

**POTENTIAL BENEFITS OF A NOVEL HOME-BASED EXERCISE PROGRAM
FOR INACTIVE OLDER ADULTS: AN EXPLORATORY CASE STUDY**

By

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ABSTRACT

PURPOSES: This study aimed to determine if home-based exercise for an inactive older adult population can help overcome barriers and stimulates enablers for regular exercise at the recommended intensity.

METHODS: The strategy was three weeks of square-stepping exercise (SSE) and bodyweight exercises with home-equipment. Using Embedded mixed methods, 10 inactive older adults completed an intervention in conjunction with follow-up interviews to enhance observations. Data analysis employed the framework method.

RESULTS: The intervention helped overcome barriers such as body image and being uncomfortable in a gym; enablers included the exercise protocol, home equipment, and how the program was convenient. The average total steps/day increased by 27% ($p=0.02$) during the intervention and moderate intensity was reached in 80% of the participants when performing SSE.

CONCLUSIONS: A home-based exercise program using SSE and bodyweight exercises could potentially increase the physical activity level of inactive older adults especially for those intimidated by a fitness facility setting.

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Introductory Chapter

Population ageing refers to the age of all Canadians increasing especially the baby-boom cohort, which exceeds the number of younger people (Statistics Canada, 2018). Those that are aged 65 and older, referred to as older adults, are the fastest growing population much faster than the general population which has a variety of implications on physical activity and health. Accordingly, the proportion of older adults is projected to increase from 17.2% in 2018 to 29.5% in 2068 (Statistics Canada, 2018). The increase in age reflects more than just a low fertility rate and lengthening of life expectancy (Statistics Canada, 2018). As societies industrialize, a demographic transition occurs in moving from high fertility rates and high mortality rates to low fertility rates and low mortality rates (Statistics Canada, 2018). Also, there is a variation in population ageing across Canada in geographic areas with higher concentrations of Aboriginal people that typically have low proportions of older adults than younger people (Statistics Canada, 2018). Population ageing is shifting with more older adults and it is important that the health and physical activity of older adults do not imply a national burden.

Ageing is a process of accumulating physical and mental changes over time. Consequently, sarcopenia (i.e., muscle atrophy) is a loss in strength known to occur with ageing and a component of frailty (Frontera, Hughes, Lutz, & Evans, 1991). However, older adult health concerns largely relate to chronic conditions that become exaggerated as a consequence of ageing such as cardiovascular disease (Tjepkema, 2005). As a combatant to such comorbidities, a large body of research stresses that, Moderate to Vigorous Physical Activity (MVPA) is associated with improved vascular function and may even decrease the risk of developing cardiovascular disease (O'Brien et al., 2018).

Academic research also points out that older adults experience many barriers to exercise such as a lack of time (LeBlanc et al., 2015; Paterson, Jones, & Rice, 2007).

Exercise has been shown to reduce the risk of chronic conditions, frailty, hospital stays and mortality (Covinsky et al., 2003). Moderate intensity is the minimum intensity recommended during aerobic exercise by many international and national agencies to optimize health and functional benefits (CSEP, 2019; Donnelly et al., 2009; Tremblay et al., 2011; WHO, 2012). Unfortunately, according to Colley et al. (2011), less than 15% of older adults meet Canada's physical activity recommendation, while MVPA is associated with better health outcomes (McGregor et al., 2018). Uncovering barriers and enablers to exercise for inactive older adults may help provide a suitable exercise strategy, which is the basis of this study. There is no perfect strategy that can overcome all barriers to exercise, and it is important to provide as many options as possible for older adults.

One such strategy is a home-based exercise program which may be a precursor to influence regular physical activity (Vanhees et al., 2012). To combat these adverse consequences to physical inactivity, home-based exercise is designed to promote physical activity in a convenient manner and to show that being active does not need to be in a fitness facility. Hence, the purpose of the research thesis is to determine the effect of a home-based exercise program for inactive older adults to overcome barriers and stimulate enablers for regular physical activity at the recommended intensity. An intervention in conjunction with follow-up interviews was implemented to enhance observations.

Barriers to Physical Activity

Some barriers that have been identified in previous research among inactive older adult men and women in two or more articles include poor health/illness (Booth,

Bauman, & Owen, 2002; Cohen-Mansfield, Marx, & Guralnik, 2003; Schutzer & Graves, 2004); a lack of time (Booth et al., 2002; Coghill & Cooper, 2009; Cohen-Mansfield et al., 2003; Costello, Kafchinski, Sullivan, & Vrazel, 2011); pain/injury (Booth et al., 2002; Cohen-Mansfield et al., 2003; Costello et al., 2011; Schutzer & Graves, 2004); and a lack of motivation (Cohen-Mansfield et al., 2003; Costello et al., 2011). Table 1 represents the above articles by author, title, date and barriers to physical activity.

Table 1. Barriers to Physical Activity Reported in the Literature

Authors	Title of Scholarly Article	Date	Barriers
Booth, Bauman, & Owen	Perceived barriers to physical activity among older Australians	2002	already active enough, injury, disability, poor health, feeling too old, time, lifestyle
Coghill & Cooper	Motivators and de-motivators for adherence to a program of sustained walking	2009	lack of social support, time, lack of weight loss
Cohen-Mansfield, Marx, & Guralnik,	Motivators and barriers to exercise in an older community-dwelling population	2003	poor health, pain, motivation, time, fatigue, weather, lack of enjoyment
Costello, Kafchinski, Vrazel, & Sullivan	Motivators, barriers, and beliefs regarding physical activity in an older adult population	2011	time, injury, self-discipline, motivation, boredom, and intimidation
Schutzer & Graves	Barriers and motivations to exercise in older adults	2004	illness, pain, fear, environment, physician advice, lack of knowledge, childhood exercise

A barrier can be a constraint that is internal or external. For instance, Ashe, Miller, Eng, Noreau, and The Physical Activity and Chronic Conditions Research Team (2009) identified that Socio-Economic Status (SES) can be an internal and external barrier which significantly influences physical activity. A barrier internal to an older

adult can be one's perception of their body image (Bethancourt et al., 2014). Cohen-Mansfield, Marx, Biddison, and Guralnik, (2004) reported a barrier that are often external to an older adult, can relate to the cost of exercise programs. A barrier can also be ranked higher or lower for older adults showing that a particular barrier can have a greater effect on older adults.

The Canadian Fitness and Lifestyle Research Institute (CFLRI) established in 1980 is a national research organization (not-for-profit) that identified barriers when monitoring 2,500 Canadian older adults' physical activity levels ("About CFLRI: Who we are,' n.d.). Although this is long-standing data, a ranking of each barrier was identified. This included a lack of energy (58%-major), lack of motivation (53%-major), lack of time (35%-moderate), excessive cost (23%-minor), and transportation (21%-minor). It is thus important to not only represent barriers among a sample but to identify which barriers are more important than others.

Baert, Gorus, Mets, Greet, and Bautmans (2011) reported 59 barriers across 44 studies and 28,583 subjects in a systematic review. Studies used in this systematic review reported barriers for specific age groups (e.g., ages 65-88, 64-85+, 78-95, 65-90). The average age of 72.8 was identified amongst 37 of the 44 studies, as some did not report average age (Baert et al., 2011). A lack of time related to the notion of physical activity being a waste of time (Gonzales & Jirovec, 2001), a lack of flexibility related to daily schedules (Schneider, Eveker, Bronder, Meiner, & Binder, 2003), and inconvenience related to the time of classes (O'Neill & Reid, 1991). Kruger, Carlson, and Kohl (2007) studied 27,894 U.S. adults who commonly reported access to fitness facilities as a barrier. Access to fitness facilities can often relate to a lack of transportation to facilities or heavy

traffic near sidewalks (Belza et al., 2004). Considering barriers presented by Baert et al. (2011), the need for a program that does not consume ample amounts of time, that is flexible, has no class time, is easily accessible, and possibly without transportation, may make home-based exercise an ideal option for an inactive population.

Enablers to Physical Activity

The opposite of barriers to physical activity are enablers of physical activity. Cohen-Mansfield et al. (2003) explain some barriers act as motivators to enable exercise (i.e., injury rehabilitation). Some enablers identified among inactive older adult men and women in two or more articles include: perception of health benefits (Allender, Cowburn, & Foster, 2006; Coghill & Cooper, 2009; Cohen-Mansfield et al., 2003; Costello et al., 2011; Schutzer & Graves, 2004); social support (Allender et al., 2006; Cohen-Mansfield et al., 2003; Costello et al., 2011; Schutzer & Graves, 2004) and enjoyment/fun (Allender et al., 2006; Baert et al., 2011; Cohen-Mansfield et al., 2003; Costello et al., 2011; Schutzer & Graves, 2004). Table 2 organizes the above articles by author, title, date and enablers identified.

Table 2. Enablers to Physical Activity Reported in the Literature

Authors	Title of Scholarly Article	Date	Enablers
Allender, Cowburn, & Foster	Understanding participation in sport and physical activity among children and adults: a review of qualitative studies	2006	social support, health benefits, enjoyment
Coghill & Cooper	Motivators and de-motivators for adherence to a program of sustained walking	2009	health benefits: weight loss, increasing physical function, lower cholesterol level, and improving fitness
Cohen-Mansfield, Marx, & Guralnik,	Motivators and barriers to exercise in an older community-dwelling population	2003	satisfaction, health benefit, social support, organized program, more time, weather, don't know, other
Costello, Kafchinski, Vrazel, & Sullivan	Motivators, barriers, and beliefs regarding physical activity in an older adult population	2011	health benefit, socialization, and staff/programing, accessibility, facilities, fun, and encouragement from one's physician
Schutzer & Graves	Barriers and motivators to exercise in older adults	2004	self-efficacy, feelings of pleasure and satisfaction, prompts, music, demographics, social support

Coghill and Cooper (2009) reported enablers with home-based walking in Bristol, England for older adult men in a 12-week Randomized Controlled Trial (RCT). Participants referred to reasons like lowering cholesterol with walking to improve their health (Coghill & Cooper, 2009). Researchers suggest that wanting to improve or maintain physical function relates to independence and the overall performance of activities of daily living (Hardcastle & Taylor, 2001). An example that can enable long-term physical activity is playing with grandchildren (Lees, Clark, Nigg, & Newman,

2005). Costello et al. (2011) encourage researchers to educate, provide knowledge about exercises, and provide equipment for inactive older adults. Exploring participant experience through open dialogue will highlight connections for enablers in this study to enablers in the literature.

Physical Activity Recommendations

National guidelines have emphasized that older adults should meet the physical activity recommendations to live a healthier life (e.g., World Health Organization [WHO], Canadian Society for Exercise Physiology [CSEP], American College for Sports Medicine [ACSM]). However, many older adults are not aware of physical activity recommendations (Dale et al., 2016). A study on physical activity awareness recruited 1,450 adult respondents and 136 older adult respondents across Canada and showed 12.9% of respondents were aware of physical activity recommendations (Dale et al., 2016). Physical activity recommendations are important because it advises some key information on Frequency, Intensity, Time, and Type of exercise (FITT principles), specifically intensity (Day, McGuigan, Brice, & Foster, 2004).

Physical activity intensity. Moderate intensity is the minimum intensity recommended by many international and national agencies to optimize health and functional benefits when achieving regular aerobic physical activity (CSEP, 2019; Donnelly et al., 2009; Tremblay et al., 2011; WHO, 2012). Moderate intensity is defined as breathing harder and sweating a little bit (CSEP, 2019). Brisk walking is used as an example of moderate activity (CSEP, 2019). Exercise intensity can be measured subjectively in self-reports on perceived exertion and objectively by monitoring Heart Rate (HR). Different methods can be used to evaluate exercise intensity, but according to

the American College of Sports Medicine (ACSM), the most accurate way to calculate an individual's moderate intensity is by using 40 to 59% of maximal oxygen capacity either expressed with VO_2 reserve ($\text{VO}_{2\text{R}}$) and Heart Rate Reserve (HRR) when VO_2 is not available (ACSM, 2014). To optimize the program, HRR was used to monitor intensity for participants completing the home-based exercise program.

Paterson et al. (2010) researched minimal or effective physical activity dose to maintain functional independence. Paterson et al. (2010) concluded that meeting the CPAG would lead to a 30% reduction in morbidity and mortality risk. If older adults accumulated at least 30-minutes of physical activity at moderate intensity each day, a variety of health-related risks could be lowered (Lee & Buchner, 2008). However, during exercise it may be difficult to distinguish light, moderate or vigorous intensities (Paterson et al., 2007).

Step counting is an alternative to monitoring physical activity intensity. Step counting devices monitor physical activity to measure steps and total time at MVPA (Bassett, Schneider, & Huntington, 2004). Research suggests that 30-minutes of daily MVPA in older adults is equivalent to taking approximately 7,000-10,000 steps/day (Tudor-locke et al., 2011). Therefore, participants accumulating more than 10,000 steps will not be included in this research thesis.

Intensity is one of the most important principles of physical activity as indicated by Dalleck and Dalleck (2008). For example, low-intensity training may lead to under-training and reduce the physical activity benefits while high intensity may lead to burnout and injury; this suggests current fitness plays a role. Those that are inactive and begin low-intensity exercises will gain substantial health benefits than those who are already

active. Varma et al. (2014) conducted a low-intensity walking study with 187 inactive older adults age 65 and older. Of that sample population, 7% met MVPA, but those meeting the recommendation had better self-reports and performance-based measures of physical function, quality of life, and fewer depressive symptoms. Even though lower intensities seem appropriate in exercise programs participants in this study were asked to reached moderate intensity in bouts of 10-minutes or more.

Physical activity bouts. There has been speculation on whether a shorter or longer duration of physical activity is more worthwhile for older adults. Loprinzi and Cardinal (2013) researched non-bouts (<10-minutes of physical activity) and bout training (>10-minutes) and found both durations can lower cardiovascular disease risk factors (e.g., metabolic syndrome, systolic blood pressure, diastolic blood pressure). This study included a total of 6,321 participants ranging in age from 18 to 85 years. Non-bout training increased cardiorespiratory fitness, support weight loss, and broke up total sedentary time when accumulating at least 30-minutes of MVPA throughout the day (Loprinzi & Cardinal, 2013). If older adults accumulated at least 30-minutes of MVPA, a variety of health-related risks could be lowered (Lee & Buchner, 2008). For older adults, non-bout training is ideal for inactive older adults who perceive time as a barrier as it may be easier to implement (Gay, Buchner, & Schmidt, 2016; Loprinzi & Cardinal, 2013). However, there is limited research on physical activity recommendations for non-bout training (Paterson & Warburton, 2010). Therefore, reaching moderate intensity in bouts and total steps per day were measured within the context of this study.

