Sallis and Owen, 1998).

Maintenance of physical activity is critically important because ongoing participation is necessary to sustain health benefits. Knowledge of effective intervention strategies for long-term maintenance and recommendations for research on physical activity behaviour change is at an early stage (Marcus et al., 2000b).

Project ACTIVE was a randomized clinical trial that compared two physical activity interventions, lifestyle and traditional structured exercise (Sevick et al., 2000). The two interventions were evaluated and compared in terms of cost effectiveness and ability to enhance physical activity among sedentary adults. The results showed that a behaviourally-based lifestyle intervention approach in which participants are taught behavioural skills to increase their physical activity by integrating moderate-intensity physical activity into their daily lives is more cost-effective than a structured exercise program in improving physical activity and cardio-respiratory health. This study represents one of the first attempts to compare the efficiency of intervention alternatives for improving physical activity among healthy, sedentary adults.

2.3.4 Theories and Techniques for Promoting Physical Activity

Several behaviour change models have received empirical support for their effectiveness, or show promise for, the design of effective physical activity interventions (Marcus et al., 1996). The health belief model applied to physical activity states that four types of beliefs influence health behaviours: 1) the individual's perceived susceptibility to developing health problems because of inactivity; 2) the perceived impact of the health problem on the individual's quality of life; 3) the individual's belief that adopting an active lifestyle will be beneficial to them; and 4) the belief that the benefits of being

active exceed the related cost (Becker, 1974; Meichenbaum, 1987). Previous research has suggested that those who perceive their health as poor, or who believe that exercise has limited health value, exercise less frequently (Dishman, 1991). On the other hand, those with more positive beliefs about physical activity demonstrate higher degrees of active lifestyle adoption. Intention to engage in a behaviour is proposed to be comprised of two factors: the individual's attitude toward the behaviour, and the social factors toward engaging in the behaviour (Godin, 1994). If an individual believes that physical activity can improve health, energy and mood, and if they have minimal barriers to being active and a support system, they are more likely to adopt and maintain an active lifestyle.

Planned behaviour and self-management techniques are widely used in exercise interventions. Strategies such as behaviour contracts, stimulus control methods and written agreements have been found to increase physical activity adherence by 10 to 75% in a variety of studies (King et al., 1992). Shaping behaviour change by a series of attainable goals with a gradual increase in the goal requirements, is more likely to lead to a final behaviour (Marcus et al., 1996). Self-monitoring of activity behaviour is an integral part of many physical activity programs, particularly in home-based programs (Juneau et al., 1987). Physical activity parameters such as duration, frequency, activity, and intensity of activity can be easily monitored and recorded by participants. The use of logs can facilitate the shaping of behaviours by identifying risk of relapse and preventing over-exercising.

Decisional balance is based on a theoretical model of decision making (Janis, 1977), and involves a comparison of the perceived balance of gain and loss, relevant to exercise. The use of a decision balance sheet procedure, in which the individual writes

down the potential gains and losses of participation in a physical activity program may promote an awareness of the benefits and costs of participation. Individuals with a positive decisional balance, who see more benefits to physical activity, or who value the benefits of physical activity above the costs, are more likely to participate in physical activity (Marcus et al., 1992).

2.3.5 Canada's Physical Activity Guide to Healthy Active Living for Older Adults

Two-thirds of Canadians are risking their health and quality of life because of lifestyles deemed too inactive for good health (CFLRI, 1998). To help Canadians get moving, Health Canada and the Canadian Society for Exercise Physiology jointly launched Canada's Physical Activity Guide to Healthy Active Living (Physical Activity Guide) in 1998 (Health Canada, 1998). The Physical Activity Guide and the accompanying handbook offer an engaging summary of the components of physical activity, and guidelines on how to achieve health benefits by being physically active. It is designed primarily for those who are currently inactive and those who have already begun to get active (Ketchum, 1998).

With the Physical Activity Guide successfully launched nation wide, Health Canada, and Canadian Society for Exercise Physiology, in collaboration with the Active Living Coalition for Older Adults, developed a guide supplement specifically for older adults. Based on sound scientific evidence, Canada's Physical Activity Guide to Healthy Active Living for Older Adults (Physical Activity Guide for Older Adults) (Health Canada, 1999) was developed in consultation with more than 70 national organizations and a variety of scientific experts (Dampier and Adams, 1999). The Physical Activity

Guide for older Adults offers clear and simple guidelines for selecting the appropriate level of physical activity to promote healthy active aging.

The key messages and information specific to the needs of older Canadians included in the Physical Activity Guide for Older Adults are as follows:

- Age is not a barrier to regular physical activity.
- Physical activity does not have to be hard to be beneficial.
- Start slowly and progress gradually.
- You can take your first step by doing more of any activities you already enjoy.
- Short bouts of physical activity, even 10-minutes in duration, can count toward your daily total.
- Try to accumulate at least 30-minutes of moderate physical activity most days of the week.
- Choose a variety of activities from each of the three activity groups: strength and balance, endurance, and flexibility.

The Physical Activity Guide for Older Adults provides tips for getting started and stories of older Canadians who found fun and interesting ways to build physical activity into their daily lives. The content of the guide includes informative and educational material. It provides evidence of population aging, and age related health problems, and demonstrates how physical activity can benefit overall health in older Canadians. It also shows how to plan an active lifestyle from a variety of daily activities focusing on strength and balance, endurance, and flexibility. The wide choice of activities includes both leisure time physical activity (dancing, walking, cycling, TaiChi, etc.) and daily living tasks (gardening, washing, carrying groceries and lifting soup cans, etc.).

Tools are provided in the Physical Activity Guide for Older Adults to facilitate lifestyle behaviour change. A Physical Activity Benefits Checklist helps older adults find the benefits of being active. Ideas for Getting Started clarify the most realistic way to begin a personal active plan. An Activities Checklist provides a variety of physical activities that are easy to build into the individual's lifestyle. A Goal Setting Sheet helps individuals to integrate the above information and set personal goals for being active. A Suggested Activities Checklist gives an alternative choice for those who have physical barriers to do physical activity. Moreover, the Daily Activity Log can be both a self-monitoring tool and gains record to plan and track the lifestyle progresses.

In summary, Canada's Physical Activity Guide to Healthy Active Living for Older Adults is more than a source of information about physical activity. It promotes healthy active living through physical activity behaviour change. The tools included in the Physical Activity Guide for Older Adult, are valuable for self-monitoring and planning self-planning. From the Physical Activity Guide for Older Adults, older Canadians can learn the ideas of healthy active living and gain the skills to manage daily physical activity.

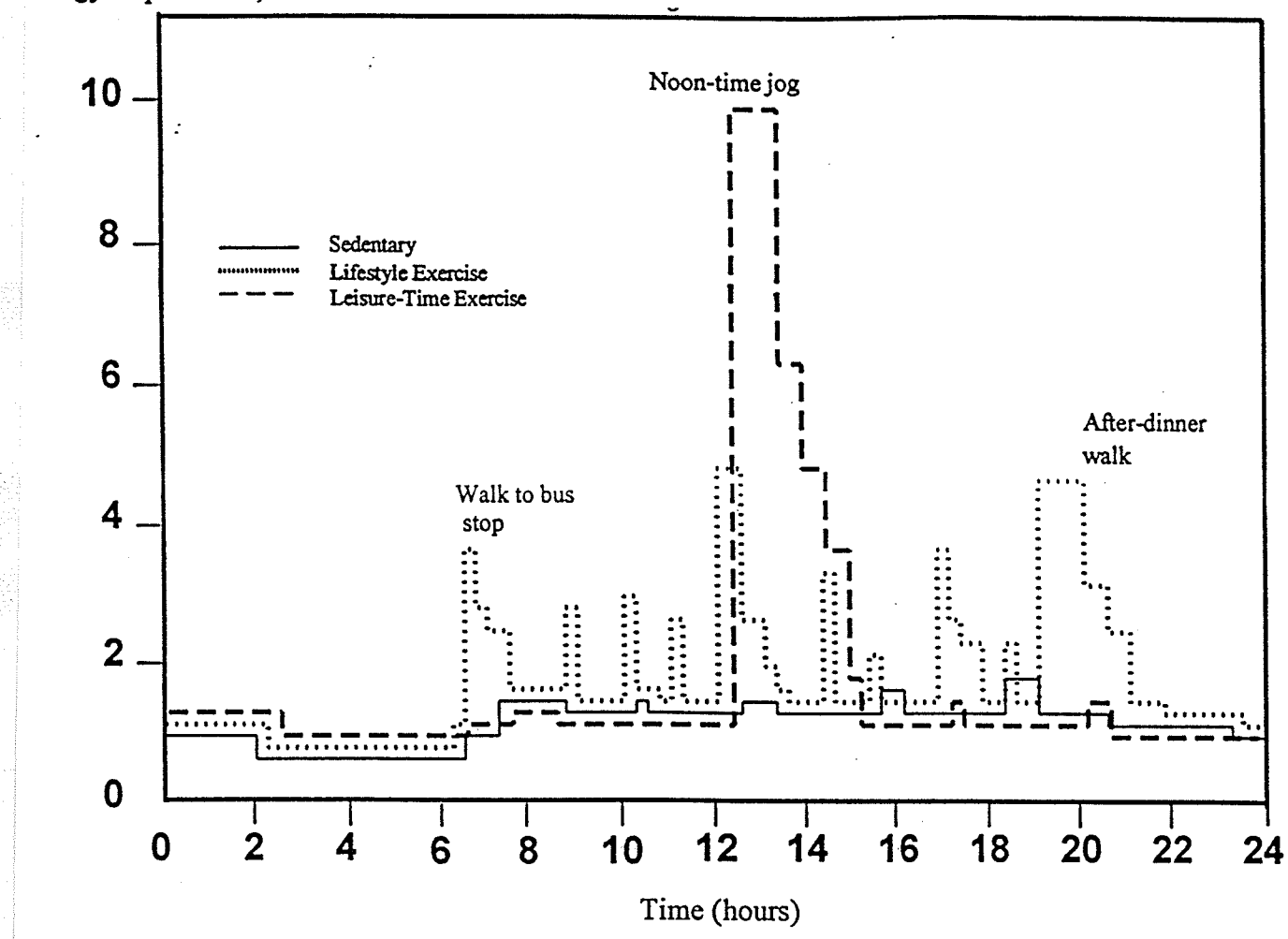


Figure 1. Conceptual figure of daily energy expenditure for a sedentary person (solid line), a person engaging in planned vigorous exercise during leisure time (dashed line), and lifestyle physical activity accumulated in moderate intensity bouts over the course of the day (dotted line). Reported from Blair et al.

(Blair et al., 1992)

Chapter 3: Methods and Procedures

3.1 Study Design

Participants from two community based senior organizations were separately recruited into an Intervention group and a Comparison group. The Intervention group undertook an eight-week behaviour change program, based on Canada's Physical Activity Guide to Healthy Active Living for Older Adults, and designed to facilitate an increase in physical activity level. The Comparison group also received Canada's Physical Activity Guide to Healthy Active Living for Older Adults, however they did not take part in the behaviour change program. Members of the two groups had no contact with each other throughout the study.

All participants underwent pre-and post-tests at the beginning and completion of the study. Tests included a questionnaire designed to estimate energy expenditure, as well as functional tests to measure strength, flexibility and motor agility/dynamic balance. For each participant, the questionnaire and functional tests were scheduled on the same day.

Participants in the Intervention group attended weekly sessions designed to encourage adoption of the Physical Activity Guide for Older Adults. Each session had a goal relevant to the guide content, and several tools were used to facilitate behaviour change. Participants in the Comparison group used the Physical Activity Guide on their own, and made changes to their lifestyle physical activity patterns on this basis alone. Due to practical difficulties of participants recruitment group from different complex buildings for the Comparison group, the testing dates were slightly different among the three locations. The study timeline is illustrated in Figure 2.

3.2 Participant Recruitment and Screening

To recruit participants for the Intervention group (IG), advertisements were placed in the St. James/Assiniboia Senior Centre newsletter and community newspapers, and flyers were delivered to apartment blocks in the St. James area. The St. James /Assiniboia Senior Centre is a non-profit organization funded by individuals and run by a Board of Directors who are community residents. The Centre is comprised of a Senior Centre, a Wellness Centre, and a Support Services Unit. It offers a variety of programs to its 800 members including recreation and sports, education, health and social opportunities. It is aiming to help seniors to stay healthy, mobile, interested, educated, independent, in their home (out of nursing homes or hospitals) and enjoying a good quality of life.

Program information was also posted in three Manitoba Housing Authority senior complexes (Carriage Rd., Strauss Rd. and Hamilton House) to solicit participants for the Comparison group (CG). The Manitoba Housing Authority (MHA) is an agency of the Department of Family Services and Housing. The MHA is the largest landlord in Manitoba and directly manages over 13,000 residences in almost every area of the province. The senior complexes are provided to those who are 55 years or older, independently living and low-income earners. This is defined as someone for whom the monthly rent is approximately 25 to 27% of their income.

Written informed consent was obtained from all subjects (Appendix A) and the study was approved by the Research Ethics Board at the University of Manitoba for research involving human subjects.

Medical history questionnaires were used to identify and eliminate those individuals for whom physical activity may be inappropriate, or those who should obtain medical clearance prior to increasing their level of physical activity (Appendix B). A registered nurse from the St. James / Assiniboia Senior Centre examined the questionnaires, and made the final decision regarding participant inclusion or exclusion.

All participants were required to be relatively inactive, and to have refrained from structured exercise programs for the past six months. The YALE Physical Activity Survey was used to estimate each participant's energy expenditure (Appendix C) (DiPietro, 1993). Those who expended less than approximately 10% of their daily energy expenditure in the performance of exercise, or who expended less than 2000 kcal/week (150 kcal/day) doing physical activity, were accepted into the study (Ainsworth et al., 1993; Bernstein et al., 1999; Pate et al., 1995).

Other criteria for inclusion were as follows:

i) Participants were required to be community residing adults, 55 years of age or older.

ii) Participants were required to be able to read and understand English, and to have sufficient cognitive function to complete the questionnaires.

iii) Participants were required to provide written informed consent prior to admission into the study.

Those excluded from the study included:

i) Individuals who were non-ambulatory (wheelchair bound).

ii) Individuals with diagnosed respiratory, metabolic or cardiovascular disease in an acute stage.

iii) Individuals with valvular or rhythm abnormalities, or other unstable medical conditions.

iv) Individuals who were deemed by their physician to require medical supervision during exercise, or for whom exercise was deemed unsafe.

3.3 Intervention

3.3.1 Intervention group

Canada's Physical Activity Guide to Healthy Active Living for Older Adults was given to each participant in the Intervention group. Participants met with the principal investigator once each week throughout the study for a 45-minute instructional session. Each session included educational and physical activity components, as well as work with a behaviour change instrument. The goals and contents of each session are listed in Table 3.1.

Session goals were made based on theories and techniques for promoting physical activity behaviours (Marcus, et al., 1996). The eight week program was designed to guide the participants through a series of behaviour change stages based on theories, such as health belief, protection motivation, reasoned action, planned behaviour, operant conditioning and decision theory (Marcus et al., 1996).

The educational component contained the essential information from the Physical Activity Guide for Older Adults. Each session was tailored to that week's goal to provide basic physical activity and health theories, and to let participants gradually master the skills necessary to choose suitable activities for daily living. The first phase of the intervention included weeks one and two. At this time, participants were asked to

identify their barriers for physical activity, and to state goals to assist in the adoption of an active lifestyle. The investigator provided the evidence of aging related health problems, and the health benefits to be gained from regular physical activity. Participants were then introduced to the Physical Activity Guide. The goal-setting sheet, video, and benefits checklist were initially used to motivate participants, and help them to develop realistic goals. The daily activity log was introduced to assist participants to plan and track daily activities throughout the study. During weeks three to five, sessions were specifically focused on the three physical activity groups included in the Physical Activity Guide: endurance, flexibility, strength and balance. Participants were educated about the basic FITT theory (frequency, intensity, time (duration) and tasks) for each activity. The investigator related the information from the Guide to FITT, thus enabling participants to make their daily activities manageable, healthy, and enjoyable. During the third phase, weeks six to eight, the education content emphasized strategies to increase daily physical activity. In this phase, participants were made aware that even small changes in daily activities could lead to significant and beneficial changes over time.

The physical activity component of each session introduced practical experiences to the participants. Activities were compatible with that week's educational content, and were also designed to encourage group interaction and increase motivation. Walking, stretching and home-based exercises were selected to better enable participants to incorporate physical activity into daily life.

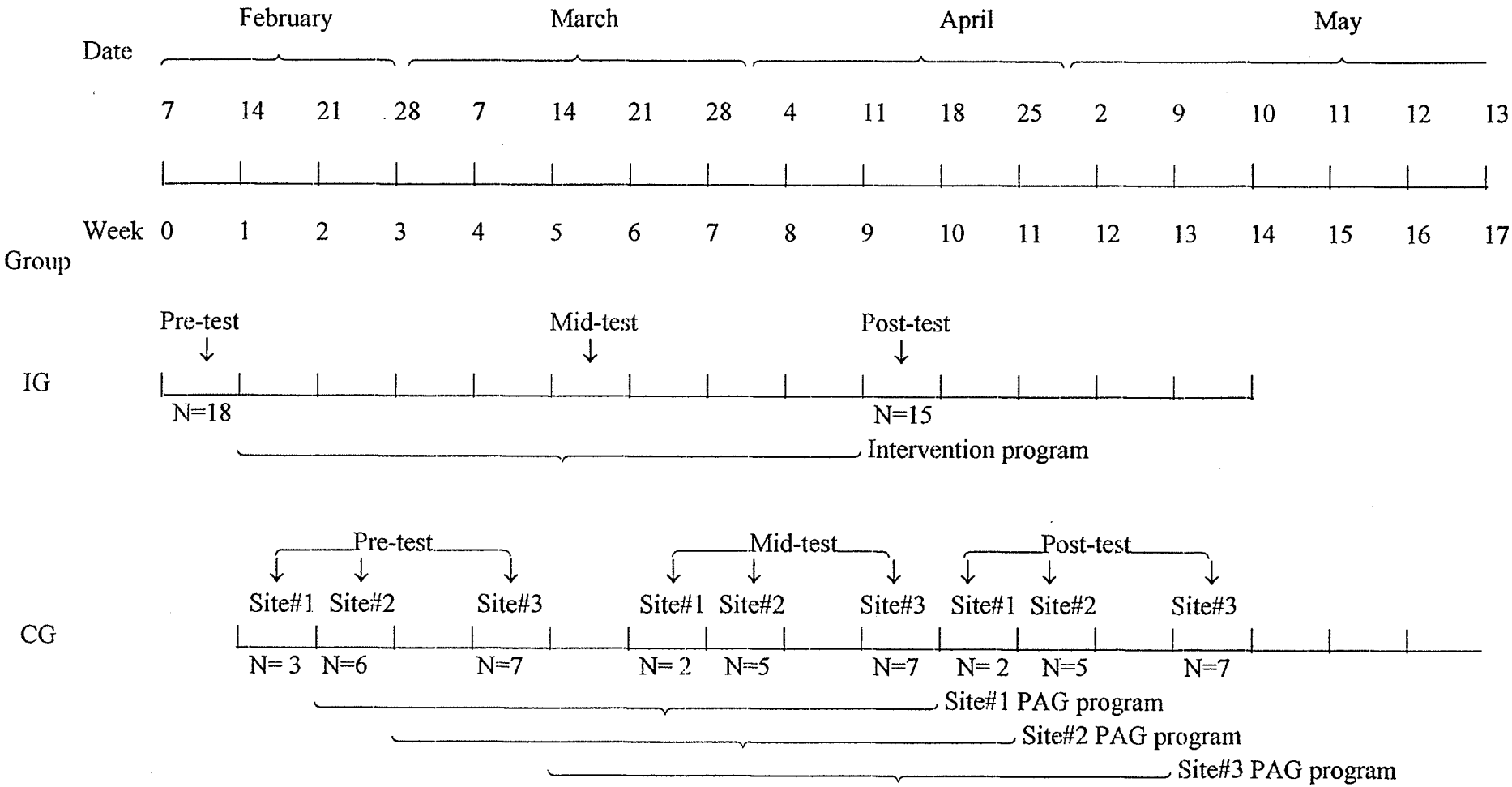


Figure 2 Timeline of the present study.
IG = Intervention group; CG = Comparison group; N = number of participants;
Site#1 = Carriage Rd.; Site#2 = Strauss Rd.; Site#3 = Hamilton House.
PAG = Physical Activity Guide to Healthy Active Living for Older Adults.

Table 3.1 Goals and content of weekly instructional sessions Canada's Physical Activity Guide for Older Adults.

Week	Goals of education session	Behavioural change tools	Physical activity content
One	*To identify goals and barriers *To introduce Physical Activity Guide	*Goal-setting (Guide pg. 9) *Canada's Physical Activity Guide for Older Adults video (12 min)	*10- minute chair exercise
Two	*To discuss benefits of physical activity. *To introduce the lifestyle approach	*Benefits checklist (Guide pg. 3) *Daily activity log	*Home-support exercise (Tudor- Locke et al, 2000) (Appendix F)
Three	*To introduce endurance activities	*Activity checklist (Guide pg.6) *Daily activity log *Walking to Fit (video).	*10-minute indoor walking
Four	*To introduce flexibility activities	*Activity checklist (Guide pg. 7) *Daily activity log	*Tai Chi class
Five	*To introduce strength & balance activities	*Activity checklist (Guide pg. 8) *Daily activity log 4 (Tool. 1)	*Home-based exercise
Six	*To revise physical activity goals	*Decision balance sheet (Appendix F) (CSEP, 1998)	*Moving to live
Seven	*To fit physical activity into daily routine	*Daily activity logs	*10-minute chair exercise
Eight	*To make the next step	*My next steps sheet (Guide pg. 20)	*Walking with music

3.3.2 Comparison group

Participants in the Comparison group also received Canada's Physical Activity Guide to Healthy Active Living for Older Adults, however the weekly behaviour change program was not provided to this group. The investigator was not in regular contact with this group, except for the three testing sessions (pre, mid and post-test).

3.4 Measurement Procedures

3.4.1 Energy Expenditure

Energy expenditure was estimated using the Yale Physical Activity Survey (DiPietro et al., 1993) (Appendix C). It was administered in a face-to-face interview setting, and the investigator read, and provided a basic explanation for each question. Participants were asked to answer each question on their own, with no input from the investigator. The Yale survey is designed to assess total energy expenditure comprised of five classes of activities. Several indices were calculated from the participants' responses:

* Activity classes. Five classes of activities (work, yard work, caretaking, exercise, and recreational activities) are listed in the survey. Participants reported their daily activities by choosing the activities that were undertaken in a typical week in the past month.

* Total time (hours per week that the participant engaged in each activity) to the nearest 0.25 hour.

* Energy expenditure. Total time for each checklist activity was multiplied by the appropriate intensity codes and then summed to get total energy expenditure. The intensity code, are defined in terms of a resting metabolic rate and hence are

independent of body weight. The index is expressed as kcal.wk-1. Estimated daily energy expenditure was calculated from the energy expenditure per week divided by 7 (days). The estimated daily energy expenditure for each of the five activity classes was also calculated from the above information. The following formula was used:

Total estimated daily energy expenditure = work + yardwork + caretaking + exercise + recreation physical activities

DiPietro and colleagues (1993) conducted a two-week repeatability and relative validity test. The results demonstrated adequate repeatability, and some validity by correlating with several physiologic variables which reflect habitual physical activity. Straling and colleagues (1999) compared the accuracy of Yale Physical Activity Survey, Minnesota Leisure Time Physical Activity Questionnaire, and Caltrac using doubly labeled water. They suggested that the Minnesota LTA recall and Caltrac may significantly underestimate free-living daily physical activity energy expenditure in older men and women with doubly labeled water. No difference was observed between daily physical activity measured by the Yale and doubly labeled water.

3.4.2 Functional Fitness

Functional fitness included lower body strength, lower body flexibility, and motor agility/dynamic balance, and was measured using a test for community-residing older adults by Rikli and Jones (1999). Evidence has been presented to support acceptable test-retest reliability for this test (.80< R< .98). All tests significantly discriminate between individuals who are regular exercisers and those who are not (Rikli and Jones, 1999). In the current study, all tests were conducted by a Certified Fitness Consultant (CSEP)

(principal investigator), following a five minute warm up, which included walking and gentle stretching exercises. The tester also demonstrated the proper technique. Participants were allowed to practice once or twice before the test trials (Rikli and Jones, 1999).

i) Chair stand — lower body strength

The test began with the participant seated in the middle of the chair, back straight and feet flat on the floor. Arms were crossed at the wrists and held against the chest. On the signal "go" the participant rose to a full stand and then returned to a fully seated position. The participant was encouraged to complete as many full stands as possible within 30 seconds. After a demonstration by the tester, a practice trial of one to three repetitions was made to check for proper technique. The score was the total number of stands executed correctly within 30 seconds. If the participant stood more than half-way at the end of the 30^{th} second, it was counted as a full stand.

ii) Chair sit-and-reach — lower body flexibility

Starting in a seated position in a chair, the participant was instructed to move forward until she or he was sitting on the front edge. The crease between the top of the leg and the buttocks was even with the edge of the chair seat. With one leg bent and the foot flat on the floor, the other leg was extended straight in front of the hip, with the heel on the floor and the foot flexed.

With the extended leg as straight as possible, the participant slowly bent forward at the hip joint sliding the hands down the extended leg in an attempt to touch the toes. The reach was held for 2 seconds. If the extended knee began to bend, the participant was asked to slowly sit back until the knee was straight before scoring. Participants were

reminded to exhale as they bent forward, to avoid bouncing or rapid, forceful movements, and to never stretch to the point of pain. After a demonstration by the tester, the participant was asked to determine the preferred leg. The participant was given two practice trials on that leg, followed by two test trails.

Using a 40 centimetre ruler, the scorer recorded the number of centimeters the participant was short of reaching the toe (minus score), or reached beyond the toe (plus score). The middle of the toe at the end of the shoe represented a zero score. The final score was the average of the two test trails' results.

iii) 8-ft up-and-go — agility/dynamic balance

The test began with the participant fully seated in the chair, hands on thighs and feet flat on the floor. On the signal "go" the participant rose from the chair, walked as quickly as possible around a cone placed eight feet away, and then returned to the chair. The participant was told that this was a timed test and that the object was to walk as quickly as possible (without running) around the cone and back to the chair. The tester served as a spotter, and stood midway between the chair and the cone, ready to assist the participant in case of loss of balance. For reliable scoring, the tester started the timer on "go", whether or not the participant had started to move, and stopped the timer at the exact instant the participant sat in the chair.