Physical function. Increases in disability and signs of poor physical function often indicate sarcopenia, an age-related condition decreasing strength, power, and

muscular endurance (Hunter, McCarthy, & Bamman, 2004). Other terms used to describe physical function include frailty (Bray, Smart, Jakobi, & Jones, 2016); functional independence (Buford, Anton, Clark, Higgins, & Cooke, 2015); and physical capacity (Kasper, Chan, & Freedman, 2017). Physical function refers to the ability to complete daily activities expected for one's age (Buford et al., 2015). Physical inactivity can worsen sarcopenia increasing difficulty in weight bearing tasks, increased risk of falling, increased fatigue, and difficulty in exercising (Hunter et al., 2004). Adverse changes in body composition (e.g., weight, fat mass, skeletal muscle mass) and muscle capacity (e.g., strength, power, endurance) are common deficits for physically inactive older adults (Brady, Straight, & Evans, 2014).

Research on the association between physical activity level and physical function is normally conclusive (Paterson et al., 2007). Physical function is measured by muscle capacity (e.g., strength, power, endurance) and balance (Tremblay et al., 2007). For example, testing muscular endurance in the legs is useful for identifying walking fatigue and walking difficulty (Brady & Straight, 2014). An exercise routine that includes functional tasks such as chair rises, stair climbing, and walking under different difficulties is beneficial for older adult physical function (Buford et al., 2015). Batsis et al. (2016) studied older adults with osteoarthritis and enhanced quality of life, balance, and life expectancy using exercises focused on walking function, musculoskeletal function, and cardiorespiratory function (Batsis et al., 2016). More weekly physical activity meant less joint pain and better overall walking performance (Batsis et al., 2016).

Older adults are recommended to maintain or increase physical function (Paterson & Warburton, 2010). Poor physical function increases the risk of falling (Batsis et al.,

2016). Physical activity level is not predicted by age, rather it compares physical function and age. Among older adults, chronological age and biological age may differ considerably (Paterson et al., 2007); for instance, a 65-year-old adult with poor physical function is worse off compared to a 70-year-old with good physical function. Poor physical function is largely associated with needing caregiver support (e.g., spouses, friends) or increased expenses on long-term care (Paterson & Warburton, 2010).

Covinsky et al. (2003) examined changes in daily activity (e.g., bathing, dressing, eating, transferring, toileting) with pre-hospitalization and post-hospitalization in 2,293 patients age 70 and older. All patients had a medical condition at hospital admission and stayed at either Hospital of Cleveland or Akron City Hospital. Most patients (55%) had a poor physical function at baseline (Covinsky et al., 2003). On discharge, 35% of patients performed worse than their baseline (Covinsky et al., 2003). Physical function between baseline and discharge declined by 23% (age 70-74), 28% (age 75-79), 38% (age 80-84), 50% (age 85-89), and 63% (age ≥ 90). When hospitalizing older adults, the priority is treating the illness; suggestion on why physical function lowers during hospitalization may relate to inadequate nutrition, excessive bed rest, polypharmacy (concurrent use of multiple medications), and sleep deprivation (Covinsky et al., 2003).

Poor physical function increases the support needed to perform self-care activities such as bathing, dressing, using a toilet, leaving a bed or standing from a chair.

Caregiving for older adults is largely handled by informal caregivers (Coughlin, McBride, Perozek, & Liu, 1992). Informal caregivers take on the responsibility of dependent older adults and face little compensation as common providers of care in the community (Kemper, 1992). Carriere et al., (2008) conducted a study on the projected

future availability of the informal support network to older adults by assessing its impact on home care services. The results suggest that for the period of 2001-2031, the average annual growth rate of older adult dependence could be approximately 2.5% in Canada.

Exercise in a home setting helps overcome some barriers, making an appropriate introduction to exercise for inactive older adults before the need for caregiver support is necessary.

Home-based Exercise

Home-based exercise is central to the purpose of this thesis research. King, Haskell, Young, Oka, and Stefanick (1995) measured long-term effects (two-year RCT) during three exercise programs for adherence, cardiorespiratory fitness, and High-Density Lipoprotein (HDL) levels in 149 men and 120 women age 50 to 65. The exercise programs were group-based vigorous intensity (local community senior center and college), home-based vigorous intensity, and home-based moderate intensity. Both vigorous programs were 40-minute endurance training three sessions per week prescribed at 73-88% (7-7.5 Metabolic Equivalents [METS]) of peak treadmill HR; the moderate exercise program was 30-minute endurance training five sessions per week prescribed at 60-73% (4-4.5 METS) of peak treadmill HR (King et al., 1995). All exercise programs were supervised. Participants were sedentary, free of cardiovascular disease, and community-dwelling. Treadmill performance improved in all three programs during year one and maintained in year two, lipoprotein levels and other heart disease risk factors had no significant change in year one but in year two, both home-based training programs showed small but significant increases in HDL cholesterol. The home-based vigorous

program had the highest rate of adherence, and King et al. (1995) concluded that supervised home-based exercise is suitable for safe and attractive sustained participation.

Martin et al. (2013) measured the effectiveness of group-based exercise for fall prevention and satisfaction by comparing other prescribed programs (e.g., home-based exercise, control) in a systematic review. RCTs included group-based exercise with participants age 65 years or older, one or more outcomes related to balance and satisfaction, and prescription from a physical therapist (Martin et al., 2013). Out of 10 articles identified, three compared group-based exercise with home-based exercise programs. Protocols varied; in two articles, group-based exercise was performed twice per week in addition to home-based exercise programming. The third article compared group-based exercise to a home-based exercise program with identical exercise prescription for both groups, although participants of the homegroup met with the exercise professional biweekly which typically does not happen (Martin et al., 2013). Improvements in both groups included quality of life and physical function.

Helbostad, Sletvold, and Moe-Nilssen (2004) suggested higher satisfaction and higher adherence in a group-based exercise occurs when participants have similar characteristics (e.g., BMI). As well, Madureira, Bonfá, Takayama, and Pereira (2010) included social interaction from group-based exercise promote adherence in group-based and home-based activities. Lastly, Donat and Ozcan (2007) found increased enjoyment and social interaction from supervised home-based exercise programs which may allow greater adherence compared to group-based programs.

Ashworth et al. (2005) assessed the effectiveness of home-based versus facility-based physical activity programs on health in older adults age 50 and older in a

systematic review. Six RCT included 224 participants (home-based) and 148 (facility-based) with a recognized cardiovascular risk factor or existing cardiovascular disease/peripheral vascular disease (four trials), chronic obstructive airway disease (two trials), or osteoarthritis (zero trials). Of the cardiovascular disease/peripheral vascular disease trials, adherence was notably higher in home-based (68%) than facility-based (36%) at two years follow-up (Ashworth et al., 2005). However, this largely based on one trial (highest quality) which had approximately 60% of participants of the four trials. As well, participants in the other three trials had greater improvements in distance walked and less reported pain at up to six months (short-term follow up) of facility-based programs. Ashworth et al. (2005), suggested home-based exercise adherence is greater long-term (two years) and can be sustained when providing equipment, supervision, shorter exercise durations, and incentives.

Simek, McPhate, and Haines (2012) investigated adherence to home-based exercise programs to prevent falls in a systematic review. Twenty-three RCTs were included (2,123 participants), and 80% of participants were 60 years or older. The purpose was to determine program characteristics and intervention efficacy (Simek et al., 2012). Adherence was defined as fully (100% participation) or partly (50% participation). Interventions varied: lower body strength and with or without balance training was most common. Most trials were supervised, implemented between eight and 78 weeks, and sessions lasted between 10-60-minutes. Participants that were fully adherent amounted to 21%. Simek et al. (2012) assumed full adherence would be higher if intervention characteristics included: balance or walking exercises, supervision, led by an exercise professional, and no flexibility training.

Simek et al. (2015) examined preferences of older adults toward home-based exercise programs for fall prevention, perceived benefits of adherence, and barriers to adherence in a two-wave cross-sectional study. Using telephone surveys for baseline and 12 months follow-up, 245 community-living older adults (70 years or older) from Victoria, Australia were surveyed. Participants were categorized as current (54), previous (22), or non-participants (169) of a home-based exercise program in the last six years. Simek et al. (2015) advised program adherence may be influenced by explaining physical and mental health outcomes, inherent flexibility and independence to decide when and how to exercise at home, and how well the program would complement personal preferences.

In summary, home-based exercise programs for older adults are acceptable and feasible to prevent declines in independence (Clegg, Barber, Young, Forster, & Iliffe, 2012; Nemček & Simon, 2016). Reaching MVPA is obtainable at home with treadmills and is good for long-term adherence. However, this is usually dependent on program characteristics (e.g., supervision, exercise prescription, providing equipment, walking or balance exercise). Finally, home-based exercise programs with older adults that used interview methods for data collection recruited 10 to 14 participants to study (Ashmead & Bocksnick, 2002; Saligheh, McNamara, & Rooney, 2016). A minimum of 10 older adults were recruited for study.

Aerobic training. Aerobic activity refers to the use of oxygen to adequately meet energy demands during exercise. Activities that can reach moderate intensity for older adults at home include treadmill walking (Ashworth et al., 2005), walking in a hallway (McDermott & Polonsky, 2016), walking on stairs (Mangione, Craik, Tomlinson, &

Palombario, 2005), marching on the spot (Luukinen, Lehtola, & Jokelainen, 2006), and stationary cycling (Fisken, Keogh, Waters, & Hing, 2015). However, one type of aerobic training that combines both memory task and moderate intensity that was developed by Shigematsu & Okura (2006) in Japan was Square-Stepping Exercise (SSE). It is a low cost, easily administered, and stepping patterns can range in difficulty as shown below in Figure 1. SSE includes forward, backward, lateral and oblique steps, and step patterns may be made progressively more complex. Participants are to repeat the step pattern five times, recognition and memorization are normally achieved after five repetitions (Shigematsu, Okura, & Nakata, 2014).

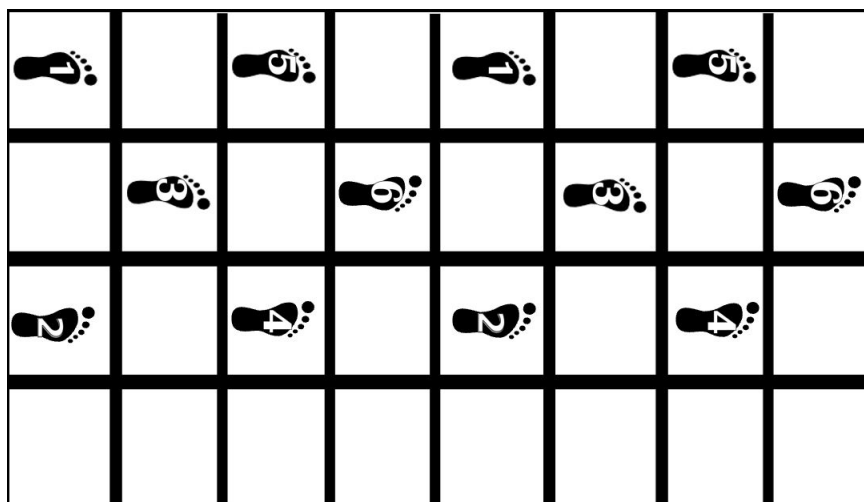


Figure 1. Square-stepping Exercise Patterns (Heath, Shellington, Titheridge, & Gill, 2017, p. 173)

Research on SSE has shown effective results in strength and balancing training (Shigematsu, Okura, Sakai, & Rantanen, 2008), and more effective than walking programs for reducing fall risk factors (Shigematsu et al., 2018). Patterns suggest benefits to managing lower-extremity function and cognitive impairment for older adults

(Shigematsu et al., 2008), prominent changes in Heart Rate Variability (HRV) parameters and BP after a 24-week SSE intervention for older adults (Riley, 2016), and that SSE is adaptable for training at home (Sebastião, McAuley, Shigematsu, & Motl, 2017). This type of exercise is performed on a thin felt mat (200×100 cm) divided into 32 small squares (25×25 cm) and is two meters in length. Low cost ($< \$5.00$) SSE mats were made for participants as home equipment for this home-based exercise program.

Resistance training. Resistance exercises improve muscular strength and endurance by moving limbs against resistance. Hunter et al. (2004) recommended older adults to perform resistance exercises at 60-80% of a One Repetition Maximum (1RM) for muscle growth (i.e., hypertrophy) twice a week. Additional training sessions can be performed at 40% 1RM for high-velocity contractions to develop power. Training with weights can counteract sarcopenia by inducing muscle growth (Hunter et al., 2004). Ashmead and Bocksnick (2002) assessed pre-and-post intervention results of 10 older adult females (mean age of 66 years) completing 10-weeks of circuit training. The program consisted of upper and lower body exercises designed for muscular endurance working individual muscle groups (Ashmead & Bocksnick, 2002). Exercises were 10-15 repetitions, separated by 20-30 seconds of rest, with a two-minute break between two circuits. The ability to perform more repetitions over 10-weeks was the focus rather than increasing weights provided (Ashmead & Bocksnick, 2002). Therefore, a similar circuit to Ashmead and Bocksnick (2002) was used in pilot-testing with volunteers to choose appropriate exercises. Participants in this research thesis completed additional bodyweight exercises to increase physical activity for this home-based exercise program.

Pilot Study

For this research thesis, a pilot study was conducted to choose appropriate exercises for the home-based exercise program. Two older adult volunteer participants in the community completed aerobic exercises, and upper and lower bodyweight exercises with home equipment. Volunteer participants attended muscle and bone strengthening classes at the Richard Currie Centre, in Fredericton, New Brunswick, Canada. A supervised one-day pilot was completed by both volunteer participants in May 2017 and took place at a volunteers' home and a local church. Vital signs of the volunteer participants were taken before exercise to ensure it was safe to exercise. Volunteer participants were asked three questions about aerobic and resistance exercises:

- i) Which exercises were difficult?
- ii) Which exercises felt unsafe?
- iii) What were your top five exercises?