After a demonstration, the participant walked through the test one time as a practice and then was given two test trials. Participants were reminded that the rest was not completed until they were fully seated in the chair. The score was the time elapsed from the signal "go" until the participant returned to a seated position in the chair. The final score was the average time of the two test trials' results.

3.4.3 Response to the Physical Activity Guide

A modified Physical Activity Guide Survey (Wheeler, 2000) (Appendix E) was used to explore the response of each group to the Physical Activity Guide.

Five questions were selected to examine the recognition and efficacy of Canada's Physical Activity Guide to Healthy Active Living for Older Adults. The survey was given to each participant at the post-test session right after the energy expenditure questionnaire interview. Participants were asked to indicate the response which best reflected their experience with the Physical Activity Guide during the study. The percentage of positive responses for each question was then calculated, and a mean score devised for each group.

3.4.4 Participant response to the study

The Decision Balance Sheet (CESP, 1998) was used to help the participants think through the possible consequences of participating in the study (Appendix F). At the end of the study, the participants were asked to write down all of their gains and losses from participating in the study. They were also asked to rate the importance of each for them on a scale of one to three: '1' meant it had a small influence on their behaviour; '3' meant it was a large influence. For the purpose of data analysis, responses (1, 2, 3) were considered as equally positive or negative, and were presented by percentage response (Appendix F). By considering potential gains and losses, the participants were able to make informed decisions about active lifestyle adoption.

3.5 Data Analysis

One independent variable (behaviour change program based on the Physical Activity Guide) with two levels (Intervention group vs. Comparison group) was incorporated into the study design. Dependent variables included total estimated daily energy expenditure (kcal/day), including work, yardwork, caretaking, exercise and recreation activities, and functional fitness , including lower body strength (number of chair stands), lower body flexibility (cm), and motor agility/ dynamic balance (seconds), as well as the Physical Activity Guide Survey, and the Decision Balance Sheet results.

All data was analyzed using SPSS Version 9.0 for Windows. To determine whether significant differences existed on daily energy expenditure and functional fitness measures between groups at baseline, unpaired t-tests were used. To determine the significance of differences between and within groups over time, a two-way analysis of variance with repeated measures was used. Alpha was set at 0.05 for all significance tests. The results of the Physical Activity Guide Survey and the Decision Balance Sheet were presented and compared using descriptive statistics (percentage change).

Chapter 4: Results

4.1 Participant characteristics and measurements at baseline

Forty-four community residing adults attended an information meeting prior to the study (19 for the Intervention group (IG), 25 for the Comparison group (CG)). One male (IG) decided not to take part due to low interest. Of the 19 individuals who volunteered to take part in the CG, one male and one female were excluded during medical screening due to cognitive problems. Another female was screened out because of physical frailty.

At baseline, a total of 34 volunteers were eligible to begin the study, 18 in the Intervention group, and 16 in the Comparison group, respectively. During the eight week study, three participants dropped out from the Intervention group, while two dropped from the Comparison group. Selected baseline characteristics for the final 29 participants (IG = 15, CG = 14) are shown in Table 4.1. On average, members of the Comparison group were slightly older than those in the Intervention group, however this difference was not significant. Although many participants had chronic diseases commonly seen with aging, they were free of acute or unstable conditions, and relatively healthy, as indicated by the Medical History Questionnaire. Members of both groups took approximately three prescription medications per day. There were four male participants in the Intervention group, and non in the Comparison group. Just less than one third of participants in the Intervention group were living in apartments, while all of the Comparison group members were apartment-residing. Two members of the Comparison group used walking assistance (cane and walker), while none was required by members of the Intervention group.

Table 4.1 Group characteristics at baseline.

	Intervention Group		Comparison Group	
	Participants (n =15)	Drop out (n =3)	Participants (n =14)	Drop out (n =2)
Age(yrs)	73.2 (5.2)*	77.6 (4.4)*	76.8 (10.0)*	79.0 (1.0)*
Medications (average n)	3.0	5.0	3.1	6.6
Hypertension (%)	46	66	50	100
Heart disease (%)	33	33	35	0
Diabetes (%)	13	33	14	0
Arthritis (%)	13	33	21	50
Male (%)	26	33	0	0
House-residing (%)	73.3	100	0	0
Apartment-residing (%)	26.7	0	100	100
Walking assistance (%)	0	1	14.3	0

- SD indicated in ( ).

Baseline measurements of lower body strength, lower body flexibility, motor agility / dynamic balance, and estimated daily energy expenditure are reported in Table 4.2. Lower body flexibility and daily energy expenditure did not differ significantly between groups ($p > 0.05$), however, the Intervention group had significantly greater lower body strength and motor agility / dynamic balance than the Comparison group at the beginning of the study.

4.2 Effect of the intervention program on functional fitness and estimated energy expenditure

4.2.1 Attendance and dropouts

Attendance of the members of the Intervention group was high (100%) for the first two sessions, then it decreased due to participant illness, travel, and for personal reasons. After phone contacts following an absence, most participants were able to attend

all subsequent sessions. The average weekly session attendance was 75.4%. One male participant dropped out from the study in the first week because of low interest. Two females did not attend the post-test session due to depression and injury at the end of study.

Two members of the Comparison group dropped out, both due to hospitalization in the middle of the study.

4.2.2 Overall results

After the eight-week study, both groups demonstrated significant within group improvements in lower body strength, lower body flexibility, motor agility/dynamic balance and estimated daily energy expenditure ($p < 0.05$). However, the initial statistical differences in lower body strength and motor agility/dynamic balance between groups at baseline remained at the end of the study ($p < 0.05$). Flexibility also significantly increased significantly with time in both groups ($p < 0.05$), and scores did not differ between groups at the completion of the study. Only estimated daily energy expenditure demonstrated an interaction effect (group times time) during the study ($p < 0.05$), suggesting that the addition of the behaviour change intervention resulted in significantly greater increases in energy expenditure than exposure to the Physical Activity Guide alone (Table 4.2).

4.2.3 Lower body strength and motor/agility dynamic balance responses over time

After the eight-week study, leg strength was increased by an average of 28.3% in the Intervention group, and by 20.2% in the Comparison group, respectively. Both groups showed significant improvement (Table 4.2), and similar changes over time (Figure 3).

There was also a significant increase in dynamic balance within groups during the eight week study. Walking speed increased, and walking time over the prescribed distance decreased by 14.9% in the Intervention group and by 8.1% in the Comparison group. The individual responses of members of both groups are shown in Figure 4.

Table 4.2 Functional fitness and estimated daily energy expenditure in the Intervention and Comparison groups before and after eight-week study.

	Intervention group (n=15)		Comparison group (n=14)	
	Pre	Post	Pre	Post
Lower body strength (rep) ↗*^	11.3±2.9	14.5±3.2	7.9±2.9	9.9±3.8
Lower body flexibility (cm) ^	-1.3±3.0	1.2±2.9	-2.3±5.0	0.1±6.0
Balance(sec) ↗*^	6.7±1.1	5.7±1.2	11.1±6.2	10.2±5.8
Estimated energy expenditure (kcal/day) ^ ‡	614.3±222.7	976.0±402.0	556.8±308.2	652.5±232.6

Data are means ± SD.

↗ Significant difference between groups at baseline ($p < 0.05$).

* Significant difference between groups at week eight ($p< 0.05$).

^ Significant difference within groups from baseline to week eight ($p<0.05$).

‡ Significant group * time interaction effect ($p<0.05$).

4.2.4 Lower body flexibility responses over time

Lower body flexibility increased substantially in both groups (IG, +192.3%; CG, +104%) during the eight-week study. Individual changes in flexibility are illustrated in Figure 5. Although there were no significant differences between groups, participants in the Comparison group had a wider range of responses than did the Intervention group participants.

4.2.5 Estimated daily energy expenditure over time

There was no significant difference in estimated daily energy expenditure between groups at baseline. After the eight-week study, both groups demonstrated increases in estimated daily energy expenditure (IG, +62.3%; CG, +14.6%) (Table 4.2), with the Intervention group achieving a significant greater improvement than the Comparison group throughout the study ($p < 0.05$) (Figure 6). The greatest increases occurred between weeks four and eight as illustrated in Figure 7. The significant interaction effect (group times time) ($p<0.05$), indicates that the effect of the intervention program is greater than that of exposure to the Physical Activity Guide alone.

To examine in detail the effects of the behviour change program on daily energy expenditure, total estimated daily energy expenditure was divided into five components. Since participants were asked to report the physical activity of a "typical" week in the past month, members of both groups did not report any regular caretaking tasks. Yard work was restricted by the winter season for the Intervention group, and by apartment residence for Comparison group. Therefore only three classes of activities were reported on a daily basis activity (Figure 8).

The activities that the participants undertook to increase their energy expenditure are illustrated as increased percentage of participation in Table 4.3. There was a significant increase of 36% in energy expended on work in the Intervention group ($p<0.05$), and a 5% decrease in the Comparison group. Both time and intervention effects were showed in this activity class. The activities with the greatest increases in participation included housework, climbing stairs, shopping and cooking.

Energy expended exercising increased by 145% in the Intervention group and by 92% in the Comparison group, due to increased participation in a variety of tasks. Both groups increased with time, but there were no difference between groups. Participants in the Intervention group reported taking part in more community centre exercise classes (stretching, Yoga, aerobic), and increased biking (treadmill). Participants in the Comparison group reported doing more stretching, and home-based exercise (PAG).

Both groups showed great increases in energy expenditure in recreational physical activities (IG,120%; CG, 88%) with time ($p<0.05$). The most commonly increased activity was leisure walking for both groups. The Intervention group also increased activities such as curling, shuffleboard, dancing and needle work, among others.

Table 4.3 Physical activities related to increased daily energy expenditure (% of group members who reported increased participation).

Activity class	Specific Activities	Intervention group	Comparison group
Work:	shopping	53%	28%
	climbing stairs	40%	0%
	cooking	60%	30%
	housework	80%	20%
Exercise:	brisk walking	40%	35%
	stretching (yoga)	73%	71%
	aerobic class	46%	7%
	treadmill (bike)	20%	0%
Recreational Activity:	leisurely walking	93%	71%
	floor curling (bowling)	53%	0%
	shuffleboard	60%	0%
	painting	40%	0%
	needlework	20%	20%
	dancing	20%	0%

4.2.6 Association between Changes in Functional Fitness and Changes in Energy Expenditure

Increased total energy expenditure was significantly correlated with increased energy expenditure at work and recreational physical activity when both groups were combined (Table 4.4). Change in energy expenditure at recreational physical activity was also significantly correlated with increased energy expenditure during work activities.

However, increased total energy expenditure was not significantly correlated to any changes in functional fitness in the combined group.

Table 4.4 Pearson correlation between changes in functional fitness and changes in energy expenditure in combined group (n = 29).

Changes in	Strength (rep)	Flexibility (cm)	Balance (sec)	EEw (kcal)	EEx (kcal)	EErec (kcal)	TEE (kcal)
Strength (rep)	1.000	.226	.138	.161	.241	.358	.352
Flexibility (cm)	.226	1.000	.100	-.019	-.012	.081	.042
Balance (sec)	.138	.100	1.000	-.005	-.004	-.237	-.157
EEw (kcal)	.161	-.019	-.005	1.000	-.115	.440*	.738**
EEx (kcal)	.241	-.012	-.004	-.115	1.000	.027	.099
EErec(kcal)	.358	.081	-.237	.440*	.027	1.000	.889**
TEE (kcal)	.352	.042	-.157	.738**	.099	.889**	1.000

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level
energy expenditure at work = EEw, energy expenditure at exercise = EEx,
energy expenditure at recreational physical activities = EErec,
total energy expenditure = TEE

When the Intervention group was considered alone, the change in total energy expenditure was also significantly correlated with increased energy expenditure at work activity and during recreational physical activity. Again, increased energy expenditure during recreational activity was significantly correlated with energy expended at work activity. Unlike data for the combined group, increased energy expenditure at work activity was significantly correlated with one measure of functional fitness, improved dynamic balance in the Intervention group. (Table 4.5).

Table 4.5 Pearson correlation between changes in functional fitness and energy expenditure in IG group (n =15).

Changes in	Strength (rep)	Flexibility (cm)	Balance (sec)	EEw (kcal)	EEx (kcal)	EErec (kcal)	TEE (kcal)
Strength (rep)	1.000	.359	.394	-.113	.170	.384	.257
Flexibility (cm)	.359	1.000	.079	-.280	.044	.251	.071
Balance (sec)	.394	.079	1.000	-.547*	.232	-.379	-.476
EEw (kcal)	-.113	-.280	-.547*	1.000	-.419	.528*	.750**
EEx (kcal)	.170	.044	.232	-.419	1.000	.054	-.073
EErec(kcal)	.384	.251	-.379	.528*	-.054	1.000	.947**
TEE (kcal)	.257	.071	-.476	.750**	-.073	.947**	1.000

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

In the Comparison group, change in total energy expenditure was significantly correlated with change in energy expended in recreational activity. Increased energy expenditure during recreational activity was significantly correlated with improved balance (Table 4.6).