The aerobic activities were satisfactory, thus furthering the literature review that was attempted to find an appropriate aerobic activity, which was the SSE. The same happened with resistance activities furthering the literature review on appropriate resistance training exercises. The pilot testing showed it was not feasible to go to participants' homes for sessions due to the length of time spent in getting to participant homes and supervising each session. The results prompted furthering the literature to find suitable exercise protocols for unsupervised training. Volunteer participants also completed the interview process and were asked three questions about the interview guide:

- i) Which questions were difficult to understand?
- ii) Which questions made you feel uncomfortable?

iii) Which questions would you like to see modified?

Upon completion of the interview process, questions that generated ‘yes’ or ‘no’ responses were modified to make them open-ended to generate dialogue.

Objectives

After reviewing the literature presented in the sections above, this study aimed to determine the effect of a home-based exercise program for inactive older adults.

Determining effective exercise programs considering foreseeable impacts on health and physical activity due to population ageing, merits this investigation on home-based exercise. As well, little evidence on SSE accompanied with resistance exercises highlight gaps in the literature on overcoming barriers and stimulating enablers. For exercise equipment, this program only requires an SSE mat which will be provided by the research staff.

Therefore, characteristics of this program (e.g., home-based, equipment provided, shorter duration) have been designed to help overcome barriers for older adults based on the literature review. The research question was: Can the combination of SSE and resistance exercises overcome baseline barriers and stimulate enablers, increase physical activity level, and reach the recommended intensity? All forms associated with this study (i.e., Pilot Study Results, Flyer, Information Letter, Consent Form, Safe for Physical Activity, Self-reports, Exercise Protocol, Semi-structured interview Guide, Summary of Results) are presented in appendices.

References - Introductory Chapter

- Allender, S., Cowburn, G., & Foster, C. (2006). Understanding participation in sport and physical activity among children and adults: A review of qualitative studies. *Health Education Research*, 21(6), 826–835. <https://doi.org/10.1093/her/cyl063>
- American College of Sports Medicine. (2014). ACSM's guidelines for exercise testing and prescription. Philadelphia: Lippincott Williams & Wilkins, 9th ed. Retrieved from <http://antoinedl.com/fichiers/public/ACSM-guidelines-2014.pdf>
- Ashe, M. C., Miller, W. C., Eng, J. J., Noreau, L., & Physical Activity and Chronic Conditions Research Team. (2009). Older adults, chronic disease and leisure-time physical activity. *Gerontology*, 55(1), 64–72. <https://doi.org/10.1159/000141518>.
- Ashmead, J. C., & Bocksnick, J. G. (2002). Home-based circuit training for elderly women. *Activities, Adaptation & Aging*, 26(4), 37–41. <https://doi.org/10.1300/J016v26n04>
- Ashworth, N. L., Chad, K. E., Harrison, E. L., Reeder, B. A., & Marshall, S. C. (2005). Home versus center based physical activity programs in older adults. *Cochrane Database of Systematic Reviews*, (1), 1–34. <https://doi.org/10.1002/14651858.CD004017.pub2>
- Baert, V., Gorus, E., Mets, T., Geerts, C., & Bautmans, I. (2011). Motivators and barriers for physical activity in the oldest old: A systematic review. *Ageing Research Reviews*, 10(4), 464–474. <https://doi.org/10.1016/j.arr.2011.04.001>
- Bassett, D. R., Schneider, P. L., & Huntington, G. E. (2004). Physical activity in an old order Amish community. *Medicine and Science in Sports and Exercise*, 36(1), 79–85. <https://doi.org/10.1249/01.MSS.0000106184.71258.32>

- Batsis, J. A., Germain, C. M., Vasquez, E., Zbehlik, A., & Bartels, S. J. (2016). Physical activity predicts higher physical function in older adults: the osteoarthritis initiative. *Journal of Physical Activity and Health, 15*(2), 137–143.
<https://doi.org/10.1001/jamasurg.2014.1086>.
- Belza, B., Walwick, J., Shiu-Thornton, S., Schwartz, S., Taylor, M., & LoGerfo, J. (2004). Older adult perspectives on physical activity and exercise: voices from multiple cultures. *Preventing Chronic Disease, 1*(4), 1-12. Retrieved from http://www.cdc.gov/pcd/issues/2004/oct/04_0028.htm
- Bethancourt, Hillary, J., Rosenberg, Dori, E., Beatty, T., & Arterburn, David, E. (2014). Barriers to and facilitators of physical activity program use among older adults. *Clinical Medicine & Research, 12*(1), 10–20. <https://doi.org/10.3121/cmr.2013.1171>
- Booth, M. L., Bauman, A., & Owen, N. (2002). Perceived barriers to physical activity among older Australians. *Journal of Aging and Physical Activity, 10*(3), 271–280.
<https://doi.org/https://doi.org/10.1123/japa.10.3.271>
- Brady, A. O., & Straight, C. R. (2014). Muscle capacity and physical function in older women: What are the impacts of resistance training? *Journal of Sport and Health Science, 3*(3), 179–188. <https://doi.org/10.1016/j.jshs.2014.04.002>
- Brady, A. O., Straight, C. R., & Evans, E. M. (2014). Body composition, muscle capacity, and physical function in older adults: An integrated conceptual model. *Journal of Aging and Physical Activity, 22*(3), 441–452.
<https://doi.org/10.1123/JAPA.2013-0009>
- Bray, N. W., Smart, R. R., Jakobi, J. M., & Jones, G. R. (2016). Exercise prescription to reverse frailty. *Applied Physiology, Nutrition, and Metabolism, 41*(10), 1112–1116.

<https://doi.org/10.1139/apnm-2016-0226>

Buford, T. W., Anton, S. D., Clark, D. J., Higgins, T. J., & Cooke, M. B. (2015).

Optimizing the benefits of exercise on physical function in older adults. *American Academy of Physical Medicine and Rehabilitation*, 6(6), 528–543.

<https://doi.org/10.1016/j.pmrj.2013.11.009>.

Canadian Fitness and Lifestyle Research Institute (n.d.). *About CFLRI: Who We Are*.

Ottawa. Retrieved from <https://www.cflri.ca/who-we-are>

Carriere, Y., Keefe, J., Légaré, J., Lin, X., Rowe, G., Martel, L., & Rajbhandary, S.

(2008). Projecting the future availability of the informal support network of the elderly population and assessing its impact on home care services. *Demography Division*. No. 009. Statistics Canada Catalogue No. 91F0015M. 1–24. Retrieved

from

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.550.8865&rep=rep1&type=pdf>

Clegg, A. P., Barber, S. E., Young, J. B., Forster, A., & Iliffe, S. J. (2012). Do home-

based exercise interventions improve outcomes for frail older people? Findings from a systematic review. *Reviews in Clinical Gerontology*, 22, 68–78.

<https://doi.org/10.1017/S0959259811000165>

Coghill, N., & Cooper, A. R. (2009). Motivators and de-motivators for adherence to a

program of sustained walking. *Preventive Medicine*, 49(1), 24–27.

<https://doi.org/10.1016/j.ypmed.2009.04.017>

Cohen-Mansfield, J., Marx, M. S., & Guralnik, J. M. (2003). Motivators and barriers to

exercise in an older community-dwelling population. *Journal of Aging and Physical*

Activity, 11(2), 242–253. <https://doi.org/10.1123/japa.11.2.242>

Cohen-Mansfield, J., Marx, M. S., Biddison, J. R., & Guralnik, J. M. (2004). Socio-environmental exercise preferences among older adults. *Preventive Medicine*, 38(6), 804–811. <https://doi.org/10.1016/j.ypmed.2004.01.007>

Colley, R. C., Garriguet, D., Janssen, I., Craig, C. L., Clarke, J., & Tremblay, M. S. (2011). Physical activity of Canadian adults: Accelerometer results from the 2007 to 2009 Canadian Health Measures Survey. *Health Reports*. No. 1. Statistics Canada Catalogue No. 82-003-XPE. 1–8. Retrieved from https://www.researchgate.net/profile/Ian_Janssen/publication/284685407_Physical_activity_of_Canadian_adults_accelerometer_results_from_the_2007_to_2009_Canadian_Health_Measures_Survey_Health_ReportsStatistics_Canada_Canadian_Centre_For_Health_InformationRapports_Sur_La_S/links/568bb7ba08ae1e63f1fdd639/Physical-activity-of-Canadian-adults-accelerometer-results-from-the-2007-to-2009-Canadian-Health-Measures-Survey-Health-Reports-Statistics-Canada-Canadian-Centre-For-Health-InformationRapports-Sur-L.pdf

Costello, E., Kafchinski, M., Sullivan, P., & Vrazel, J. (2011). Motivators, barriers, and beliefs regarding physical activity in an older adult population. *Journal of Geriatric Physical Therapy*, 34(3), 138–147. <https://doi.org/10.1519/JPT.0b013e31820e0e71>

Coughlin, T. A., McBride, T. D., Perozek, M., & Liu, K. (1992). Home care for the disabled elderly: predictors and expected costs. *Health Services Research*, 27(4), 453–479.

Covinsky, K. E., Palmer, R. M., Fortinsky, R. H., Counsell, S. R., Stewart, A. L., Kresevic, D., ... Landefeld, C. S. (2003). Loss of independence in activities of daily

- living in older adults hospitalized with medical illnesses: Increased vulnerability with age. *Journal of the American Geriatrics Society*, 51(4), 451–458.
<https://doi.org/10.1046/j.1532-5415.2003.51152.x>
- CSEP. (2019). *CSEP-PATH Physical Activity Training for Health (2nd ed.)*. Ottawa, ON: Canadian Society for Exercise Physiology.
- Dale, L. P., LeBlanc, A. G., Orr, K., Berry, T., Deshpande, S., Latimer-Cheung, A. E., ... Faulkner, G. (2016). Canadian physical activity guidelines for adults: are Canadians aware? *Applied Physiology, Nutrition, and Metabolism*, 41(9), 1008–1011.
<https://doi.org/10.1139/apnm-2016-0115>
- Dalleck, L., & Dalleck, A. (2008). The ACSM exercise intensity guidelines for cardiorespiratory fitness: Why the misuse. *Journal of Exercise Physiology*, 11(4), 1–11. <https://doi.org/10.1519/JSC.0b013e3181874564>
- Day, M. L., McGuigan, M. R., Brice, G., & Foster, C. (2004). Monitoring exercise intensity during resistance training using the session RPE scale. *The Journal of Strength and Conditioning Research*, 18(2), 353–358. <https://doi.org/10.1519/R-13113.1>
- Donat, H., & Ozcan, A. (2007). Comparison of the effectiveness of two programmes on older adults at risk of falling: Unsupervised home exercise and supervised group exercise. *Clinical Rehabilitation*, 21(3), 273–283.
<https://doi.org/10.1177/0269215506069486>
- Donnelly, J. E., Blair, S. N., Jakicic, J. M., Manore, M. M., Rankin, J. W., & Smith, B. K. (2009). Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Medicine and Science in Sports and Exercise*,

41(2), 459–471. <https://doi.org/10.1249/MSS.0b013e3181949333>

Fisken, A., Keogh, J. W. L., Waters, D. L., & Hing, W. A. (2015). Perceived benefits, motives, and barriers to aqua-based exercise among older adults with and without osteoarthritis. *Journal of Applied Gerontology*, 34(3), 377–396.

<https://doi.org/10.1177/0733464812463431>

Frontera, W. R., Hughes, V. A., Lutz, K. J., & Evans, W. J. (1991). A cross-sectional study of muscle strength and mass in 45- to 78-yr-old men and women. *Journal of Applied Physiology*, 71(2), 644–650. <https://doi.org/10.1152/jappl.1991.71.2.644>

Gay, J. L., Buchner, D. M., & Schmidt, M. D. (2016). Dose-response association of physical activity with HbA1c: Intensity and bout length. *Preventive Medicine*, 86(1), 58–63. <https://doi.org/10.1016/j.ypmed.2016.01.008>

Gonzalez, B. C. S., & Jirovec, M. M. (2001). Elderly Mexican women's perceptions of exercise and conflicting role responsibilities. *International Journal of Nursing Studies*, 38(1), 45–49. [https://doi.org/http://dx.doi.org/10.1016/S0020-7489\(00\)00062-6](https://doi.org/http://dx.doi.org/10.1016/S0020-7489(00)00062-6)

Hardcastle, S., & Taylor, A. H. (2001). Looking for more than weight loss and fitness gain: Psychosocial dimensions among older women in a primary-care exercise-referral program. *Journal of Aging & Physical Activity*, 9(3), 313–328. <https://doi.org/10.1123/japa.9.3.313>

Heath, M., Shellington, E., Titheridge, S., & Gill, D. P. (2017). A 24-week multi-modality exercise program improves executive control in older adults with a self-reported cognitive complaint: Evidence from the Antisaccade Task, 56, 167–183. <https://doi.org/10.3233/JAD-160627henrnandes>

- Helbostad, J. L., Sletvold, O., & Moe-Nilssen, R. (2004). Home training with and without additional group training in physically frail old people living at home: Effect on health-related quality of life and ambulation. *Clinical Rehabilitation*, 18(5), 498–508. <https://doi.org/10.1191/0269215504cr761oa>
- Hunter, G. R., McCarthy, J. P., & Bamman, M. M. (2004). Effects of resistance training on older adults. *Journal of Sport Medicine*, 34(5), 329–348. <https://doi.org/10.2165/00007256-200434050-00005>
- Kasper, J. D., Chan, K. S., & Freedman, V. A. (2017). Measuring Physical Capacity. *Journal of Aging and Health*, 29(2), 289–309. <https://doi.org/10.1177/0898264316635566>
- Kemper, P. (1992). The use of formal and informal home care by the disabled elderly. *Health Services Research*, 27(4), 421–451. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1069888&tool=pmcentrez&rendertype=abstract>
- King, A. C., Haskell, W. L., Young, D. R., Oka, R. K., & Stefanick, M. L. (1995). Long-term effects of varying intensities and formats of physical activity on participation rates, fitness, and lipoproteins in men and women aged 50 to 65 years. *Journal of the American Heart Association*, 91(10), 2596–2604. <https://doi.org/10.1161/01.CIR.91.10.2596>
- Kruger, J., Carlson, S. A., & Kohl, H. W. (2007). Fitness facilities for adults: Differences in perceived access and usage. *American Journal of Preventive Medicine*, 32(6), 500–505. <https://doi.org/10.1016/j.amepre.2007.02.003>
- LeBlanc, A. G., Berry, T., Deshpande, S., Duggan, M., Faulkner, G., Latimer-Cheung, A.

- E., ... Tremblay, M. S. (2015). Knowledge and awareness of Canadian Physical Activity and Sedentary Behaviour Guidelines: a synthesis of existing evidence. *Applied Physiology Nutrition and Metabolism*, 40(7), 716–724.
<https://doi.org/10.1139/apnm-2014-0464>
- Lee, I. M., & Buchner, D. M. (2008). The importance of walking to public health. *Medicine and Science in Sports and Exercise*, 40(7), 512–518.
<https://doi.org/10.1249/MSS.0b013e31817c65d0>
- Lees, F. D., Clark, P. G., Nigg, C. R., & Newman, P. (2005). Barriers to exercise behavior among older adults: A focus-group study. *Journal of Aging and Physical Activity*, 13(1), 23–33. <https://doi.org/10.1123/japa.13.1.23>
- Loprinzi, P. D., & Cardinal, B. J. (2013). Association between biologic outcomes and objectively measured physical activity accumulated in >10-minute bouts and <10-minute bouts. *American Journal of Health Promotion*, 28(4), 259–268.
<https://doi.org/10.4278/ajhp.110916-QUAN-348>
- Luukinen, H., Lehtola, S., & Jokelainen, J. (2006). Prevention of disability by exercise among the elderly: A population-based, randomized, controlled trial. *Scandinavian Journal of Primary Health Care*, 24(4), 199–205.
<https://doi.org/10.1080/02813430600958476>
- Madureira, M. M., Bonfá, E., Takayama, L., & Pereira, R. M. R. (2010). A 12-month randomized controlled trial of balance training in elderly women with osteoporosis: Improvement of quality of life. *Maturitas*, 66(2), 206–211.
<https://doi.org/10.1016/j.maturitas.2010.03.009>
- Mangione, K. k., Craik, R. L., Tomlinson, S. S., & Palombario, K. M. (2005). Can

- elderly patients who have had a hip fracture perform moderate to high intensity exercise at home? *Journal of Physical Therapy*, 85(8), 727–739. Retrieved from <https://login.proxy.hil.unb.ca/login?url=https://search-proquest-com.proxy.hil.unb.ca/docview/223110807?accountid=14611>
- Martin, J. T., Wolf, A., Moore, J. L., Rolenz, E., DiNinno, A., & Reneker, J. C. (2013). The effectiveness of physical therapist-administered group-based exercise on fall prevention: A systematic review of randomized controlled trials. *Journal of Geriatric Physical Therapy*, 36(4), 182–193.
<https://doi.org/10.1519/JPT.0b013e3182816045>
- McDermott, M., & Polonsky, T. S. (2016). Home-based exercise: A therapeutic option for peripheral artery disease. *Journal of the American Heart Association*. 134(16), 1127–1129. <https://doi.org/10.1161/CIRCULATIONAHA.116.023691>
- McGregor, D. E., Carson, V., Palarea-Albaladejo, J., Dall, P.M., Tremblay, M.S., & Castin, S. F. M., (2018). Compositional analysis of the associations between 24-h movement behaviours and health indicators among adults and older adults from the Candian Health Measure Survey. *International Journal of Environmental Research and Public Health*, 15(8), 1-14. <http://dx.doi.org/10.3390/ijerph15081779>
- Nemček, D., & Simon, A. (2016). Effect of 3-months home-based exercise program on changes of cognitive functioning in older adults living in old people's home. *Acta Facultatis Educationis Physicae Universitatis Comenianae*, 56(1), 16–29.
<https://doi.org/10.1515/afepuc-2016-0002>
- O'Brien, M., Robinson, S. A., Frayne, R., Mekary, S., Fowles, J. R., & Kimmerly, D. S. (2018). Achieving Canadian Physical Activity Guidelines is associated with better

- vascular function independent of aerobic fitness and sedentary time in older adults. *Applied Physiology, Nutrition, and Metabolism*, 43(10), 1003–1009. Retrieved from <https://tspace.library.utoronto.ca/bitstream/1807/90431/1/apnm-2018-0033.pdf>
- O'Neill, K., & Reid, G. (1991). Perceived barriers to physical activity by older adults. *Canadian Journal of Public Health*, 82(6), 392–396. <https://doi.org/10.1111/j.1365-2702.2009.02990>
- Paterson, D. H., Jones, G. R., & Rice, C. L. (2007). Ageing and physical activity: evidence to develop exercise recommendations for older adults. *Canadian Journal of Public Health*, 98(2), 69–108. <https://doi.org/10.1139/H07-111>
- Paterson, D. H., & Warburton, D. E. R. (2010). Physical activity and functional limitations in older adults: A systematic review related to Canada's physical activity guidelines. *International Journal of Behavioral Nutrition and Physical Activity*, 7(38), 1–22. <https://doi.org/10.1186/1479-5868-7-38>
- Riley, C. E. (2016). *The Effect of a Square-Stepping Exercise Intervention on Heart Rate Variability in Older Individuals with Type 2 Diabetes and Subjective Cognitive Complaints* (Master's thesis, The University of Western Ontario, Faculty of Kinesiology, 2020). Retrieved from <https://ir.lib.uwo.ca/etd/4117%0AThis>
- Saligheh, M., McNamara, B., & Rooney, R. (2016). Perceived barriers and enablers of physical activity in postpartum women: A qualitative approach. *BMC Pregnancy and Childbirth*, 16(1), 1–8. <https://doi.org/10.1186/s12884-016-0908-x>
- Schneider, J. K., Eveker, A., Bronder, D. R., Meiner, S. E., & Binder, E. F. (2003). Exercise training program for older adults incentives and disincentives for participation. *Journal of Gerontological Nursing*, 29(9), 21–31.

<https://doi.org/https://doi.org/10.3928/0098-9134-20030901-06>

Schutzer, K. A., & Graves, B. S. (2004). Barriers and motivations to exercise in older adults. *Preventive Medicine*, 39(5), 1056–1061.

<https://doi.org/10.1016/j.ypmed.2004.04.003>

Sebastião, E., McAuley, E., Shigematsu, R., & Motl, R. W. (2017). Feasibility study design and methods for a home-based, square-stepping exercise program among older adults with multiple sclerosis: The SSE-MS project. *Contemporary Clinical Trials Communications*, 7, 200–207. <https://doi.org/10.1016/j.conctc.2017.07.012>

Shigematsu, R., & Okura, T. (2006). A novel exercise for improving lower-extremity functional fitness in the elderly. *Aging Clinical and Experimental Research*, 18(3), 242–248. <https://doi.org/1464> [pii]

Shigematsu, R., Okura, T., & Nakata, Y. (2014). Effects of exercise program requiring attention, memory and imitation on cognitive function in elderly persons: A non-randomized pilot study. *Journal of Gerontology & Geriatric Research*, 3(2). <https://doi.org/10.4172/2167-7182.1000147>

Shigematsu, R., Okura, T., Nakagaichi, M., Tanaka, K., Sakai, T., Kitazumi, S., & Rantanen, T. (2018). Square-stepping exercise and fall risk factors in controlled trial: A single blind, randomized controlled trial. *Journal of Gerontology*, 63A(1), 76–82. Retrieved from <https://academic.oup.com/biomedgerontology/article-abstract/63/1/76/672319>

Shigematsu, R., Okura, T., Sakai, T., & Rantanen, T. (2008). Square-stepping exercise versus strength and balance training for fall risk factors. *Aging Clinical and Experimental Research*, 20(1), 19–24. <https://doi.org/4378> [pii]

- Simek, E. M., McPhate, L., & Haines, T. P. (2012). Adherence to and efficacy of home exercise programs to prevent falls: A systematic review and meta-analysis of the impact of exercise program characteristics. *Preventive Medicine*, 55(4), 262–275. <https://doi.org/10.1016/j.ypmed.2012.07.007>
- Simek, E. M., McPhate, L., Hill, K. D., Finch, C. F., Day, L., & Haines, T. P. (2015). What are the characteristics of home exercise programs that older adults prefer?: A cross-sectional study. *American Journal of Physical Medicine & Rehabilitation*, 94(7), 508–521. <https://doi.org/10.1097/PHM.0000000000000275>
- Statistics Canada. (2018). Population projections for Canada (2018 to 2068), provinces and territories (2018 to 2043). *Population Projections for Canada, Provinces and Territories*. Statistics Canada Catalogue No. 91-520-X. Retrieved from <https://www150.statcan.gc.ca/n1/pub/91-520-x/91-520-x2019001-eng.htm>
- Tjepkema, M. (2005). Measured obesity adult obesity in Canada: Measured height and weight. *Analytical Studies and Reports*. Statistics Canada Catalogue No. 82-620-MWE2005001. Retrieved from <https://www150.statcan.gc.ca/n1/pub/82-620-m/2005001/article/adults-adultes/8060-eng.htm>
- Tremblay, M., Shephard, R. J., Brawley, L. R., Cameron, C., Craig, C. L., Duggan, M., ... Zehr, L. (2007). Physical activity guidelines and guides for Canadians: facts and future. *Canadian Journal of Public Health*, 98, 218–224. <https://doi.org/10.1139/H07-125>
- Tremblay, M., Warburton, D. E., Janssen, I., Paterson, D. H., Latimer, A. E., Rhodes, R. E., ... Duggan, M. (2011). New Canadian physical activity guidelines. *Applied Physiology, Nutrition, and Metabolism*, 36(1), 36–58. <https://doi.org/10.1139/h11->

- Tudor-locke, C., Craig, C. L., Aoyagi, Y., Bell, R. C., Croteau, K. A., Bourdeaudhuij, I. De, ... Blair, S. N. (2011). How many steps/day are enough? For older adults and special populations. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 1–19. <https://doi.org/10.1186/1479-5868-8-80>
- Vanhees, L., Geladas, N., Hansen, D., Koudi, E., Niebauer, J., Reiner, Ž., ... Börjesson, M. (2012). Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular risk factors: recommendations from the EACPR. *European Journal of Preventive Cardiology*, 19(5), 1005–1033. <https://doi.org/10.1177/1741826711430926>
- Varma, V. R., Tan, E. J., Wang, T., Xue, Q.-L., Fried, L. P., Seplaki, C. L., ... Carlson, M. C. (2014). Low-intensity walking activity is associated with better health. *Journal of Applied Gerontology*, 33(7), 870–887. <https://doi.org/10.1177/0733464813512896>
- WHO. (2012). *WHO: Global Recommendations on Physical Activity for Health*. Retrieved from https://www.who.int/dietphysicalactivity/factsheet_recommendations/en/

Article

POTENTIAL BENEFITS OF A NOVEL HOME-BASED EXERCISE PROGRAM FOR INACTIVE OLDER ADULTS: AN EXPLORATORY CASE STUDY

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Abstract

This study aimed to influence current barriers and enhance enablers to exercise more regularly by proposing a 3-week home exercise program using the square-stepping exercise (SSE) and bodyweight exercise without specialized equipment. Using embedded mixed methods, 10 inactive older adults completed the intervention in conjunction with follow-up interviews. Barriers that were reached during the intervention were being uncomfortable in a gym, body image, and enablers were the use of home equipment and easy access. The average total steps/day increased by 27% ($p=0.02$), and moderate intensity was reached in 80% of participants when performing the SSE. The exercise program addresses common barriers to exercise and could increase the physical activity level of inactive older adults especially for those intimidated by a fitness facility setting and those concerned with their body image.

Keywords: Aging, Physical function, Inactivity

Résumé

Cette étude visait à explorer si un programme d'exercices sans équipement spécialisé, utilisation le pas en carré influence les barrières et les facilitateurs à être actif régulièrement pour des gens âgées considérées physiquement inactifs. Un total de 10 personnes âgées ont participé à l'intervention une entrevue. Les résultats montrent que le nombre total moyen de pas par jour a augmenté de 27% ($p = 0.02$). Les barrières atteintes durant le programme étaient le fait de se sentir inconfortable dans un centre d'entraînement, et la perception de l'image corporelle. Les facilitateurs atteints sont le fait d'utiliser de l'équipement facilement accessible et l'accessibilité du programme. Le nombre de pas par jour a augmenté de 27% ($p=0.02$) et 80% des participants ont atteint l'intensité modérée dans la partie aérobie du programme. Le programme propose adresse des barrières communes et pourrait augmenter le niveau d'activité physique des gens âgés inactif.

Mots-clés: Vieillissement, Fonction physique, Inactivité

Introduction

Population ageing refers to the age of all Canadians increasing especially the baby-boom cohort, which exceeds the number of younger people (Statistics Canada, 2018). Most countries are aiming to increase the number of older adults who remain independent. To reach this goal, exercise is a suitable option that reduces the risk of chronic conditions, frailty, hospital stays, and mortality (Covinsky et al., 2003). Moderate intensity is typically the minimum intensity recommended during aerobic exercise by many international and national agencies to optimize health and functional benefits (Bushman, 2019; Donnelly et al., 2009; Tremblay et al., 2011; WHO, 2012). Unfortunately, according to Colley et al. (2011), less than 15% of older adults meet these physical activity recommendations. Uncovering barriers and enablers to exercise for inactive older adults may help provide a suitable exercise strategy, which is the basis of this study.

Previous research has identified several barriers and enablers to a regular practice of physical activities. Such barriers to exercise include lack of time (LeBlanc et al., 2015), pain/injury (Booth, Bauman & Owen, 2002; Cohen-Mansfield et al., 2003; Costello et al., 2011; Schutzer & Graves, 2004) and lack of motivation (Cohen-Mansfield et al., 2003; Costello et al., 2011). Conversely, some enablers identified in previous research include perception of health benefits (Allender, Cowburn, & Foster, 2006; Coghill & Cooper, 2009; Cohen-Mansfield, Marx & Guralnik, 2003; Costello et al., 2011; Schutzer & Graves, 2004), social support (Allender et al., 2006; Cohen-Mansfield et al., 2003; Costello et al., 2011; Schutzer & Graves, 2004), and enjoyment/fun (Allender et al., 2006; Baert et al., 2011; Cohen-Mansfield et al., 2003; Costello et al.,

2011; Schutzer & Graves, 2004). According to Vanhees et al. (2012) strategies such as home-based exercise can help mitigate the majority of barriers.