Table 4.6 Pearson correlation between changes in functional fitness and energy expenditure in CG group (n =14).

Changes in	Strength (rep)	Flexibility (cm)	Balance (sec)	EEw (kcal)	EEx (kcal)	EErec (kcal)	TEE (kcal)
Strength (rep)	1.000	.216	.019	.283	.113	.073	.345
Flexibility (cm)	.216	1.000	.103	.095	-.128	-.083	.034
Balance (sec)	.019	.103	1.000	.283	-.366	-.601*	-.042
EEw (kcal)	.283	.095	.283	1.000	-.003	-.343	.082
EEx (kcal)	.113	-.128	-.366	-.003	1.000	-.285	-.004
EErec(kcal)	.073	-.083	-.601*	-.343	-.285	1.000	.899**
TEE (kcal)	.345	.034	-.042	.082	-.004	.899**	1.000

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

4.2.7 Response to Canada's Physical Activity Guide to Healthy Active Living for Older Adults and Decision Balance Sheet

The percentage of positive responses to each question about the Physical Activity Guide is listed in Table 4.7. Most participants considered the Guide as a good information resource and a motivation tool (Question 1). More than half of the participants in both groups attempted to seek additional information or guidance about physical activity (Question 2). During the eight-week study, three quarters of the participants in the Intervention group used a daily log as their lifestyle change strategy to monitor their physical activity change, as compared to less than half of the participants in the Comparison group (Question 3). Members of both groups stated that they had increased their physical activity level, and had experienced physical benefits, such as increased strength, better flexibility, better movement and increased energy, as a result of

using the Physical Activity Guide (Question 4). Three times as many Intervention group members as Comparison group members indicated that their use of the Physical Activity Guide had resulted in gains to others (Question 5).

Gains and losses were described using the Decision Balance Sheet (Table 4.8). "Good information" was stated as the principal gain (to self) which was thought to have a large influence on behaviour change. The participants in the Intervention group stated specific gains such as improved flexibility, better balance, and increased strength, as compared to the participants in the Comparison group who stated the overall gain of physical fitness. Increased self-confidence and mobility were also very important gains to one third or more of participants in both groups. Almost one-half of the Intervention group members reported that others had gained from increased motivation due to their involvement in this study, as compared to 28% of the Comparison group members. In addition, the gains of more confidence, and self-reliance made participants less dependent on family. Only two participants in the Comparison group reported less pain and loss of weight as losses to self. No losses to others were reported in either group.

Table 4.7 Physical Activity Guide Survey Result

Question	Intervention group	Comparison group
1. Do you think the guide works as a good information resource in helping you get motivated ?	90%	80%
2. Besides the guide, did you seek other physical activity information or guidance?	80%	50%
3. Did you use the daily physical activity log to manage your daily physical activity?	76%	43%
4. Have you increased your physical activity level or gained physical benefits since you've used the guide?	80%	77%
5. Do you think there is any gain to others since you've used the guide?	60%	21%

Based on Wheeler, G.D., 2000.

Table 4.8 Decision Balance Sheet Result (% of group members who reported gains and losses from participation).

	Intervention group	Comparison group
Gains to self		
* Good information and/or Increased awareness	95%	85%
* Improved flexibility	35%	13%
* Better balance	6%	6%
* Increased strength	20%	0%
* Physically fit	14%	33%
* Improved confidence	40%	35%
* Increased mobility	28%	33%
Gains to others		
* Motivation	46%	28%
* Less dependence	26%	35%
Losses to self		
* Pain	0%	7%
* Weight	0%	7%
Losses to others	0%	0%

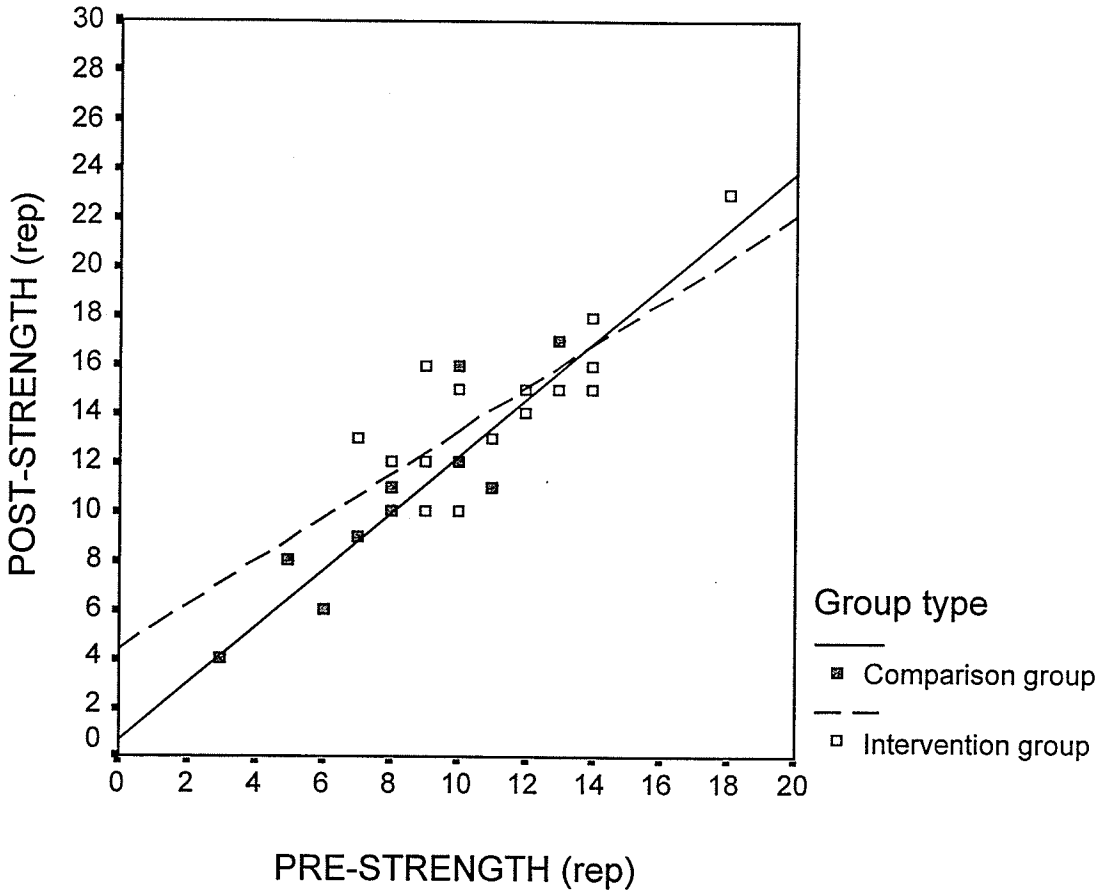


Figure 3 Lower body strength responses before and after the eight week intervention program.

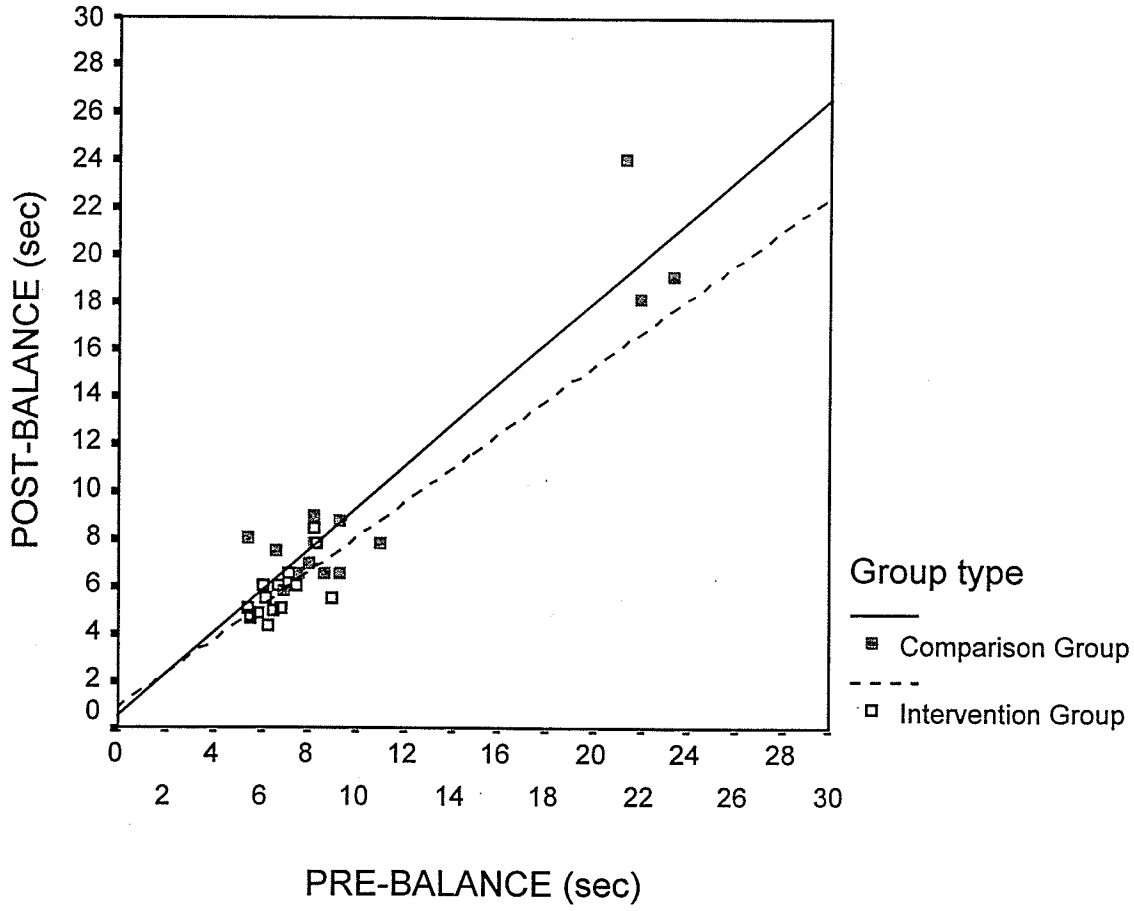


Figure 4 Balance (walking time) responses before and after the eight week intervention program.

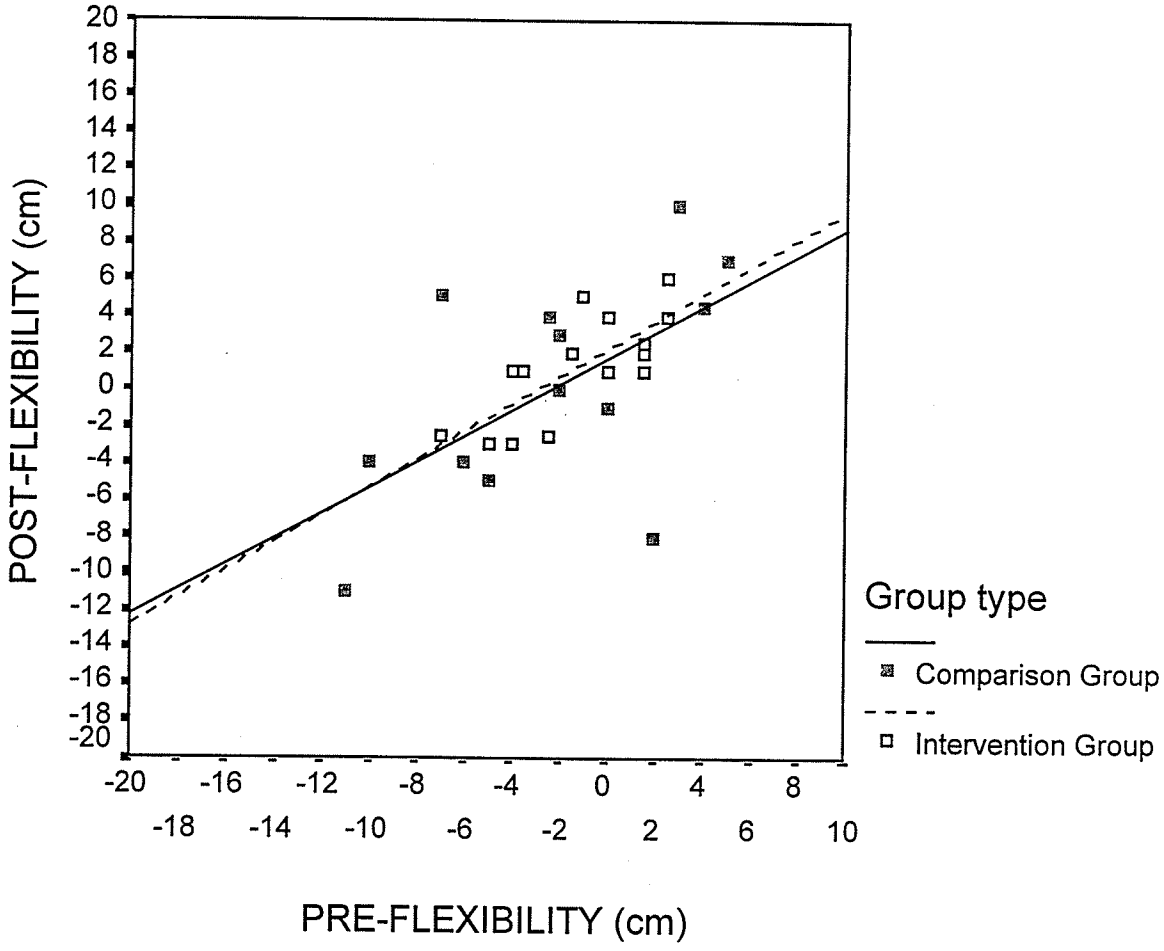


Figure 5 Flexibility responses before and after the eight week intervention program.