Home-based exercise offers the opportunity to complete exercise every day using a flexible schedule and at a low cost (Ashworth et al., 2005). An example of a successful home-based resistance exercise consisting of body exercises designed for muscular endurance is circuit training (Ashmead & Bocksnick, 2002). Another example of a home-based exercise is Square-Stepping Exercise (SSE) for aerobic activity. SSE poses a dualistic function as it combines both a cognitive aspect (memory task) and physical activity. This exercise was developed by Shigematsu and Okura (2006) in Japan and deemed suitable for home-based exercise (Sebastião et al., 2017). SSE is performed on a thin felt mat divided into small squares that is two meters in length, making it an unobtrusive piece of equipment to be used in the home. Research on SSE has shown effective results in strength and balance training (Shigematsu, Okura, Sakai, & Rantanen, 2008), that it is more effective than walking programs to reduce fall risk factors (Shigematsu et al., 2018), and could even improve cognitive impairment when changing patterns (Shigematsu et al., 2008). Despite the promises offered by the SSE, the intensity reached while performing the SSE is unknown.

After reviewing the literature to combat adverse consequences to physical inactivity, this home-based exercise program was designed to promote physical activity to show that being active does not need to be in a fitness facility. When considering the impacts of health and physical activity in tandem with the average age of the population increasing, it is important to provide as many suitable options for exercise. This study aimed to determine the effect of a home-based exercise program for inactive older adults

to overcome barriers and stimulate enablers for regular physical activity at the recommended intensity. The research question was: Can the combination of SSE and resistance exercises overcome baseline barriers to exercise or stimulate enablers, increase physical activity level, and reach the recommended intensity?

Methods

To answer the research question, this study used a case study methodological approach. This approach was deemed to be appropriate as it provides, “an empirical inquiry that investigates a contemporary phenomenon (the “case”) within its real-world context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2003, p. 13). Thus, cases (i.e., participants) are real-world examples understood through observation; baseline characteristics offered a similar context.

By taking this methodological approach, Embedded mixed methods was used for the data collection process. More specifically, Ivankova and Cresswell (2009), described Embedded mixed methods as one data set providing a supportive and secondary role in a study based primarily in the other type of data. This is useful to intertwine the quantitative data (i.e., intervention) with a qualitative methodology (i.e., case study) while answering the research questions.

Participants. Participants recruited were from a small city and advertising was done using flyers in local public facilities and newspapers. Patton (2002) defined purposeful sampling as identification of information-rich cases to offer the greatest experience. A purposeful sampling approach allows for,

information-rich cases offering an in-depth study. Information-rich cases are those from which one can learn a great deal about issues of central importance to

the purpose of inquiry, thus the term purposeful sampling. Studying information-rich cases yields insights and in-depth understanding rather than empirical generalizations. (Patton, 2002, p.273).

Therefore, the selected sample was purposefully inactive older adults. As well, the geographical location of the study attracted many participants that had post-secondary education and high-income level. Each case contributed a large amount of information central to the research objectives.

To reduce sample heterogeneity, the inclusion criteria was the following:

- i) Age 65-80;
- ii) Not receiving any kind of home care services (formal or informal);
- iii) Informed safe to exercise using the Get Active Questionnaire (CSEP, 2019);
- iv) Resting heart rate <99 and blood pressure <160/90; and
- v) Average total steps/day <10,000 measured over seven days;

The Get Active Questionnaire was used to help ensure it was safe to become more physically active (CSEP, 2019).

Exercise protocol. The goal of participants was to accumulate ≥ 150 -minutes of SSE with two sessions of resistance exercises per week. A similar circuit to Ashmead and Bocksnick (2002) was used, but without dumbbells which emphasized five main muscle groups: quadriceps femoris, pectoralis major, biceps brachii, triceps brachii, and calf (gastrocnemius and soleus). The exercises were arm curl, squat to a chair, triceps dip, calf raise, and wall push-ups. Participants were asked to include weight where necessary (e.g., bag of book for arm curls), exercises were 10-15 repetitions, separated by 20-30 seconds

of rest, with a two-minute break between two circuits. Resistance exercise was completed in about 10 minutes.

An SSE mat was provided, and all exercise sessions began with SSE, which was completed before resistance exercise. SSE includes forward, backward, lateral and oblique steps; only one SSE pattern was used for all aerobic activity (Figure 1). SSE was performed on a mat (200 × 100 cm) divided into 32 small squares (25 × 25 cm) two meters in length. Typically, SSE is completed in groups and participants travel forward on the mat and circle around the mat to complete additional sequences. Participants in this study were asked to complete the sequences as they preferred such as back and forth or circling back to the starting point. Positioning the mat close to a wall for support was asked as well. Low cost (<\$5.00) SSE mats were made for participants using white Bristol board paper and black permanent marker.

In total, there were four visits and all visits took place in the same designated space mimicking a home setting where the only requirement was a flat floor. The remaining intervention criteria were the responsibility of the study participants to complete at home. Below is a description of measures completed over four visits (data collection/intervention):

Visit one (60-minutes). Participants read and signed a consent form to participate. Resting Heart Rate (HR) and Blood Pressure (BP) was measured using an automatic blood pressure cuff (Omron, blood pressure monitor, Kyoto, Japan) for safety purposes. Height and body weight were measured using a stadiometer (Seca, stadiometer, Hamburg Germany). Four Senior Fitness Tests (SFT) were 2-minute step test (endurance), 8 foot up and go (agility), and squat to chair (lower body strength) and arm curl (upper body

strength). A description of tests is within the Senior Fitness Test Manual by Rikli and Jones (2013). The unipedal test was used to measure balance. Participants self-reported a level of importance (e.g., 1: not very important to 10: very important) on 25 barriers to exercise with a maximum score of 250 (CSEP, 2019). Participants answered additional questions: What is your ethnicity, level of education obtained, and personal income? Education options were High School, Diploma, or University degree; personal incomes values were less than 20,000, 20,000 to 34,999, 35,000 to 49,999, 50,000 to 74,999, 75,000 to 99,999, or N/A. Participants were given a Step RX pedometer (Steps Count, StepRX, Ontario, Canada) to measure total steps and total time spent at Moderate to Vigorous Physical Activity (MVPA). The threshold for MVPA was 100 steps or above per minute (Marshall et al., 2009) with a minimum of four consecutive days of wear-time to be considered as a valid measure (Hart, Swartz, Cashin, & Strath, 2011).

Visit two (45-minutes). Before starting exercise, participants returned Step RX pedometer. The laboratory staff confirmed their eligibility criteria. During the visit, participants were given an SSE mat to bring home and practiced the home-based exercise program. The session of SSE was 10-minutes and approximately 10-minutes for resistance training. The session might have been longer or shorter based on the number of questions asked by the participant.

Visit three (45-minutes). Before the last week of intervention, participants practiced the home-based exercise program. The session of SSE was 10-minutes and approximately 10-minutes for resistance training. Fewer questions were asked as research staff wanted to observe how exercises were being completed after completing the exercise program for 2-weeks. Participants were given a Step RX pedometer again. This

device was worn again at the hip for a minimum of four consecutive days while having access to the SSE mat and resistance training exercises.

Visit four (90-minutes). Participants returned the Step RX pedometer and completed a 10-minute SSE session and two circuits of resistance training. Heart rate (HR) was registered via the HR sensor (Polar H7, Woodbury, New York, USA). To estimate the exercise intensity, HR reserve (HRR): $(\text{max HR} - \text{resting HR}) \times .40 + \text{resting HR}$; max HR was calculated by $220 - \text{age}$. The average HR while performing the SSE was recorded during minutes 5 to 10. To reach moderate intensity 40% of HRR had to be achieved (ACSM, 2014). No feedback from the staff was made. Then, participants completed a 30-60-minute interview to understand their experience with the home-based exercise program.

Interview process. After completing SSE during the fourth visit, each participant was involved in a 30 to 60-minute interview. Interviews were done face-to-face. Semi-structured interviews with open-ended questions were used to allow participants to respond freely, provide descriptions, and understand participant perceptions in more detail (Datko, 2015). A total of 14 open-ended questions were asked. By taking this approach, new ideas emerged to gain a deeper understanding of the participant's experience. The general areas of questions posed related to personal experiences with becoming more physically active with the program. All interviews were audio-recorded and transcribed with participant permission. Participant's names were changed to ensure confidentiality (e.g., case1, case2, case3). Data saturation is often used to determine when to end conducting interviews (Guest, Bunce, & Johnson, 2006). This point was reached when the minimum of 10 participants were sampled.

Data analysis. The analysis employed the framework method to handle results between the quantitative and qualitative findings for interpretation; the framework analysis consists of five stages (Ritchie & Lewis, 2003). The framework method developed by Ritchie and Lewis (2003) was used to analyse data for a matrix output. Typically, the method originated in large-scale social policy research but has become more popular in health research (Gale, Heath, Cameron, Rashid, & Redwood, 2013). The analysis is suitable for both qualitative and quantitative researchers providing spreadsheet format, and clear steps to follow for qualitative exploration (Nicola et al., 2013). However, caution is recommended as data sets should cover similar topics and be overseen by an experienced researcher. The matrix output offers interconnected data for charting quantitative and qualitative data which includes rows (cases), columns (codes), and ‘cells’ to summarize this data.

Before the five stages of the framework analysis could begin quantitative measures including baseline characteristics and pre-post required analysis were taken. The Wilcoxon Signed Ranks Test was used to quantify the change pre-post on continuous variables. Below is a description of each stage in the framework analysis:

Stage 1 familiarisation. Interview transcriptions were reviewed while listening to the corresponding audio file to ensure content accuracy.

Stage 2 theme identification. Leximancer 4.0 was used to detect themes and concepts that emerged from the interviews (i.e., coding). The computer program’s generation of themes and concepts were the starting point. A manual review was then conducted for each interview transcript to compare with the computer generation of themes. The researcher recognized emerging themes in the data. Nvivo 12 stored each

transcript, and transcripts were read several times before marking reoccurring phrases and keywords to make themes.

Stage 3 indexing. The researcher met with supervisors involved to compare labels. Once themes were created, a visual analysis of each case's referenced phrases and keywords were reread. Portions of quantitative data that corresponded with a particular theme were identified.

Stage 4 charting. Data lifted from the original data sets was rearranged accordingly.

Stage 5 mapping and interpretation. Combining data sets provided verbal insight towards quantitative outcomes. This was done to interpret and discuss specific cases, perceptions, experiences, patterns, and connections in search of explanation and meaning.

Results

Quantitative data. Demographic information on participants is presented in Table 1. The sample included 10 participants; 60% female. The average age was 71 years with a body mass index (BMI) of 30 kg/m². All participants completed at least a high school diploma; four participants had obtained a university degree. Five participants had personal incomes above \$35,000 per year. Physical function measurements show that most participants were above average compared to age-sex norms.

Participants self-reported a level of importance (1-10) on 25 barriers to exercise with a maximum score of 250 (Table 2). The most important barriers were: lack of motivation (6.2), lack of energy (4.8), other priorities (4.7), uncomfortable or intimidated in a gym (4.7), lack of exercise programs suitable for my level (4.7), keep talking myself out of it (4.3), and how I see my body (4.3). Most of the participants increased physical

activity when comparing the last week of the intervention and baseline (Table 3). The average total steps/day increased by 27% from 5878 to 7495-steps/day ($p=0.02$), but no difference was observed in daily MVPA (Table 4). Figure 2 presents the average HRR for each participant when supervised performing 10-minutes of the SSE at week 3. A total of 8 of 10 participants reached moderate intensity.

Qualitative data. After the framework analysis, five barriers and five enablers for cases were represented in the program based on several common references. Table 4 presents barriers and Table 5 presents to enablers. Actual transcribed quotations are included in these tables. Interestingly, the most important barrier was lack of motivation which may have been modified by participants during the intervention. Case 1 noted that “10-minutes is easy, when I first started it felt a little difficult, in the beginning, some days I was at 10-minutes then I increased it to 15 to 20-minutes and 10-minutes, in fact, started to become easy [Achievable Goal]”. Case 8 added said, “It is nice, you don’t really need any special equipment. In the hall there’s a treadmill and a bike, at home, I keep my eye on that. But you can just stand up to the wall and do it... [Home equipment]”. Finally, Case 5 stated that “The fact that the program is all set up and it’s not difficult to do on your own [Convenience]”.

The simplicity of the program presented a non-daunting task that facilitated participants to adhere to exercise regardless of the perceived lack of motivation. It was simple to do and can be done anywhere in such a short amount of time. As well, the provided home equipment such as the SSE mat and resistance training exercises was convenient and at no associated cost to all participants. Acquiring equipment at no cost or of little cost can have a dramatic effect on physical activity. The SSE mat required a

certain level of concentration described as too much focus needed to perform the exercise (e.g., Case 2, Case 3). Regarding resistance training, all participants performed circuits during the last visit, however, some cases adjusted at home. For instance, one skipped an exercise due to shoulder pain.

Table 6 provides an overview of cases with high and low average total steps/day with qualitative results which is the framework matrix. The matrix summarizes the connections of self-reported barriers, senior fitness, pre-post average total steps/day, intensity, and themes sorted by row. The first two rows offer a unique representation of cases with the lowest average total steps/day; the last two rows represent cases that reached >10,000-steps. From the first row, Case 8 had a low average total steps/day and discussed some limitations that were experienced,

Just on the mat, things that came to my mind, just don't overdo it. Yes, keep a rhythm, but you don't have to go fast. When you're a beginner you start slowly. And I think it was going around and around. I was getting dizzy at the end; I couldn't do the turn around and come back... its part of the reason, too much at once. If I just cut down and do 5-minutes and go to my stretches and maybe a week or two later, I add another minute and I can work up to 10-minutes.

As well, Case 2 had a low average total steps/day and had difficulty balancing. They also perceived a barrier total of 118/250 based on the level of importance. Case 2 elaborates on a negative previous experience in their 50's while playing soccer where they tore some tendons in their knee,

My regular routine is sedentary, I do a lot of work at the computer and read books a lot. We live in the country, I want to spend more time outside, but the bugs are a

problem, the ground is a problem as well. I have a poor sense of balance, I don't really enjoy walking, I'm always looking at the ground. We have a treadmill at home to have me do exercise, if I'm listening to a food radio program or watching TV programs, I'll go exercise, but the reception is poor, I have a lot of reasons I come up with for not doing exercise. That's why I wanted to come here to be more active in the home without involving much equipment.