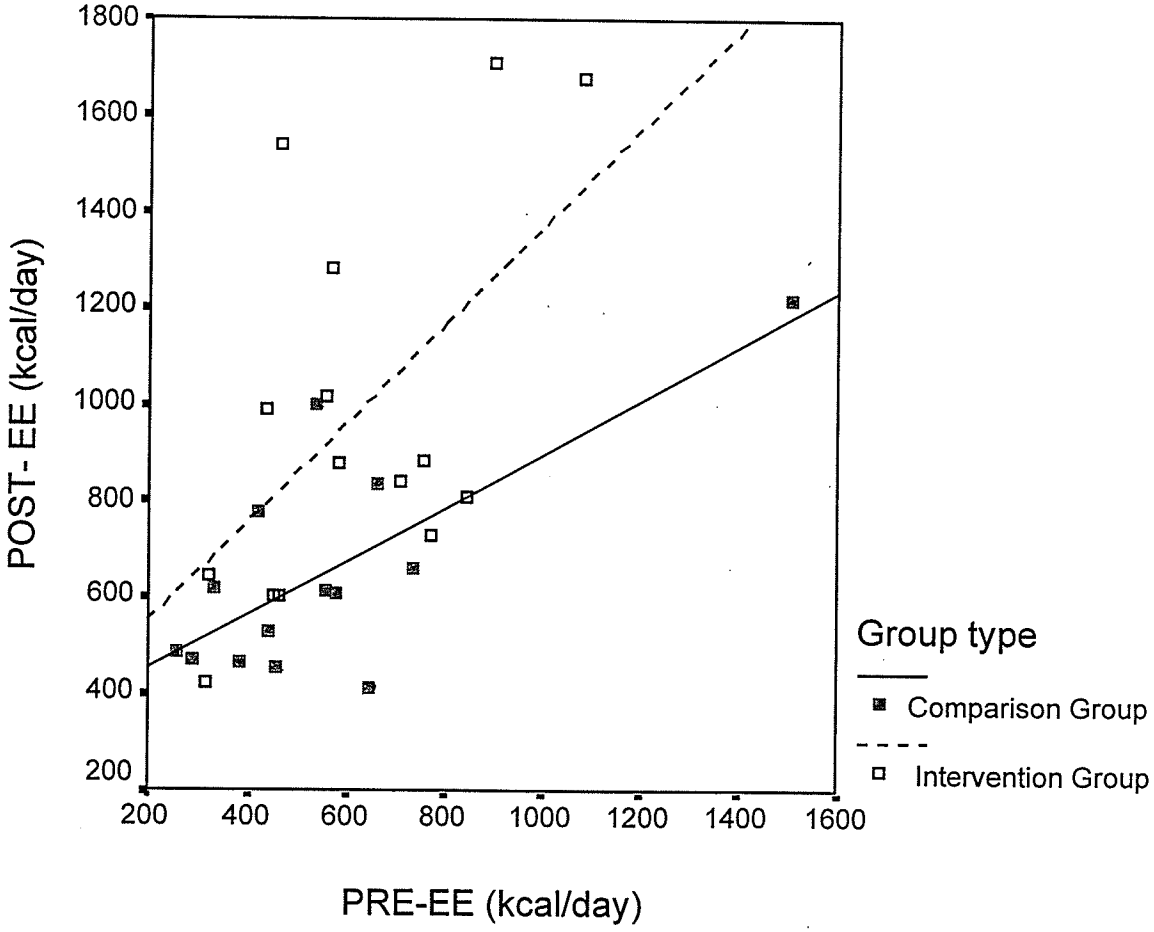


Figure 6 Total estimated energy expenditure (EE) responses before and after the eight week intervention program.

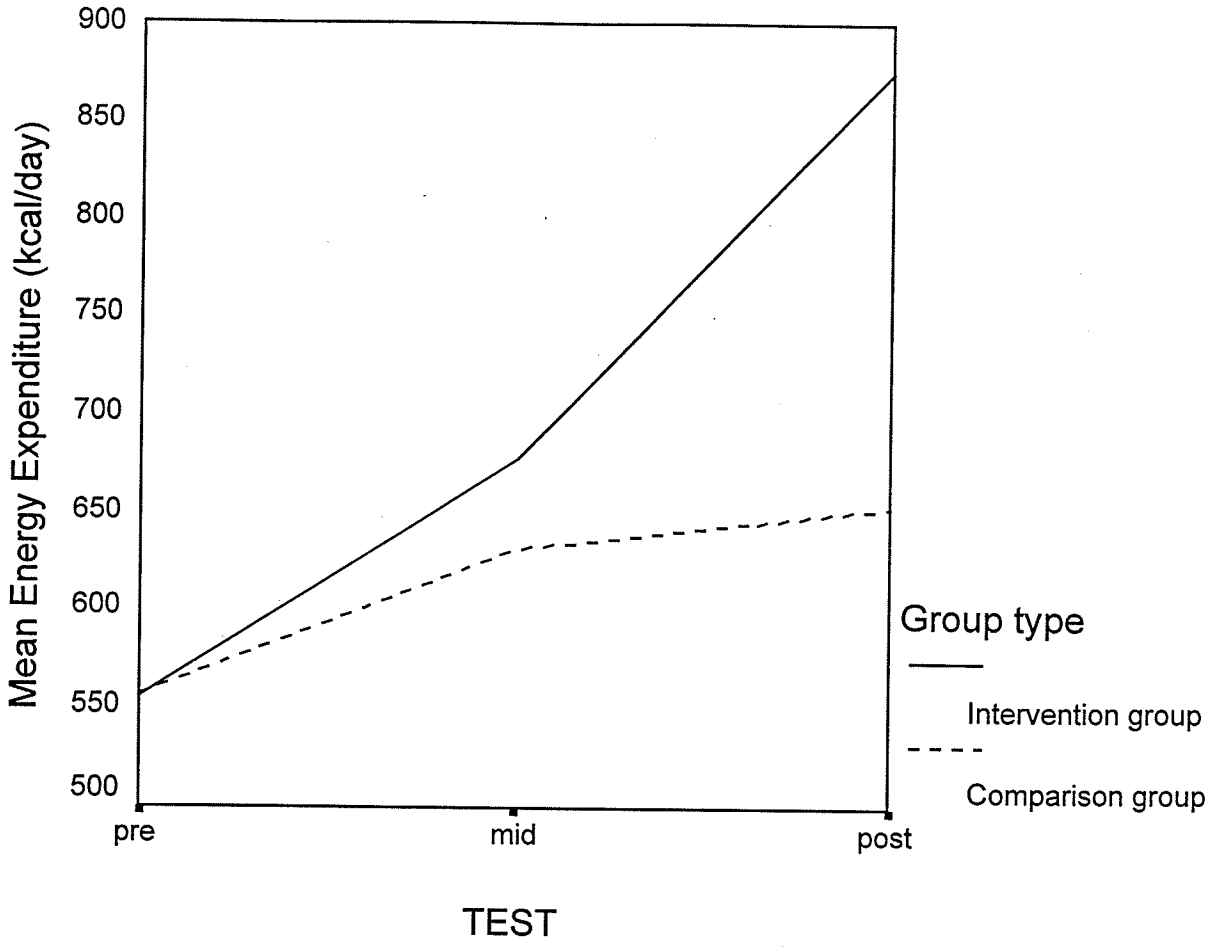
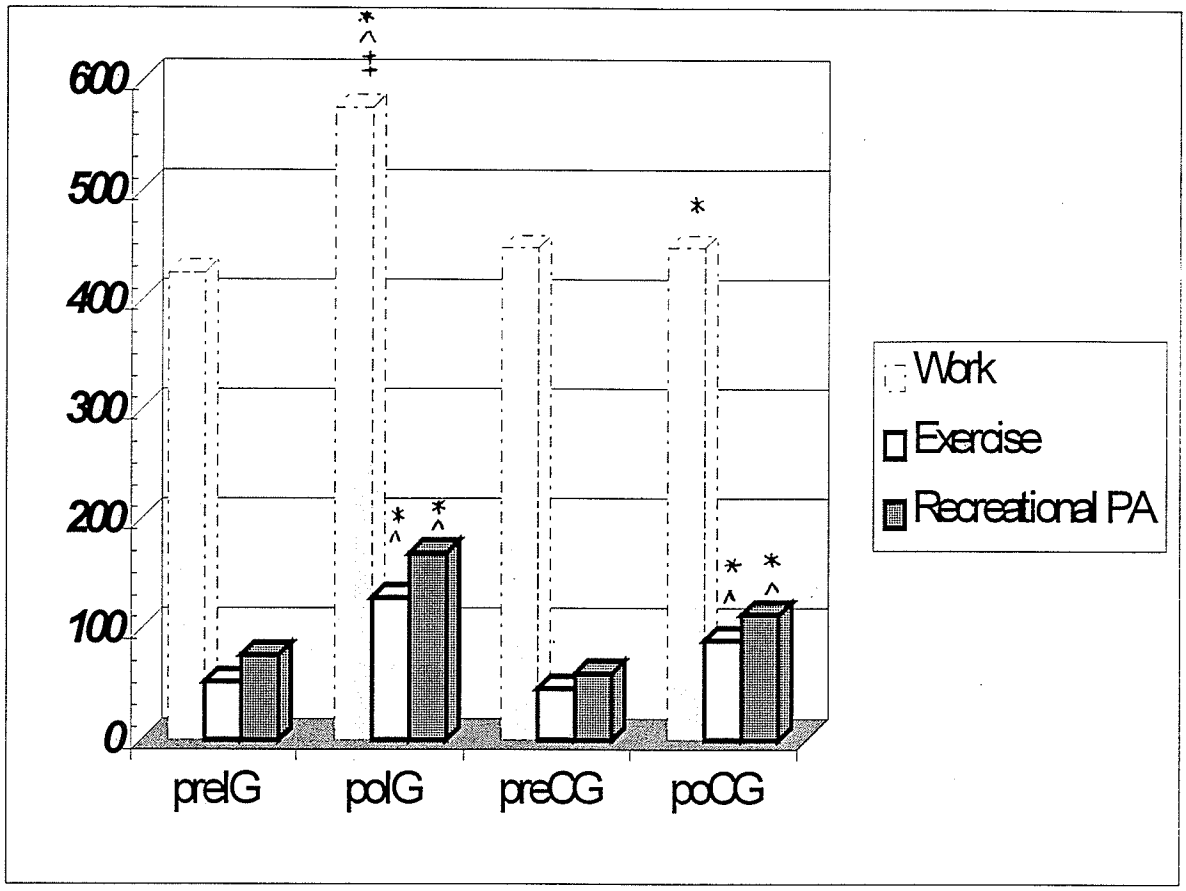


Figure 7 Total estimated daily energy expenditure at the pre, mid and post-tests.



Total estimated EE	**556.2**	**875.5**	**557.8**	**652.5**

Figure 8 Energy expenditure (EE) in three classes of activities (kcal/day).

preIG = Intervention group at pre-test.

poIG = Intervention group at post-test.

preCG = Comparison group at pre-test.

poCG = Comparison group at post-test.

* Significant difference between groups at week eight ($p < 0.05$).

^ Significant difference within groups from baseline to week eight ($p<0.05$).

‡ Significant group * time interaction effect ($p<0.05$).

Chapter 5: Discussion

The purpose of this study was to investigate whether a behaviour change program based on Canada's Physical Activity Guide to Healthy Activity Living for Older Adults would elicit greater benefits than adoption of the Physical Activity Guide alone. The first hypothesis was that an eight- week behaviour change intervention based on the Physical Activity Guide would significantly increase functional fitness, including lower body strength, lower body flexibility and motor agility/dynamic balance in community-residing older adults. The second hypothesis was that the intervention would also result in significantly increased daily energy expenditure from lifestyle physical activity due to behaviour change. This discussion examines these hypotheses, and the results of the study as presented in Chapter Four, in relation to the existing literature. The effects of the intervention program on strength, balance, flexibility, and daily energy expenditure will be discussed. In addition, the responses to the Physical Activity Guide will be interpreted from the results of the Physical Activity Guide Survey and the Decision Balance Sheet.

5.1 Characteristics of the community-residing study participants

Exercise programming for older adults has primarily targeted either high-functioning community-living seniors, or very frail seniors residing in institutions (Tudor-Locke et al., 2000). Participants in this study were more typical of the former group, that is relatively healthy, with some non-life threatening conditions or functional limitations, but still living independently in the community environment. The wider age range in the Comparison group (55-91yr), as compared to the Intervention group (67-82

yr) in this study partly resulted from self-selection of participants. The 55-year old member of the Comparison group had suffered from a previous stroke, and had impaired mobility that required use of a walker, while the 91-year old was comparatively healthy. These differences illustrate that age may not be the primary determinant of function, and that illness and health status also influence participation in programs of this nature.

The non-randomized study design, with an Intervention group and a Comparison group from three different locations was initially intended to avoid between group interaction. In addition, practical difficulties in recruiting participants necessitated this approach. This resulted in the inclusion of users of a walker and a cane in the Comparison group, while no one in the Intervention group required an assistive device. Type of residence also differed significantly by design between groups, as all of the Comparison group were low income earners who resided in Manitoba Housing complexes (apartment). Members of the Intervention group were active in the local Seniors Centre, and three-quarters resided in a house. Unfortunately home ownership versus rental, and other socioeconomic differences such as income and education, were not examined. Such differences are probable, and may partially explain the differences in activity choices between the two groups.

Most older adults have at least one chronic condition, and many have multiple conditions (Spirduso, 1995; Rikli and Jones, 1999). Participants in the present study reported a similar number of daily medications as reported in a previous study of community-dwelling seniors (Rooks et al., 1997). The health conditions reported in the Medical History Questionnaire are also similar to most frequently occurring conditions reported per 100 elderly, including hypertension (40%), arthritis (49%), heart disease

(31%) and diabetes (13%) (Armbuster and Gladwin, 2001). That the incidence of arthritis was significantly lower in our study is not surprising, given its focus on physical activity. The especially low incidence in the Intervention group (13%) reflects self-selection of the participants.

All fourteen participants in the Comparison group were female, and only four of fifteen in the Intervention group were males who joined the study with their spouses. This is in agreement with a previous study showing that women ("wives") are likely to be more knowledgeable concerning health matters, and are more likely to monitor health behavior (Stoller and Pollow, 1994). All the participants in this study were at post-retirement age, and were single or living alone with a spouse. The need to adjust to change and loss (e.g. retirement, role change, loss of a spouse, and change in functional abilities) is one of the most important and difficult developmental tasks that an older individual faces (Eriskson, 1967).

The dropouts in both groups were slightly older than the participants. The number of medications were reported nearly twice in the dropouts than the participants. Four of these five member dropped out due to physical conditions. The percentages of hypertension and arthritis were much higher in both groups. A sense of loss of control and helplessness could make elderly vulnerable to depression (Eriskson, 1967; Wheeler et al., 1998), which was a direct cause of terminating physical activity participation in the current study. The reasons for dropping out of this study (depression, low interest, fall and hospitalization) are also typical barriers for older adults engaging in regular physical activity, which suggests that unstable health status can cause barrier to maintain physical activities. Coping with emotional challenges when their physical health was

compromised may have even more difficult for those participants coping on chronic medical conditions.

Research shows that one in three people 65 years of age and older, and one in two people older than 80 years who, live independently in the community will fall each year (American Association of Retired Persons, 1999). In the United States, older people account for 37% of all hospitalizations and 47% of all days of care in hospitals (American Association of Retired Persons, 1999). The dropout reasons in the present study reflected typical situations which cause sedentary lifestyle in the elderly.

5.2 Baseline differences between groups

Significant differences between groups in lower body strength and motor/dynamic agility balance were present at the beginning of the study. The presence of two walking assistance users in the Comparison group, and none in the Intervention group may partly explain this difference. Moreover, we must consider the potential functional fitness differences relating to house residing versus apartment residing. Although there are few studies on this topic, it is commonly believed that the elderly people often prefer apartment living, as decreasing physical ability or deconditioning makes them unable to handle a variety of house and yard work. It is also thought that changing from house-residing to senior apartment-residing may suggest an increased need for supportive living, because many senior apartments have home caretaker or grocery shopping services. Members of the Intervention group were also members of the community center, who would need relatively good physical abilities to travel between home and the

community centre. In addition, they had better access to social and physical activities while at the Centre than did the Comparison group members.

5.3 Attendance at behavioural intervention program

In the current eight week study, the average session attendance was 75.4%, similar to previous studies that have reported attendance from 36%-98% (mean = approximately 75%) (King et al., 1992). Studies have also found out that only about 50% of adults without heart disease who begin an exercise program will maintain participation in the program beyond 3 months. Since the participants in the Intervention group were members of the Senior Centre, they were already in the habit of regular attendance at the Centre. The eight weeks study period was also short term, which could account for the relatively high attendance. Social support may have also played a major role encouraging participation, as the program offered interaction with other older adults, and effective exercise staff who provided assistance with exercise participation (Brandon et al., 2000). The educational components of the program established the belief that physical activity prolongs and improves physical function and health, which may also have supported the initiation and adherence of participation (Brandon et al., 2000). The use of lower-intensity exercises may also have contributed to the high participation rate (Dishman, 1994).

5.4 Strength responses to the intervention program

Research has consistently demonstrated that, given a stimulus of sufficient intensity, muscle strength can be improved in older adults. In the current study, lower

body strength, as reflected by chair rises, was significantly increased by 28.3% in the Intervention group, while the Comparison group also had significant improvement of 20.2% over time. These improvements are similar to changes reported by others who trained their subjects using a moderate strength training program, and who achieved an average increase from 20% to 48% in lower body strength (Schlich et al.2001; Singhet al., 1997; Hakkinen and Hakkinen, 1995; Charette et al., 1991). These findings also agree with a recent report that from eight to 12 weeks of strength training, may be sufficient to demonstrate physiological and functional improvement (Keysor and Jette, 2001). Nonetheless, adoption of the Physical Activity Guide alone also successfully improved lower body strength in the Comparison group from pre-to post-test. This suggests that, in the short term, an active lifestyle change, accompanied by a behavioural intervention program or not, may result in similar strength gains. Moreover, the study demonstrated a similar training effect from adopting a variety of lifestyle physical activities, as found in other studies which have used a structured exercise protocol (Brandon et al., 2000). Both groups showed a great deal of interest in the activities recommended by the Physical Activity Guide, such as lifting soup cans or self-made weight bags, chair standing, leg raises and stair climbing. This suggests that self-selection on a daily basis of physical activities that are recommended by the Physical Activity Guide may demonstrate benefits similar to those achieved in a structured strength training program. In addition, these types of self-selected strength activities are suitable for community residing older adults for building "exercise" in to their daily routine by offering the freedom of exercising at a self-determined intensity and using less expensive or no equipment (Rooks et al., 1997).

According to these results, there is no evidence that the Intervention group improved more than the Comparison group. It is interesting to note, however, that the lower body strength in the Comparison group changed at a slightly greater slope compared with the Intervention group (Figure 3). This evidence agrees with previous reports that the very greatest benefits occur when sedentary individuals begin a program of regular physical activity. The most significant improvement is gained when people start at a lower physical ability level (Haskell, 1994). Finally, the lack of a control group (no Physical Activity Guide) does not allow clear differentiation between the effects of Physical Activity Guide and learning/ practice effects on the strength response.

5.5 Dynamic balance responses to the intervention program

Leg weakness has been identified as an important risk factor for functional tasks, such as walking speed and balance (Gehlsen and Whaley, 1990). We used walking speed as an indicator to evaluate dynamic balance in this study. With significant improvements of lower body strength in both groups, yet larger increases in the Intervention group. Members of the Intervention group also increased average dynamic balance greater (14.9%) than member of the Comparison group (8.1%). This finding is in agreement with the finding that lower-body strength training improves walking speed (Schlich et al., 2001).

Previous studies have shown improvement in "balance related" tests in older community living adults after participation in a variety of activities, such as walking, dancing, resistance exercise, Tai chi, and strengthening exercise (Judge et al., 1993; Jarnlo, 1991). This type of self-selected and self-paced physical activity is not commonly

used in research studies, due in part to the concern that such a format does not ensure an adequate stimulus for significant physiological gain. However, the magnitude of improvement in this study suggests that the lifestyle physical activity model of the Physical Activity Guide can provide a physiological stimulus sufficient to elicit improvement in physical performance and functional mobility in community -dwelling older adults. Finally, the lack of a control group (no Physical Activity Guide) does not allow clear differentiation between the effects of the Physical Activity Guide and learning/ practice effects on the dynamic balance response.

5.6 Flexibility response to the intervention program

There has been surprisingly little recent research in the area of interventions to increase flexibility in the older adult. Flexibility interventions have not provided the evidence for clear dose-response effects of exercise (Mazzeo et al, 1998). In the present study, the intervention program, which included weekly instructive sessions and used behaviour change strategies to promote lifestyle change, did not improve flexibility beyond changes resulting from adoption of the Physical Activity Guide alone. Regardless of the behavioural intervention program, both groups improved their flexibility significantly during the eight-week study. This suggests that improvement in flexibility is related more directly to participation in physical activity tasks, than to the behaviour change program.

The majority of previous studies have demonstrated significant improvements in the range of motion of various joints (neck, shoulder, elbow, hip, knee and ankle) in older adults who have participated in a regular exercise (Hubley-Kozey et al.,1995; Morey et

al, 1991; Lesser, 1978; Munns, 1981). Experts indicate that if a person wishes to improve, he or she needs to do special flexibility exercises that involve stretching the muscles and using the joints through their full range of normal motion (Corbin and Pangrazi, 1990). In the present study, flexibility activities were included as one of the three activity groups in the Physical Activity Guide. Therefore, rather than doing lifestyle physical activity and recreational activities, participants learned to incorporate specific flexibility activities in to daily living. Members of both groups added an average of 10 minutes of stretching per day, albeit in response to two different programs (intervention versus Physical Activity Guide alone). This is in keeping with ACSM (1998) recommendation of using many different approaches, with even short program duration, to elicit beneficial effect on flexibility.

Finally, the lack of a control group (no Physical Activity Guide) does not allow clear differentiation between the effects of the Physical Activity Guide and learning/ practice effects on the flexibility response.

5.7 Daily energy expenditure responses and energy expenditure in three activity types

Physical activity levels in older adults have been assessed using numerous approaches depending on the study purpose (Stewart et al., 2001). In the present study, we used the Yale Physical Activity Survey (YPAS) based on several considerations. Firstly, using questionnaires for the elderly population may minimize concerns about the complicated experimental setting and safety issues raised by laboratory testing. Secondly, this questionnaire covers a wide variety of physical activities of daily life. Unlike other

questionnaires, which assume regularity in the way in which people participate in exercise, and which assume that duration is consistent for each exercise session, the Yale Physical Activity Survey asks respondents to report the total time spent per week rather than the average time per session. This compensates for the fact that older adults participate in at least some of their activities on an irregular basis, and for different amounts of time per session (DiPietro et al., 1993). In addition, since daily energy expenditure is an indicator of overall physical activity level, the broader range of activity tasks included in this survey provide a more precise record of physical activity involvement.

In the present study, estimated total daily energy expenditure increased in both groups, however the greater increase in energy expenditure in the Intervention group as compared to the Comparison group supports the hypothesis that the behavioural intervention program would be more effective than the Physical Activity Guide alone. Also, the mean daily energy expenditure at pre, mid and post-test demonstrated a constant increase in the Intervention group, and a plateau after four weeks in the Comparison group. This suggests that the combination of education, behavioral tools and physical activity components used in the intervention program may have promoted higher active living awareness, and greater higher physical activity, and enhanced the effectiveness of the Physical Activity Guide.

Increases of energy expenditure in the three activity classes were different between groups. Although some members of both groups individually reported increased time on "work" related tasks, the average energy expended on this type of activity only increased significantly in the Intervention group. Thus, a group*time interaction effect

was found for this class of physical activity, suggesting greater lifestyle change through daily living tasks in the Intervention group. The greater increase in estimated total energy expenditure in the Intervention group also resulted largely from increased energy expenditure on "exercise" and "recreational activities", which demonstrated an effect of active lifestyle change. The average energy expenditure increase in each activity class in the Intervention group was greater than in the Comparison group. This was also considered as an intervention effect of the physical activity behaviour modification, which improved participants' ability to incorporate a variety of physical activities into daily life.

The behavioural change strategies played an important role in leading participants through a three -step process, to identify the benefits of physical activity, to clarify suitable activities for personal needs and seeking realistic ways to maintain activity level. A goal setting sheet, benefit checklist, decision balance sheet and self-contract were well used in the weekly sessions to help participants stick with the program. The weekly sessions also provided group interaction, which brought in updated information, personal experience, and constant encouragement. Most importantly, an activity log was used to track and adjust daily activity tasks, total time and goal attainment. This may have gradually affected participants' lifestyle and the ability to plan for active living, and contributed to program adherence and successful lifestyle change. Studies to date show that interventions that employ behavioural change strategies can effectively support people from the contemplation stage progressing to preparation, and from preparation progressing to action (Marcus et al., 1996).

Finally, the lack of a control group (no Physical Activity Guide) does not allow clear differentiation between the effects of Physical Activity Guide and learning/ practice effects on the daily energy expenditure response.

5.8 The Correlation between Functional Fitness and Energy Expenditure

The present study showed a positive relationship between changes in total energy expenditure, and energy expenditure at both work and recreational activity in the Intervention group, but only at recreational activity in the Comparison group. This suggests that a greater percentage of Intervention group members increased both their work activity and recreational activity, than did the members of the Comparison group, who increased only recreational activity during the study. The result is not surprising, because the total energy expenditure was calculated from the sum energy expenditure from work, exercise and recreational activities.