To reduce data, the framework matrix summarized information on Cases 2 and 8 (low average steps/day) and Cases 4 and 5 (>10,000 steps/day) to compare, contrast, and search for patterns.

Discussion

This study aimed to determine the effect of a home-based exercise program for inactive older adults to influence current barriers and stimulate enablers for regular physical activity at the recommended intensity. As well, it evaluated a novel home-based exercise program for inactive older adults. This study shows that the proposed program is targeting some barriers and enablers and can lead to greater exercise at moderate intensity. However, like any exercise program, it can be more suited for some than others. Our results show that inactive older adults who benefit from this program are those intimidated by a fitness facility setting and those concerned with their body image.

Barriers. The results from this current study demonstrate that some main barriers commonly reported by older adults (i.e., lack of time, pain/injury, lack of social support, poor health/illness, lack of knowledge; Booth et al., 2002; Coghill & Cooper, 2009; Cohen-Mansfield et al., 2003; Costello et al., 2011) were not observed to be of high importance in the sample when self-reporting perceived barriers to exercise at baseline.

This could be in part related to the baseline characteristics, with most of the participants being highly functional, highly educated, and financially comfortable. However, five barriers with the highest level of importance reported at baseline questionnaire (i.e., lack of motivation, lack of energy, other priorities, uncomfortable or intimidated in a gym, lack of exercise programs suitable for my level, keep talking myself out of it, and how I see my body) mostly changed during this home-exercise program as reported in the interviews.

Motivation to exercise can be linked to other barriers; for example, the perception of lack of time often relates to a lack of motivation to exercise (Rai, Jongenelis, Jackson, Newton, & Pettigrew, 2019). A lack of time was reported in the participants of this study. The perception of a lack of time and a lack of motivation are both modifiable by individuals (Rai et al., 2019). Motivation is dependent on self-discipline when trying to adhere to an exercise program (Costello et al., 2011). However, motivation is a multi-dimensional construct suggesting that a host of barriers can be linked to not feeling up to exercise. There are many reported barriers in the literature and none of the exercise programs in the literature address all barriers. Home-based exercises as proposed in this study did not address all barriers but addressed some important ones. This is known as ‘responders’ and was coined by Ross, Lannoy, and Stotz (2015) that showed not everybody will respond the way anticipated; even physiologically.

Barriers reported at baseline were not always reported in the interviews. This shows that perceived barriers are dynamic and depend on the program characteristics. Participants performing this home-based exercise program did not experience constraints with accessibility and feeling uncomfortable in a fitness facility. The participants reported

barriers to exercise at baseline and even if the intervention addressed some of these, participants identified other barriers after the intervention. This phenomenon can be explained by the fact over time habits and behaviour patterns change (Mertens et al., 2019). As a result, finding the perfect exercise program to overcome barriers might change over time and from one person to the other. Therefore, the tested exercise program seemingly addresses some barriers identified in the literature as perceived at baseline and could be useful at a different time of year or a different part of life. For example, for some when it is raining or high temperature, this program is considered.

Enablers. Effective exercise programs for older adults can stimulate enablers to exercise (i.e., perception of health benefits, social support, enjoyment/fun; Allender et al., 2006; Baert et al., 2011; Coghill & Cooper, 2009; Cohen-Mansfield et al., 2003; Costello et al., 2011; Schutzer & Graves, 2004) as identified in the literature. For example, one of the enablers stimulated was increasing fitness as mentioned in the interviews; this most often relates to wanting to improve health (Cohen-Mansfield et al., 2003). Through the course of this intervention, most participants performed the program at moderate intensity and increased average steps/day which is known to lead to an increase in fitness.

Framework matrix. Most participants completed the SSE and reached moderate intensity when supervised. However, based on the interviews, this program may not be suitable for adults age 75 and older as they reported more barriers to keep intensity required because of a lack of energy or a lack of motivation. This is consistent with some barriers in the literature suggested for this demographic (Cohen-Mansfield et al., 2003). Interestingly, participants with higher BMI were as capable to complete the home-based

exercise program. Lastly, those who were more active, even if considered inactive at baseline reported fewer barriers to the proposed program.

Physical activity level. The fact that the number of steps increased to the recommended level, which is 7000 steps per day for older adults as indicated by Tudor-locke et al. (2011) could be due to baseline high participants' functional abilities and the short-term intervention. However, important to note is the long-term effect of any program normally declines over time. Long-term follow-up of these participants would be important to see the true value of such a program to increase the physical activity level.

Even if the total number of steps increased significantly during the program, the number of minutes spent at moderate to vigorous intensity was not significantly increased. This is surprising since eight out of ten participants reached moderate intensity while exercising with us during the last week of intervention. This could be explained by the fact that they were supervised when the intensity was measured and not at home. The literature supports that the intensity is greater when supervised (Hunter, Gordon, Bird, & Benson, 2019). This can explain the difference between moderate intensity at home with a pedometer (>100 steps per minute) compared to a heart rate monitor using ($>40\%$ of HRR) during supervision. Indeed, some have reported that the number of steps per minute to be considered moderate intensity should be greater than 100 (120 steps per minute; O'Brien et al., 2018; Slaght, Sénéchal, & Bouchard, 2017).

Limitations

This study is not without limitations. None of the resistance training exercises were tracked at home; it is thus impossible to understand the contribution of this part of

the program. Participants seemingly enjoyed the visits having the research staff present, which may have developed a bias encouraging participation and increased adherence to the program. This study used the framework method for analysis which was overseen by an experienced researcher however the framework method requires similar research objectives so that it is possible to categorize it. The majority of participants had post-secondary education and high-income level which is not the norm for the target population. This could have been caused by the location of data collection, the university setting, or the strategy used to attract participants (e.g., internet). This may have been an underlining foundation of the themes that emerged for barriers at baseline, barriers overcome during intervention, and stimulated enablers.

Impact/Conclusion

The results are showing that this program can increase the physical activity level of older adults considered inactive, overcome barriers and stimulate enablers to exercise. Regardless of body weight, older adults below 75 years old with greater physical function, are likely to benefit the most from this program. Older inactive adults who are uncomfortable in a gym or those who do not have a great perception of their body image could also benefit from the proposed program. As older adults begin to remain inactive longer and possibly at home longer, this home-based exercise program can be beneficial to some older adults. Possibilities are endless when you consider the amount of time one might spend at home allowing for a greater opportunity to encourage ageing in place (i.e., health, social support, and services to live safely and independently) or rather ageing in home.

Future studies

This was a three-week program. Recommendations for this program in the future could be to offer supervision perhaps online over a long-term period. Options to explore online communication or tracking may be helpful to some older adults to continue a program like this on a monthly to yearly basis. It is also recommended to offer additional exercise protocols for more SSE patterns and resistance training exercises to keep the program new and flexible. The proposed SSE exercise program could potentially increase physical activity level at the recommended intensity, but a longer intervention would be required to test this and adequate sample size to test this research question.

References - Article

- Allender, S., Cowburn, G., & Foster, C. (2006). Understanding participation in sport and physical activity among children and adults: A review of qualitative studies. *Health Education Research*, 21(6), 826–835. <https://doi.org/10.1093/her/cyl063>
- American College of Sports Medicine. (2014). ACSM's guidelines for exercise testing and prescription. Philadelphia: Lippincott Williams & Wilkins, 9th ed. Retrieved from <http://antoinedl.com/fichiers/public/ACSM-guidelines-2014.pdf>
- Ashmead, J. C., & Bocksnick, J. G. (2002). Home-based circuit training for elderly women. *Activities, Adaptation & Aging*, 26(4), 37–41. <https://doi.org/10.1300/J016v26n04>
- Ashworth, N. L., Chad, K. E., Harrison, E. L., Reeder, B. A., & Marshall, S. C. (2005). Home versus center based physical activity programs in older adults. *Cochrane Database of Systematic Reviews*, (1), 1–34. <https://doi.org/10.1002/14651858.CD004017.pub2>
- Azagba, S., & Sharaf, M. F. (2014). Physical inactivity among older Canadian adults. *Journal of Physical Activity & Health*, 11(1), 99–108. <https://doi.org/10.1123/jpah.2011-0305>
- Baert, V., Gorus, E., Mets, T., Geerts, C., & Bautmans, I. (2011). Motivators and barriers for physical activity in the oldest old: A systematic review. *Ageing Research Reviews*, 10(4), 464–474. <https://doi.org/10.1016/j.arr.2011.04.001>
- Booth, M. L., Bauman, A., & Owen, N. (2002). Perceived barriers to physical activity among older Australians. *Journal of Aging and Physical Activity*, 10(3), 271–280. <https://doi.org/https://doi.org/10.1123/japa.10.3.271>
- Bushman, B. (2019). Physical activity guidelines for Americans. *ACMS's Health &*

- Fitness Journal*. 23(3). <https://doi.org/10.1249/FIT.0000000000000472>
- Coghill, N., & Cooper, A. R. (2009). Motivators and de-motivators for adherence to a program of sustained walking. *Preventive Medicine*, 49(1), 24–27. <https://doi.org/10.1016/j.ypmed.2009.04.017>
- Cohen-Mansfield, J., Marx, M. S., & Guralnik, J. M. (2003). Motivators and barriers to exercise in an older community-dwelling population. *Journal of Aging and Physical Activity*, 11(2), 242–253. <https://doi.org/10.1123/japa.11.2.242>
- Colley, R. C., Garrigué, D., Janssen, I., Craig, C. L., Clarke, J., & Tremblay, M. S. (2011). Physical activity of Canadian adults: Accelerometer results from the 2007 to 2009 Canadian Health Measures Survey. *Health Reports*. No. 1. Statistics Canada Catalogue No. 82-003-XPE. 1–8. Retrieved from https://www.researchgate.net/profile/Ian_Janssen/publication/284685407_Physical_activity_of_Canadian_adults_accelerometer_results_from_the_2007_to_2009_Canadian_Health_Measures_Survey_Health_ReportsStatistics_Canada_Canadian_Centre_For_Health_InformationRapports_Sur-La_S/links/568bb7ba08ae1e63f1fdd639/Physical-activity-of-Canadian-adults-accelerometer-results-from-the-2007-to-2009-Canadian-Health-Measures-Survey-Health-Reports-Statistics-Canada-Canadian-Centre-For-Health-InformationRapports-Sur-L.pdf
- Costello, E., Kafchinski, M., Sullivan, P., & Vrazel, J. (2011). Motivators, barriers, and beliefs regarding physical activity in an older adult population. *Journal of Geriatric Physical Therapy*, 34(3), 138–147. <https://doi.org/10.1519/JPT.0b013e31820e0e71>
- Covinsky, K. E., Palmer, R. M., Fortinsky, R. H., Counsell, S. R., Stewart, A. L., Kresevic, D., ... Landefeld, C. S. (2003). Loss of independence in activities of daily

- living in older adults hospitalized with medical illnesses: Increased vulnerability with age. *Journal of the American Geriatrics Society*, 51(4), 451–458.
<https://doi.org/10.1046/j.1532-5415.2003.51152.x>
- CSEP. (2019). *CSEP-PATH: Physical Activity Training for Health (2nd ed.)*. Ottawa, ON: Canadian Society for Exercise Physiology.
- Datko, J. (2015). Semi-structured interview in language pedagogy research. *Journal of Language and Cultural Education*, 3(2), 142–156.
<https://doi.org/10.1002/ejoc.201200111>
- Depp, C. A., Glatt, S. J., & Jeste, D. V. (2007). Recent advances in research on successful or healthy ageing. *Current Psychiatry Reports*, 9, 7–13.
<https://doi.org/https://doi.org/10.1007/s11920-007-0003-0>
- Donnelly, J. E., Blair, S. N., Jakicic, J. M., Manore, M. M., Rankin, J. W., & Smith, B. K. (2009). Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Medicine and Science in Sports and Exercise*, 41(2), 459–471. <https://doi.org/10.1249/MSS.0b013e3181949333>
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough?: An experiment with data saturation and variability. *Field Methods*, 18(1), 59–82.
<https://doi.org/10.1177/1525822X05279903>
- Hart, T. L., Swartz, A. M., Cashin, S. E., & Strath, S. J. (2011). How many days of monitoring predict physical activity and sedentary behaviour in older adults? *International Journal of Behavioral Nutrition and Physical Activity*, 8(62), 1–7.
<https://doi.org/10.1186/1479-5868-8-62>
- Heath, M., Shellington, E., Titheridge, S., & Gill, D. P. (2017). A 24-Week Multi-

- Modality Exercise Program Improves Executive Control in Older Adults with a Self-Reported Cognitive Complaint: Evidence from the Antisaccade Task. *Journal of Alzheimers Disease*, 56(1), 167–183. <https://doi.org/10.3233/JAD-160627>
- Hunter, J. R., Gordon, B. A., Bird, S. R., & Benson, A. C. (2019). Exercise supervision is important for cardiometabolic health improvements: A 16-week randomized controlled trial. *Journal of Strength and Conditioning Research*, 34(3), 866–877.
- Ivankova, N. V., & Creswell, J. W. (2009). Mixed methods. *Qualitative Research in Applied Linguistics: A Practical Introduction*. London, UK: Palgrave Macmillan. <https://doi.org/10.1057/9780230239517>
- Kinetics.
- LeBlanc, A. G., Berry, T., Deshpande, S., Duggan, M., Faulkner, G., Latimer-Cheung, A. E., ... Tremblay, M. S. (2015). Knowledge and awareness of Canadian Physical Activity and Sedentary Behaviour Guidelines: a synthesis of existing evidence. *Applied Physiology Nutrition and Metabolism*, 40, 716–724. <https://doi.org/10.1139/apnm-2014-0464>
- Gale, N. K., Health, G., Cameron, E., Rashid, S., & Redwood (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, 13(117), 1-8. <http://www.biomedcentral.com/1471-2288/13/117>
- Marshall, S. J., Levy, S. S., Tudor-locke, C. E., Kolkhorst, F. W., Wooten, K. M., Ji, M., ... Ainsworth, B. E. (2009). Translating physical activity recommendations into a pedometer-based step goal: 3000 steps in 30 minutes. *American Journal of Preventive Medicine*, 36(5), 410–415. <https://doi.org/10.1016/j.amepre.2009.01.021>

- Mertens, L., Dyck, D. V., Deforche, B., Bourdeaudhuij, I. D., Brondeel, R., & Cauwenberg, J. V. (2019). Individual, social, and physical environmental factors related to changes in walking and cycling for transport among older adults: A longitudinal study. *Health & Place*. 55, 120–127.
<https://doi.org/10.1016/j.healthplace.2018.12.001>
- O'Brien, M. W., Kivell, M. J., Wojcik, W. R., Ghislain, R. D., Kimmerly, D. S., & Fowles, J. R. (2018). Influence of anthropometrics on step-rate thresholds for moderate and vigorous physical activity in older adults: Scientific modeling study. *Journal of Medical Internet Research Aging*, 1,(2) 1–10.
<https://doi.org/10.2196/12363>
- Patton, M. Q. (2002). Two decades of developments in qualitative inquiry: A personal, experimental perspective. *Qualitative Social Work*, 1(3), 261–283.
<https://doi.org/10.1177/1473325002001003636>
- Rai, R., Jongenelis, M. I., Jackson, B., Newton, R. U., & Pettigrew, S. (2019). Factors influencing physical activity participation among older people with low activity levels. *Ageing and Society*, 1–21. <https://doi.org/10.1017/S0144686X1900076X>
- Rikli, R. E., & Jones, C. J. (2013). *Senior Fitness Test Manual* (2nd ed.). Champaign, IL: Human Kinetics. *Mayo Clinic Proceedings*, 90(11), 1506-1514.
<http://dx.doi.org/10.1016/j.mayocp.2015.07.024>
- Ritchie, J., & Lewis, J. (2003). *Qualitative research practice: a guide for social science students and researchers*. London, UK: Sage; 2003
- Ross, R., Lannoy, L. D., & Stotz, P. J. (2015). Separate effects of intensity and amount of exercise on interindividual cardiorespiratory fitness response. *Mayo Clinic*

- Proceedings*. 90(11), 1506-1514. <https://doi.org/10.1016/j.mayocp.2015.07.024>
- Schutzer, K. A., & Graves, B. S. (2004). Barriers and motivations to exercise in older adults. *Preventive Medicine*, 39(5), 1056–1061.
<https://doi.org/10.1016/j.ypmed.2004.04.003>
- Sebastião, E., McAuley, E., Shigematsu, R., & Motl, R. W. (2017). Feasibility study design and methods for a home-based, square-stepping exercise program among older adults with multiple sclerosis: The SSE-MS project. *Contemporary Clinical Trials Communications*, 7, 200–207. <https://doi.org/10.1016/j.conctc.2017.07.012>
- Shigematsu, R., & Okura, T. (2006). A novel exercise for improving lower-extremity functional fitness in the elderly. *Aging Clinical and Experimental Research*, 18(3), 242–248. <https://doi.org/1464> [pii]
- Shigematsu, R., Okura, T., Nakagaichi, M., Tanaka, K., Sakai, T., Kitazumi, S., & Rantanen, T. (2018). Square-stepping exercise and fall risk factors in controlled trial: A single blind, randomized controlled trial. *Journal of Gerontology*, 63(1), 76–82. Retrieved from <https://academic.oup.com/biomedgerontology/article-abstract/63/1/76/672319>
- Shigematsu, R., Okura, T., Sakai, T., & Rantanen, T. (2008). Square-stepping exercise versus strength and balance training for fall risk factors. *Aging Clinical and Experimental Research*, 20(1), 19–24. <https://doi.org/4378> [pii]
- Slaght, J., Sénéchal, M., & Bouchard, D. R. (2017). Impact of walking cadence prescription to reach the global physical activity recommendations in older adults. *Journal on Aging and Physical Activity*, 25(4), 604–611.
<https://doi.org/10.1123/japa.2016-0079>.

- Statistics Canada. (2018). Population projections for Canada (2018 to 2068), provinces and territories (2018 to 2043). *Population Projections for Canada, Provinces and Territories*. Statistics Canada Catalogue No. 91-520-X. Retrieved from <https://www150.statcan.gc.ca/n1/pub/91-520-x/91-520-x2019001-eng.htm>
- Tremblay, M. S., Warburton, D. E. R., Janssen, I., Paterson, D. H., Latimer, A. E., Rhodes, R. E., ... Duggan, M. (2011). New Canadian Physical Activity Guidelines. *Applied Physiology, Nutrition, and Metabolism*, 36(1), 36–46. <https://doi.org/10.1139/H11-009>
- Tudor-locke, C., Craig, C. L., Aoyagi, Y., Bell, R. C., Croteau, K. A., Bourdeaudhuij, I. De, ... Blair, S. N. (2011). How many steps/day are enough? For older adults and special populations. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 1–19. <https://doi.org/10.1186/1479-5868-8-80>
- Vanhees, L., Geladas, N., Hansen, D., Koudi, E., Niebauer, J., Reiner, Ž., ... Börjesson, M. (2012). Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular risk factors: recommendations from the EACPR. *European Journal of Preventive Cardiology*, 19(5), 1005–1033. <https://doi.org/10.1177/1741826711430926>
- WHO. (2012). *WHO: Global Recommendations on Physical Activity for Health*. Retrieved from https://www.who.int/dietphysicalactivity/factsheet_recommendations/en/
- Yin, R. K. (2003). *Applications of case study research* (6th ed.). Los Angeles, US: SAGE Publications.

Table 1.***Demographic information on participants***

<u>Characteristics</u>	<u>Mean</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Age (years)	M (72) F (70)	66	74	76	70	67	76	68	75	65	71
Sex	M (40) F (60)	M	M	M	M	F	F	F	F	F	F
BMI (kg/m²)	M (31) F (31)	32.8	30.4	28.6	32.1	28.4	33.1	31.0	34.1	29.9	26.8
Education Level		HS	U	U	HS	U	U	D	D	HS	D
Personal Income (\$)		3	4	5	2	5	5	1	2	0	4

Physical function senior fitness and balance test

2-min Step Test (steps)	99 (60)	129 (90)	71 (25)	186 (90)	97 (75)	118 (90)	121 (90)	84 (50)	73 (50)	45 (10)	63 (25)
Chair Stand Test (reps)	16 (60)	19 (90)	9 (10)	20 (90)	25 (90)	22 (90)	21 (90)	16 (75)	9 (25)	10 (25)	8 (10)
8 foot up and go (feet)	6.4 (45)	5.6 (25)	8.4 (10)	5.1 (75)	5.1 (50)	4.9 (75)	5.8 (75)	4.78 (75)	7.85 (25)	9.19 (10)	7.36 (25)
Arm curl (reps)	16 (55)	23 (90)	14 (25)	21 (90)	20 (70)	14 (50)	24 (90)	17 (75)	9 (25)	12 (25)	7 (10)
Unipedal balance open eyes	15.1	15	3	28	14	25	5	45	2	6	45

M: Male; F: Female; HS: High School; D: Diploma; U: University. Personal incomes, 0: Less than 20000; 1:20000 to 34999; 2: 35000 to 49999; 3: 50000 to 74999; 4 75000 to 99999; 5 N/A

BMI: Body Mass Index

Data shown as the score (percentile compared to sex and age-group norms)

Jones, C. J., & Rikli, R. E. 2013, Gerontologist, 53(2), 255-267.

Table 2.
Physical activity barriers to exercise

<u>Barrier level (1-10)</u>	<u>Mean</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
1- Previous negative experience	2.5	1	8	1	1	1	1	1	8	1	2
2- Lack of time	3.1	1	1	1	1	7	1	1	6	10	2
3- Not a priority	4.7	1	7	1	1	2	1	8	9	10	7
4- Costs	3.1	1	1	1	1	8	1	1	5	10	2
5- Lack of energy	4.8	1	8	1	5	2	3	4	8	10	6
6- Lack of knowledge	3.6	1	3	1	7	2	1	1	9	5	6
7- Lack of motivation	6.2	3	8	6	1	9	9	10	5	5	6
8- Lack of skill	3.8	2	3	1	3	4	3	6	5	5	6
9- Feeling uncomfortable in a gym	4.7	1	10	1	1	2	1	8	9	10	4
10- Fear of injury	3.3	1	7	1	1	2	1	1	6	10	3
11- Fear of making an existing condition worse	3.8	1	6	1	1	5	1	4	6	10	3
12- How I see my body	4.3	1	2	7	4	2	3	10	8	3	3
13- Failure to reach goals in past attempts	3.8	1	9	1	2	2	2	1	4	10	6
14- Know that I cannot achieve my goals	2.2	1	1	1	2	2	3	6	3	1	2
15- Lack of access to opportunities	3.7	1	10	1	6	2	1	10	3	1	2
16- Keep talking myself out of it	4.3	2	5	1	1	8	8	10	2	1	5
17- Lack of safe places	1.3	1	1	1	1	2	1	1	2	1	2
18- Lack of childcare	1.1	1	1	1	1	1	1	1	1	1	2
19- Lack of partner	1.8	1	1	7	1	1	1	1	2	1	2
20- Lack of available/suitable programs	4.7	1	10	1	2	9	1	10	7	1	5
21- Lack of support from others	2.8	1	1	4	2	9	1	1	6	1	2
22- Lack of transportation	1.4	1	3	1	1	1	1	1	2	1	2
23- Hard to keep intensity required	3.5	1	10	1	10	1	3	1	2	1	5
24- Peer pressure	1.4	1	1	1	1	1	3	1	2	1	2
25- Other	1.5	1	1	6	1	1	1	1	1	1	1
Barriers total _/250	81	29	118	50	58	86	53	100	121	111	88

Barrier level of importance from 1-10 on 25 indicators for physical activity barriers
Barriers total of 250

Table 3.***The daily physical activity level***

<u>Baseline</u>	<u>Mean</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Average steps per day	5878	6922	3403	6864	7129	6921	7056	6364	5412	3226	5478
Average minutes of MVPA per day	25	18	7	43	30	18	46	30	24	1	27

During the last week of intervention

Average steps per day	7495	9175	3674	7297	10952	10688	7035	9243	4008	5158	7717
Average minutes of MVPA per day	37	25	7	46	53	75	32	71	17	18	37

Note. Date shown as average per day

Table 4.
Case examples of barriers experienced by participants

Barrier	Definition	Keywords	Quote	Cases	References
Hard to keep intensity required	Fitness related limitations during exercise program.	fitness, balance, ageing, or fatigue	Case2: We live in the country, I want to spend more time outside, but bugs are a problem, the ground is a problem as well. I have a poor sense of balance, I don't really enjoy walking, and I'm always looking at the ground. Case1: Well its difficult, it takes a lot of concentration because you have to look down where you want to put your feet. I tried to look up but I had to look down at the boxes...	6	16
Lack of time	Conflicts regarding exercise schedule.	too busy, prioritizing activities, unorganized, or travel	Case4: See, well, I never reached the total goal [≥ 150 -minutes]. I got 90-minutes because I did it once a day. Case2: With difficulty, I had to fit it in my days, day by day I would think ahead, I did it after breakfast and after lunch.	6	16
Pain	Mild pain during the exercise program.	knee joints, lower back, shoulder joints, leg, or foot	Case1: Every time I did the steps for a few minutes I would feel a little pain in the knees as I continued it seemed to go away, my back, lumbar spine gives some pain, occasionally sometimes when I hit the ground and I would feel it in my back. Case9: I had a difficult time the first week because I did have day surgery on my legs so I had a healing process	6	16
Unsuitable program	Dislikes in specific areas of the exercise program.	boring, repetitive, no incentive, no social interaction, too much space.	Case3: Specifically, I don't like the home-steps program it's not for me and it's too boring just the short distance and rotation... Case6: They were simple exercises with the exception of one that I found difficult and that was the triceps exercise and that was only because my back was hurting...	6	15
Negative previous experience	Recalls a negative previous experience	torn tendons in knee, cancer, or injuries from falling	Case3: As I told you I busted my ACL tendon. When you do that then you can walk or you can fall, and that's what actually happened... Case2: When I was 50, I did soccer, but my experience was not good, I tore some tendons in my knee really badly.	5	6

Note. Each quote is an example of a case where the barrier is experienced

Table 5.
Case examples of enablers experienced by participants

Barrier	Definition	Keywords	Quote	Cases	References
Achievable goal	Shorter durations became more realistic.	easy/simple to follow, shorter durations	Case1: 10-minutes is easy, when I first started it felt a little difficult, in the beginning some days I was at 10 then I increased it to 15 to 20 and 10-minutes in fact started to become easy. Case6: Not really, once you keep going you just kind of gain momentum... I always do more than 10-minutes.	10	58
Home equipment	Supplied equipment helped physical activity.	helpfulness, convenience, value, flexibility, or no associated costs	Case4: You go to a restaurant now and half the people are on their iPhone, they might as well stay home. But with this, you have to concentrate, and that's a good thing, that's what I think. Case8: It is nice, you don't really need any special equipment. In the hall there's a treadmill and a bike, at home, I keep my eye on that. But you can just stand up to the wall and do it...	10	42
Convenience	Staying home to complete exercise was convenient.	suitable at home, no cost, own time, simple, no transportation, no gym, no specific attire, weather, short duration.	Case9: Yes, it's convenient, and I have the space to put the mat down and I have windows on both sides of my mini home to get the breeze, so I don't get hot because when I get hot, I feel faint. Case5: The fact that the program is all set up and it's not difficult to do on your own.	10	32
Fitness	Physical fitness was important	too inactive, afraid to fall, sedentary, maintaining activity, health benefit/quality of life, stay home longer.	Case6: Yes, well I realize that I was not doing any exercise, like zero, I knew better but like many people they may have a rational thought about it, but they might not do anything about it. Case2: Weight. My regular routine is sedentary, I do a lot of work at the computer and read books a lot.	10	23
Preferred home exercise	Prefers exercising at home.	personal space, secure, without communication, indoors, easier to get started, lacking access to facilities	Case9: Yes, so I don't have any neighbours beside me, I have a sister in law and my sister are in senior's apartment and you can hear the doors opening and closing. Case4: I like doing it at home, I wouldn't go to a gym, I never been to one in my life, I get out and I do a lot around the yard and the house where I live now...	9	36