Improvements of lower body strength and flexibility were not related to changes in energy expenditure during any of the three activity classes. This maybe due to the short study period, which was not enough to show the significant relationship. However, the significantly relationship between improved dynamic balance and increased work activity in the Intervention group suggests that undertaking a variety of lifestyle daily living tasks, such as those incorporated in the behaviour change program (i.e. work activity) can effectively improve balance in older adults. Moreover, increased recreational activity was related to significant improvement in dynamic balance in the Comparison group. This suggests that increased leisure time activity, especially activities such as walking, may enhance balance in this population. For those older adults who have limited access to exercise or recreational facilities, or who are limited by their physical conditions from

doing strenuous physical activity, small changes in recreational activity may lead to improved function ability. The PAG alone maybe sufficient for sedentary older adults to get motivated and to see some physical benefits from increased daily physical activity.

5.9 Physical Activity Guide Survey and Decision Balance Sheet

Results from both the Physical Activity Guide Survey and the Decision Balance Sheet reflect the effectiveness of the Physical Activity Guide and the intervention program. The majority of participants in both groups stated that they received significant motivation from the Physical Activity Guide, which is designed primarily for those who are currently inactive and those who have already begun to get active (Ketchum, 1998). The gained motivation also supported by the objective of the Physical Activity Guide to offer an engaging summary of the components of physical activity, and guidelines on how to achieve health benefits by being physically active (Ketchum, 1998). That participants reported the Physical Activity Guide to be a good information source suggests that they had established belief in the benefits of an active lifestyle, known to act as a positive influence on health behaviour change (Meichenbaum, 1987). Participants attempts to seek additional information sources and guidance is further evidence of the successful motivating effect of the Physical Activity Guide in both groups.

The daily physical activity log was used as a planned behaviour and self-management technique in the current study. Compared to participants in the Comparison group, twice as many in the Intervention group actually used the daily activity log. This result suggestes that the behaviour change tool could be better used when facilitated with an intervention program. The greatest value of a behaviour intervention change program may be for long-term adoption of a regular physically active lifestyle.

It is interesting that both groups stated that they had increased their physical activity level, and gained physical benefits. These results are similar to those reported by Wheeler's (2000), who investigated the impact of the Physical Activity Guide to Healthy Active Living for the general populations, on the intention to engage in activity, as well as on actual physical activity levels. It suggests that the Guide bridges the gap from the traditional exercise approach to practical reality for older people.

More than half of the participants in the Intervention group stated that their participation in the program also had a positive effect on others. For example, they reported that they served as a role model, were less dependent on others, and were less depressed, which also affected others. Participants in the Comparison group were less likely to believe that their use of the Physical Activity Guide resulted in positive impacts on others due to lack of group interaction.

In summary, the Physical Activity Guide served as an effective motivator for the majority of participants in both groups. The variety of information in the guide was thought to provide sufficient motivation to help sedentary seniors get active. Both the intervention program and the Physical Activity Guide alone promoted adoption of physical activity, and resulted in functional improvement. The behaviour change program lead to significant increases of total estimated energy expenditure, and to increases of lifestyle physical activity on both daily living tasks, exercise, and recreational physical activities. It also enhanced the participants' interaction, which in turn enhanced the social awareness and the recognition of the benefits of healthy active living lifestyle.

6.0 Summary and conclusion

The purpose of the study was to investigate whether a behaviour change program based on Canada's Physical Activity Guide to Healthy Activity Living for Older Adults would elicit greater increases in functional fitness and daily energy expenditure than the adoption of the Physical Activity Guide alone. It was hypothesized that an eight- week behaviour change intervention would increase functional fitness, including lower body strength, lower body flexibility and motor agility/dynamic balance in community-residing older adults, to a greater extent than adopting the Physical Activity Guide alone. It was also hypothesized that the above intervention would result in a higher increase in daily energy expenditure from lifestyle physical activity, due to the behaviour modification.

All Intervention group (n =15) and Comparison group (n=14) participants who completed the study, and who participated in all three test sessions (pre, mid and post) at St. James/ Assiniboia Senior Centre, or at three Manitoba Housing Authority complexes, were included in the data analysis. The pre- and post-test sessions included functional fitness tests (lower body strength, lower body flexibility and dynamic balance), using a functional fitness test for community-residing older adults (Rikli and Jones, 1999), and daily energy expenditure estimated from the Yale Physical Activity Survey (DiPetro et al., 1993). Energy expenditure was also estimated at the study mid-point (four weeks).

All participants in the Intervention group attended eight behaviour change intervention sessions, once per week for eight weeks. Each session included educational, behavioural and physical activity components based on the contents of the Physical Activity Guide. General healthy active living information, basic behaviour change strategies, and physical activity principles were covered throughout the intervention

program. All participants in the Comparison group were given the Physical Activity Guide and asked to make the best use of the guide on their own. The investigator met these participants only during the testing sessions, and no regular contact was made with members of this group.

After the eight-week intervention program, both the Intervention group and the Comparison group had significant increases in lower body strength, lower body flexibility, motor agility/dynamic balance, and estimated daily energy expenditure. All of the functional fitness measurements had a time effect but no intervention effect. This suggests that use of the Physical Activity Guide alone can effectively improve functional fitness in community-residing older adults, by helping them to build suitable physical activity into their sedentary lives. The behaviour change intervention did not result in greater improvement in functional fitness in the eight week study period.

Daily energy expenditure was the only outcome measurement that showed a significant interaction effect. Although the average daily energy expenditure increased throughout the study in both groups, the Intervention group had a significant and substantially greater increase from weeks four to eight. This may be attributed to enhanced physical activity behaviour change brought about by the intervention program. Members of the Intervention group increased their daily energy expenditure by undertaking increased work, exercise and recreational physical activity, while the smaller increase in the Comparison group was due to increased exercise and recreational physical activity only. The Intervention group expended significantly greater energy in all of the three activity classes than did the Comparison group through out the study.

The current study did not fully support the hypothesis that an eight-week behaviour change intervention would elicit significantly greater functional fitness improvement than adoption of the Physical Activity Guide alone. However, the finding of improvements with the use of the Physical Activity Guide alone is significant. To the majority of community-residing older adults, it is good news that the Physical Activity Guide can effectively bridge the gap between exercise science and practice. The Physical Activity Guide was able to motivate sedentary people to improve their strength, flexibility and balance, and to increase energy expenditure. Moreover, the results do suggests that the addition of the behaviour change program resulted in significantly increased daily energy expenditure, which indicates the potential for greater health benefits over the long term.

Further studies should use a randomized design, and include a control group (no Physical Activity Guide), to better examine the effect of the Physical Activity Guide alone. Physical activities and energy expenditure should be monitored on a daily basis to reduce recall mistakes in this age group. Follow up studies should be conducted to evaluate participant adherence over the long term. More studies should also focus on long-term active living behaviour change interventions, to better explain the impact of behaviour modification on physical activity, and ultimately health in this population.

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APPENDICES

Appendix A Consent Forms

Adoption of Canada's Physical Activity Guide for Older Adults: effect on physical activity level, daily energy expenditure and functional fitness

In Formed Consent Form For Intervention Group

Purpose

The purpose of this study is to test whether adoption of Canada's Physical Activity Guide to Healthy Living for Older Adults changes physical activity level, daily energy expenditure and functional fitness.

Time-line

The study will start February 1st, 2001 and will require your commitment for 10 weeks. Questionnaires and some basic physical tests will be done one week before and after an 8-week intervention.

Intervention

Participants who are eligible to take part in the study, and who are assigned to the Intervention group, will be given Canada's Physical Activity Guide to Healthy Living for Older Adults, and will meet with the instructor in weekly sessions (45min). Our instructor will talk with you about health and physical activity, introduce the new lifestyle activity mode to you, help you with any questions regarding the guide and familiarize you with lifestyle activities (e.g. walking, gardening, housework, cycling). Self-planning and self-monitoring tools from the guide will be used to educate you about managing your daily activity and adopting healthy lifestyle physical activity behaviors.

Expectations of Participants

1. Testing

Before you are accepted into the study, you will be asked to complete a brief medical history. This will be reviewed by a nurse, and will be used solely to ensure your safe participation.

You will be asked to undergo pre- and post-tests at the beginning and completion of the eight-week study. Tests will include questionnaires designed to estimate physical activity level and energy expenditure, as well as functional tests to measure strength, flexibility and motor agility/dynamic balance. The questionnaire tests and the functional tests will be scheduled in two different days. The questionnaires tests will be administered in person. An instructor will read each question and provide a basic explanation. Participants will be asked to make their own decision about each answer. These tests will take approximately 30 minutes. The functional tests will be conducted by testers who are Certified Fitness Consultants. Before each test task, testers will demonstrate to you the proper technique. You will be allowed to practice once or twice before the test trail(s). These tasks will take about 45 minutes in total.

2. Lifestyle Physical Activity Program

You will be asked to attend weekly sessions throughout the study. These sessions will last from 45 minutes to one hour, and will take place at St.Jame/ Assiniboia Senior Centre. In these sessions you will be encouraged to follow the Physical Activity Guide, and build lifestyle physical activity into your daily routine. Each session will also include some form of physical activity (e.g. Chair exercise, TaiChi, ect.).

Potential Benefits

The potential benefits from your participation in the study are: 1) you will be assisted by health professionals to adopt a healthy and active lifestyle; 2) you may notice health benefits, such as more energy, fewer aches and pains, and better posture and balance in the short term. In the long term, these benefits will translate into stronger muscles and bones, weight maintenance, and better independent living; 3) you will also meet new people, and benefit from taking part in group activities.

Possible Risks Associated with Participation in the Study

The only foreseeable risks may be the minor muscle soreness that normally accompanies unaccustomed exercise.

Your participation is completely voluntary and you will be free to refuse to answer any question, or take part in any test, or to leave the program without penalty. All information will be number coded and kept strictly confidential. Your identity will not be revealed without your written consent.

If you have any questions, please feel free to call Dr. Elizabeth Ready, thesis advisor ( ), or Xuesong Jiang, graduate student ( ).

Please read the following paragraph. If you agree to participate, please sign below.

I understand that the University of Manitoba is conducting a study of lifestyle physical activity intervention and older adult's physical activity level, daily energy expenditure and functional fitness. I am aware of the study procedures and potential risks and benefits from participation in the study.

I have the right to refuse to answer any question in the questionnaire interview.

I have the right to withdraw from the study at any time.

All information about me obtained from the study will be kept strictly confidential.

Signature_____ Date_____

Interviewer_____ Date_____

Please place your initials here acknowledging receipt of a copy of this consent form_____

Adoption of Canada's Physical Activity Guide for Older Adults: effect on physical activity level, daily energy expenditure and functional fitness

In Formed Consent Form For Comparison group

Purpose

The purpose of this study is to test whether adoption of Canada's Physical Activity Guide to Healthy Living for Older Adults changes physical activity level, daily energy expenditure and functional fitness.

Time-line

The study will start February 1st, 2001 and will require your commitment for 10 weeks. Questionnaires and some basic physical tests will be done one week before and after an 8-week intervention.

Intervention

Participants who are eligible to take part in the study, and who are assigned to the Comparison group, will be given Canada's Physical Activity Guide to Healthy Living for Older Adults.

Expects to Participants

1. Testing

Before you are accepted into the study, you will be asked to complete a brief medical history. This will be reviewed by a nurse, and will be used solely to ensure your safe participation.

You will be asked to undergo pre- and post-tests at the beginning and completion of

the eight week study. Tests will include questionnaires designed to estimate physical activity level and energy expenditure, as well as functional tests to measure strength, flexibility and motor agility/dynamic balance. The questionnaire tests and the functional tests will be scheduled in two different days. The questionnaires tests will be administered in person. An instructor will read each question and provide a basic explanation. Participants will be asked to make their own decision about each answer. These tests will take approximately 30 minutes. The functional tests will be conducted by testers who are Certified Fitness Consultants. Before each test task, testers will demonstrate to you the proper technique. You will be allowed to practice once or twice before the test trail(s). These tasks will take about 45 minutes in total.

2.Self-learning

You will work on your own to study the Physical Activity Guide and make the decision to change your lifestyle physical activity.

Potential Benefits

The potential benefits from your participation in the study are: 1) you will learn a lot of healthy and active lifestyle tips; 2) you may notice health benefits, such as more energy, fewer aches and pains, and better posture and balance in the short term. In the long term, these benefits will translate into stronger muscles and bones, weight maintenance, and better independent living.

Possible Risks Associated with Participation is the Study

The only foreseeable risks may be the minor muscle soreness that normally accompanies unaccustomed exercise.

Your participation is completely voluntary and you will be free to refuse to answer any question, or take part in any test, or to leave the study without penalty. All information will be number coded and kept strictly confidential. Your identity will not be revealed without your written consent.

If you have any questions, please feel free to call Dr. Elizabeth Ready, thesis advisor ( ), or Xuesong Jiang, graduate student ( ).

Please read the following paragraph. If you agree to participate, please sign below.

I understand that the University of Manitoba is conducting a study of lifestyle physical activity intervention and older adult's physical activity level, daily energy expenditure and functional fitness. I am aware of the study procedures and potential risks and benefits from participation in the study.

I have the right to refuse to answer any question in the questionnaire interview.

I have the right to withdraw from the study at any time.

All information about me obtained from the study will be kept strictly confidential.