Note. Each quote is an example of a case where the barrier is experienced

Table 6.
Framework matrix for barriers and enablers

Case #	Self-reported barriers	Senior fitness	Pre-post	Intensity	Themes
Case 2 Age 74 BMI 30.4 Male	Uncomfortable in gym, Access to opportunities, Suitable programs, Hard to keep intensity	Endurance: 25 Lower strength: 10 Agility: 10 Upper strength: 25 Balance: 3sec	3403-3674	23%	Prefers home exercise [enabler]: I don't like changing in front of people, I can't balance and can't get my clothes on. I don't want people watching that... I have had unpleasant experience with changing with people watching and me exercising. Hard to keep intensity [barrier]: It's hard, it's really boring, I was just counting, boring, easier if I had a radio program on, I organized it around radio programs, then it was easy. It's mentally hard when nothing is playing.
Case 8 Age 75 BMI 34.1 Female	Not a priority, Knowledge, Uncomfortable in gym	Endurance: 50 Lower strength: 25 Agility: 25 Upper strength: 24 Balance: 2sec	5412-4008	9%	Home equipment [enabler]: the materials I used were just great! I didn't have to buy anything new... Hard to keep intensity [barrier]: Too much at once. If I just cut down and do 5-minutes and got do my exercises and maybe a week or two later, I add a minute and I can work up to 10-minutes.
Case 4 Age 70 BMI 32.1 Male	Hard to keep intensity, Knowledge, Access to opportunities,	Endurance: 75 Lower strength: 90 Agility: 50 Upper strength: 70 Balance: 14sec	7129-10952	79%	Prefers home exercise [enabler]: I like doing it at home, I wouldn't go to a gym, I never been to one in my life, I get out and I do a lot around the yard and the house... Lack of time [barrier]: If the work hadn't had come up it wouldn't had been a big deal... this would've been fun.
Case 5 Age 67 BMI 33.1 Female	Social support, Suitable programs, Motivation, Cost, Self-talk	Endurance: 90 Lower strength: 90 Agility: 75 Upper strength: 50 Balance: 25sec	6921-10688	54%	Convenience [enabler]: The fact that the program is all set up and it's not difficult to do on your own... we've got the thing [SSE mat], we have time, we have Alexis [AI device] for a timer... we had a backpack with a weight in it... Pain [barrier]: When I was younger, I use to go to the gym all the time, step classes etc, but now you know bad knees and feet or back and now you don't do those kinds.

Note. Intensity reaching MVPA at 40-85%

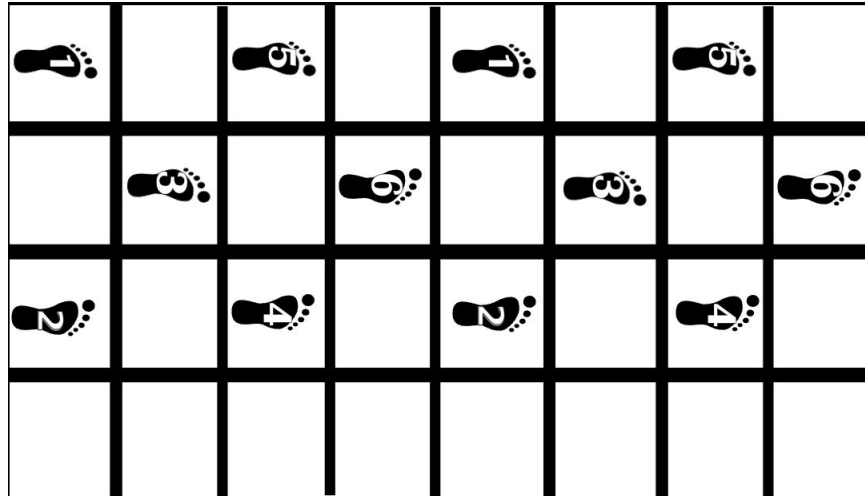


Figure 1. *Square-stepping Exercise Pattern* (Heath, Shellington, Titheridge, & Gill, 2017, p. 173).

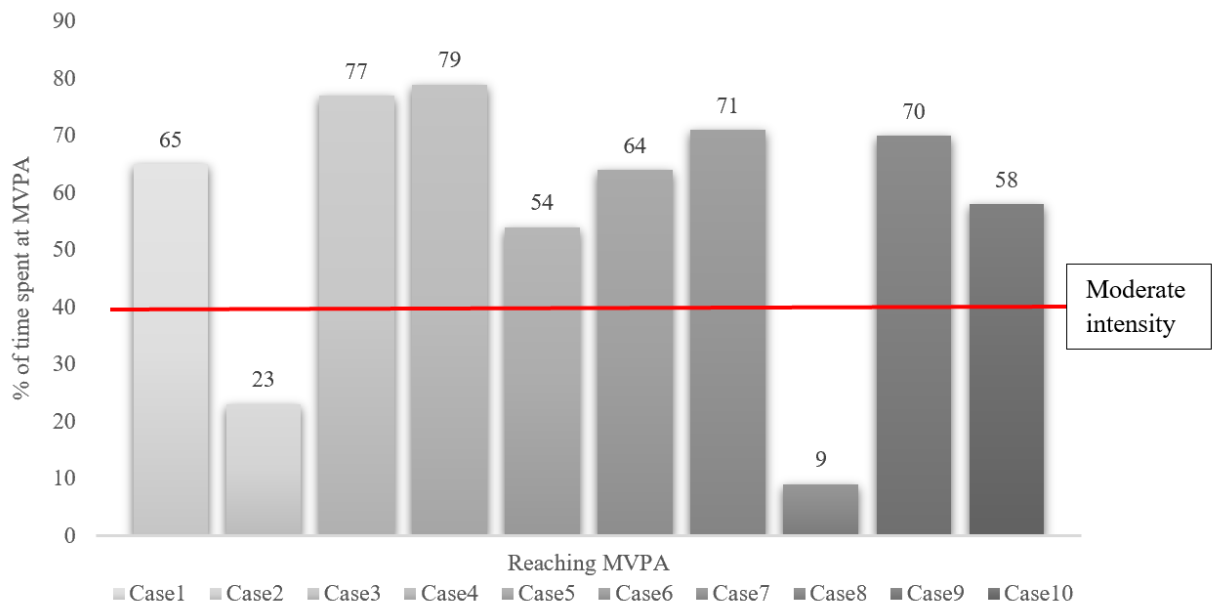


Figure 2. Average HRR percent recorded from minute 5-10 during a 10-minute bout of SSE

Appendix A: Pilot Study Results

Volunteer participants completed various aerobic and resistance exercises. To register intensity, subjects wore a heart rate sensor during activity. The first volunteer participant was 60 years old, the intensity of exercise needed to be reaching between 40-85% HRR (98-144bpm). The second volunteer participant was 76 years old, the intensity of exercise needed to be reaching between 40-85% HRR (90-128bpm). Volunteer participants were asked the following questions: Which exercises were difficult? Which exercises felt unsafe? What were your top five exercises?

Aerobic training	Duration	Subject1-intensity	Subject2-intensity
Jogging on the spot	1min	103	117
Square-stepping dance w/ belts	1min	98	113
Stair-stepping	1min	102	n/a
Lateral stepping	1min	105	114
Single leg jumping jacks	1min	107	n/a
Standing leg extension towel slide	1min	93	85
Jumping jacks	1min	101	118
Standing row with lateral leg extension	1min	110	n/a
Marching w/ arm rotations	1min	105	118
Standing knee raise	1min	111	n/a

Resistance training	Sets	Reps
Squat to Chair	1	12
Bicep Curl	1	12
Push up	1	12
Triceps Dip	1	12
Calf Raise	1	12
Pall off Press	1	12
Lunge	1	12
Chest Press	1	12
Dead Bug	1	12
High Knee Stair Step Up	1	12

Appendix B: Flyer



Home Steps Program

Do you want to try a **NEW** home-based program for beginners that requires **NO** special equipment?

Benefits to Participating:

- **FREE** health assessment!
- **FREE** training!
- **CONTRIBUTE** to healthy aging research in New Brunswick!

Eligibility:

- If you are age 65-80
- If you can commit to 4-visits
- If you are engaging in less than 75-minutes of organized exercise per week

Calling for people currently not very active!

Interested? Questions?

Contact:
(506) 458-7034 OR
mlees@unb.ca

 **UNB**
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UNIVERSITY OF NEW BRUNSWICK

 **CELLAB**
Cardiometabolic Exercise and Lifestyle Laboratory

[REB #2019-057]

Appendix C: Information Letter

Title of Study: **POTENTIAL BENEFITS OF A NOVEL HOME-BASED EXERCISE PROGRAM FOR INACTIVE OLDER ADULTS: AN EXPLORATORY CASE STUDY**

Participant Case Number:

Dear [Participant - insert name here],

My name is Marcus Lees and I am a graduate student with the University of New Brunswick. This project has been reviewed by the Research Ethics Board of the University of New Brunswick and is on file as [REB #2019-057]. Based on your age and physical activity level, we would like to invite you to take part in a research study that evaluates an exercise program on training, development, and support older adult physical activity. The specific purpose of this study is to explore the barriers and enablers of a home-based exercise program to influence regular physical activity. The study is voluntary, and you will only be included if you provide permission.

I would like to invite you to take part in evaluating your health and physical activity and provide you with a three-week exercise program. Afterwards you will be invited back, once for post-assessment and again for further assessment and a one-on-one interview in person. Interviews will last approximately 30 to 60 minutes. Before starting the exercise program, we will review the information letter and consent form and you will be asked to provide verbal consent to participate in the study. The interview will be audio-recorded and transcribed. Furthermore, you will receive a summary of the results regarding the exercise program within approximately one year of the completion of the study. There are no known risks with this study. You are free to withdraw at any time up until the analysis of the data begins and you can request that the tape recorder be shut off at any time during the interview without any consequence. There are no negative consequences for non-participation in this study.

All transcribed data will remain confidential and be stored on password-protected computers at the University of New Brunswick. Data will be stored for five years post-publication. All the names of interviewees and organizations will be removed, and pseudonyms will be used in the written report and within the transcribed data so that your identity is kept private. The benefits of participating in this study are that you will be involved in evaluating your health.

If you have concerns about this study, you can contact is Dr. Wayne Albert of the Faculty of Kinesiology at the University of New Brunswick, at 506-453-4576 or by email at walbert@unb.ca. Dr. Albert has no direct involvement with this project.

Sincerely,

Marcus Lees

Appendix D: Consent Form

Title of Project: **POTENTIAL BENEFITS OF A NOVEL HOME-BASED EXERCISE PROGRAM FOR INACTIVE OLDER ADULTS: AN EXPLORATORY CASE STUDY**

Principal Investigator: Marcus Lees; University of New Brunswick, Faculty of Kinesiology; mlees@unb.ca

PURPOSE OF THE STUDY

Even if most people, including older adults, know the benefits of exercise, many do not meet the recommendation. In Canada, at least 2.5 hours per week of activities that increase heart rate and a minimum of two sessions of weightlifting are recommended. We are proposing a 3-week exercise program that will require no specialized equipment performed in the comfort of your home: 1) to see if the intensity meets the recommendation and 2) understand your experience by asking questions.

Below is a summary of all research activities

Eligibility

For those interested age 65-80, you must have a low physical activity level and willing to exercise.

Exercise Program

The majority of exercise time is an aerobic activity where you are asked to walk following patterns drawn on a Bristol board that will be given to you, called square-stepping exercise. Also, you will be asked to complete some resistance training twice per week using things available in your home (i.e., bag). You simply need to be wearing comfortable clothes.

Exercise Protocol

Participants will be given a booklet with the exercise protocol to follow should they need a reference. The booklet had instructions and images for guidance.

Interview

Upon completing the 3-week exercise program you will complete a follow-up interview to gather information on your experience. With your permission, interviews will be audio-recorded and transcribed to a text document to provide feedback on the exercise program. The interview will be approximately 60-minutes and will be conducted at the University of New Brunswick.

Phone or email of interest: You did show interest in the research study and have made an appointment with the graduate student. When contacting Mr. Lees, he will ask questions to see if you are eligible. These questions will include information about your

age, physical activity level, weight and height, how functional you think you are. Mr. Lees will then make an appointment to have you come to UNB to confirm these answers and start the process.

Overview of Visits

Visit 1

(60-minutes): Participant read and signed consent form to participate. Resting heart rate (HR) and blood pressure (BP) was measured using an automatic blood pressure cuff. Height was measured using a stadiometer. Four Senior Fitness Tests (SFT) assessed endurance, agility, and lower and upper body strength. The unipedal test was used and measured balance. Participants completed Barriers to Physical Activity Questionnaire of 25 questions and answered additional questions on income and education to describe the demographic.

Visit 2

(45-minutes): A minimum of seven consecutive days wearing a Step RX pedometer measured total steps and total time spent at moderate intensity. The staff confirmed their eligibility criteria. Participants were given a square-stepping exercise (SSE) mat and practiced a home-based exercise program before leaving.

Visit 3

(60-minutes): Before the last week of intervention, participants picked up a Step RX pedometer. This device was worn again at the hip for seven consecutive days to measure changes. Participants practiced the home-based exercise program before leaving.

Visit 4

(90-minutes): Participants returned the pedometer and completed an exercise session to register exercise intensity via the HR sensor. The average HR of the SSE bout was recorded during minutes 5-10. No feedback from the staff was made. Then, participants completed a 30-60-minute interview to understand their experience with the exercise program.

POTENTIAL RISKS AND DISCOMFORTS

The program poses minimal risk. There is minor risk associated with this project, it is the same as doing an exercise at home or in a fitness facility on your own. You might be sore after one or two days after multiple exercise sessions. Marcus is a certified personal trainer (CPT) through the Canadian Society of Exercise Physiology (CSEP) and has his emergency first aid CPR “C” and AED, and a vulnerable sector check. If you feel extreme pain, fatigue or dizziness, you can stop the session or the program.

POTENTIAL BENEFITS

By participating in this study, you will increase your physical activity level and potentially improve some aspects of your health if you keep doing it. Maintaining and/or improving weekly activity in older adults is crucial to independent living. If we were to show you the benefits of our program, this could contribute to more home-based initiatives. Additionally, you will be provided with a summary of results from assessments and exercise programs.

CONFIDENTIALITY

Any information that can identify you will remain completely confidential. Participant identity will be referred to as a number instead of your name. It will be used to code all