Signature_____ Date_____

Interviewer_____ Date_____

Please place your initials here acknowledging receipt of a copy of this consent form_____

Appendix B

MEDICAL HISTORY QUESTIONNAIRE

NAME: _____
DATE OF BIRTH: _____ **PHONE NUMBER:** _____

Medications: None ☐ or : **(List all pills prescribed)**

1) _____

2) _____

3) _____

4) _____

5) _____

1. HIGH BLOOD PRESSURE:

YES ☐ NO ☐ UNKOWN ☐

ON MEDICATION ☐

2. DIABETES:

YES ☐ NO ☐ UNKOWN ☐

ON MEDICATION ☐

3. DO YOU HAVE?	YES	NO
a) HEART DISEASE	☐	☐
b) STROKE	☐	☐
c) POOR CIRCULATION	☐	☐
d) LUNG DISEASE	☐	☐
e) KIDNEY DISEASE	☐	☐
f) BOWEL DISEASE	☐	☐

	YES	NO
g) LIVER DISEASE	☐	☐
h) BLOOD DISEASE	☐	☐
i) BONE PROBLEM	☐	☐

4. DO YOU NOTICE OR EXPERIENCE THE FOLLOWING WHEN DOING HOUSEWORK OR MODERATE PHYSICAL ACTIVITY (E.G. WALKING, GARDENING) ?

	YES	NO
a) CHEST DISCOMFORT	☐	☐
b) TROUBLE BREATHING	☐	☐
c) LEG CRAMPS	☐	☐

5. HAVE YOU ?	YES	NO
a) HAD AN EXERCISE TEST	☐	☐
b) SEEN A CARDIOLOGIST	☐	☐

6. DO YOU ?	YES	NO
a) LOSS YOUR BALANCE OR CONSCIOUSNESS BECAUSE OF DIZZINESS	☐	☐
b) KNOW OF <u>ANY OTHER RE-SON</u> WHY YOU SHOULD NOT DO PHYSICAL ACTIVITY	☐	☐

SIGNED: _____

DATE: _____

Appendix C

The Yale Physical Activity Survey

Interviewer, please mark time: ___ : ___ : ___
Hr Min Sec

Interviewer: (Please hand the subject the list of activities while reading this statement.) Here is a list of common types of physical activities. Please tell me which of them you did during a *typical week in the last month*. Our interest is learning about the types of physical activities that are a part of your *regular work and leisure routines*.

For each activity you do, please tell me how much time (in hours) you spent doing this activity during a typical week. (Hand subject card #1.)

Work	Time (hr/week)	Intensity code (kcal/min)
Shopping (e.g., grocery, clothes)	_____	3.5
Stair-climbing while carrying a load	_____	8.5
Laundry (time loading, unloading, hanging, folding only)	_____	3.0
Light housework: tidying, dusting, sweeping; collecting trash in home; polishing; indoor gardening; ironing	_____	3.0
Heavy housework: vacuuming, mopping; scrubbing floors and walls; moving furniture, boxes, or garbage cans	_____	4.5
Food preparation (10+ min in duration): chopping, stirring; moving about to get food items, pans	_____	2.5
Food service (10+ min in duration): setting table; carrying food; serving food	_____	2.5
Dishwashing (10+ min in duration): clearing table; washing/drying dishes; putting dishes away	_____	2.5
Light home repair: small appliance repair; light home maintenance/ repair	_____	3.0
Heavy home repair: painting, carpentry, washing/polishing car	_____	5.5
Other: _____	_____	_____
Yard work		
Gardening: planting, weeding, digging, hoeing	_____	4.5
Lawn mowing (walking only)	_____	4.5
Clearing walks/driveway: sweeping, shoveling, raking	_____	5.0
Other: _____	_____	_____

Caretaking		
Older or disabled person (lifting, pushing wheelchair)	_____	5.5
Childcare (lifting, carrying, pushing stroller)	_____	4.0
Exercise		
Brisk walking (10+ min in duration)	_____	6.0
Pool exercises, stretching, yoga	_____	3.0
Vigorous calisthenics, aerobics	_____	6.0
Cycling, exercycle	_____	6.0
Swimming (laps only)	_____	6.0
Other: _____	_____	_____
Recreational activities		
Leisurely walking (10+ min in duration)	_____	3.5
Needlework: knitting, sewing, needlepoint	_____	1.5
Dancing (moderate/fast): line, ballroom, tap, square	_____	5.5
Bowling, bocci	_____	3.0
Golf (walking to each hole only)	_____	5.0
Racquet sports: tennis, racquetball	_____	7.0
Billiards	_____	2 5
Other: _____	_____	_____

WEEKLY PHYSICAL ACTIVITIES

Work

Shopping (e.g., grocery, clothes)	
Stair climbing while carrying a load	
Laundry	
Light Housework:	tidying, dusting, sweeping, collecting garbage in home, polishing, indoor gardening, ironing
Heavy Housework:	vacuuming, mopping, scrubbing floors and walls, moving furniture, moving boxes or garbage cans
Food preparation (10+ min):	chopping, stirring, moving around to get food items and pots or pans
Food service (10+ min):	setting table, carrying food, serving food
Dishwashing (10+ min):	clearing table, washing and drying dishes, putting dishes away
Light home repair:	small appliance repair, light household maintenance and repair tasks
Heavy home repair:	painting, washing and polishing car, carpentry
Other:	_____

Yardwork

Gardening:	pruning, planting, weeding, hoeing, digging
Lawn mowing (walking only)	
Clearing walks and driveway:	raking, shoveling, sweeping
Other:	_____

Caretaking

Older or disabled person:	lifting, pushing wheelchair
Child care:	lifting, pushing stroller

Exercise

Brisk walking for exercise (10+ min):	causes large increases in heart rate, breathing or leg fatigue
Stretching exercises, yoga, pool exercise	
Vigorous calisthenics, aerobics:	causes large increases in heart rate, breathing or leg fatigue
Cycling, exercycle	
Lap swimming	
Other:	_____

Recreational Activities

Leisurely walking (10+ min)

Hiking

Needlework: knitting, sewing, crocheting, needlepoint

Dancing (mod/fast): line dancing, ballroom, square, tap, etc.

Bowling, boccie

Golf (walking to each hole only)

Racquet sports: tennis, racquetball

Billiards

Other: _____

Appendix D

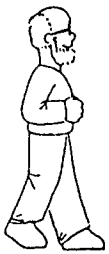
Home-Support Exercise

(Tudor-Loke et al., 2000)

#1
BEGINNER

March on the spot.
Begin with two minutes. Increase time up to five minutes, then progress.

PROGRESSION

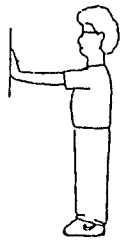


Walk from room to room. Begin with five minutes. Increase time every day.

THE CENTRE FOR ACTIVITY AND AGEING

#2
START

FINISH

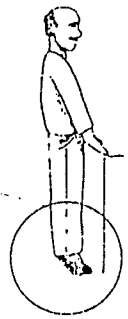


Wall Push-ups.
Begin with five. Add more everyday until you can do 15.

THE CENTRE FOR ACTIVITY AND AGEING

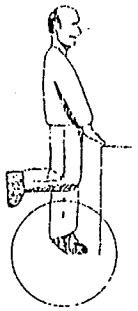
#3

BEGINNER



Lift up on your toes (standing on both feet).
Begin with five. Add more until you can do 15. Then progress.

PROGRESSION

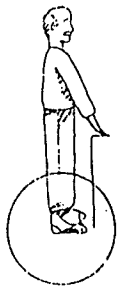


Lift up on your toes (standing on one foot).
Begin with 5 on each foot. Add more until you can do 15.

THE CENTRE FOR ACTIVITY AND AGEING

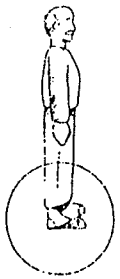
#4

BEGINNER



Tap your toes while holding onto a solid object. Begin with two minutes and increase time up to five minutes. Then progress.

PROGRESSION

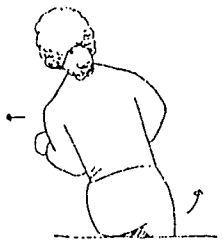


Tap **your toes** without holding on.

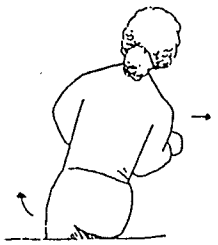
THE CENTRE FOR ACTIVITY AND AGEING

#5

START



FINISH

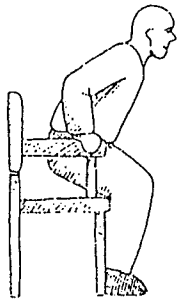


Seat walks.
Lift your hip and shift your weight. Over. Begin with two minutes and increase time up to five minutes.

THE CENTRE FOR ACTIVITY AND AGEING

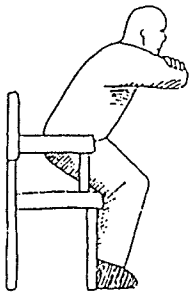
#6

BEGINNER



Get up from a chair using your arms. Begin with five. Add more every day until you can do 15. Then progress.

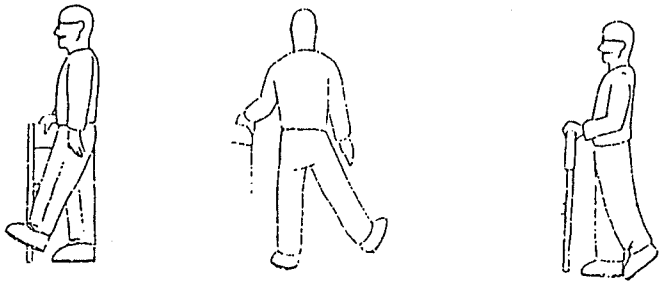
PROGRESSION



Get up from a chair without using your arms. Begin with five. Add more every day until you can do 15.

THE CENTRE FOR ACTIVITY AND AGEING

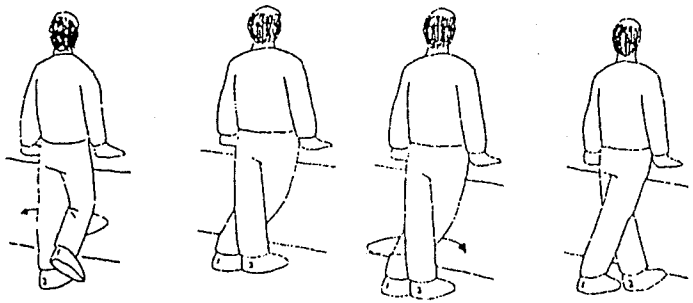
FRONT SIDE BACK



Leg lifts.
Lift your leg (front, side, and back). Begin with 5 repetitions on each leg. Increase as you become stronger until you can do 10 on each leg.

THE CENTRE FOR ACTIVITY AND AGEING

#8

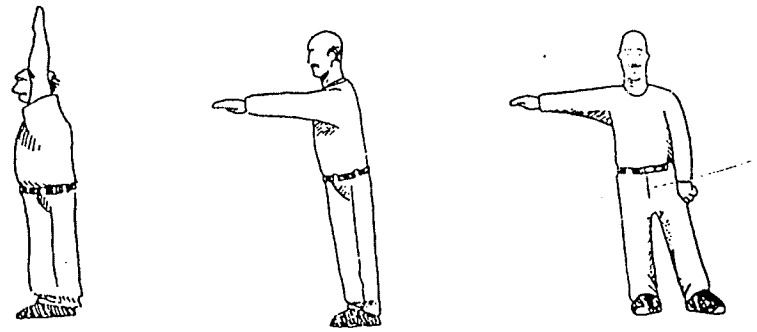


Braid walking. (If you have had a hip replacement, skip this exercise.) Hold onto a solid object. Step one leg over the other, like a "braid." Begin with two minutes. Increase until you can do five minutes.

THE CENTRE FOR ACTIVITY AND AGEING

#9

UP FRONT SIDE

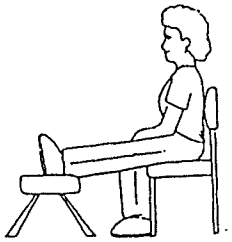


Reaching.
Out to the front, side, and up, as far as you can. Begin with five each direction. Add more until you can do ten.

THE CENTRE FOR ACTIVITY AND AGEING

#10

Lower leg stretch.
Hold this position for 30 seconds on each leg. Increase to one minute.



Back of leg stretch.
Hold this position for 30 seconds on each leg. Increase to one minute.

THE CENTRE FOR ACTIVITY AND AGEING

Appendix E Physical Activity Guide Survey

Physical activity guide survey

QUESTION	YES	NO
1. Do you think the guide works as a good information resource in helping you get motivated ?		
2. Besides the guide, did you seek other physical activity information or guidance?		
3. Did you use the daily physical activity log to manage your daily physical activity?		
4. Have you increased your physical activity level or gained physical benefits since you've used the guide?		
6. Do you think there is any gain to others since you've used the guide?		

Based on Wheeler, G. D., 2000.

Appendix F Decision Balance Sheet

This balance sheet will help you think through the possible consequences of participating in the Physical Activity Guide study. By considering the potential gains and losses, you will be able to make an informed decision.

- Write down all the gains and losses you anticipate from the study.
- Rate how important each one is for you - '1' would mean it has a small influence on your behaviour; '3' would mean it is a large influence.

Gains to Self:	Losses to Self:
Gains to Others:	Losses to Others:

Appendix G

CANADA'S **Physical Activity Guide** to Healthy Active Living for Older Adults

Move Better, Feel Better, Be Better

You can do it - Getting started is easier than you think. Keep track of your activities. Record your progress.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday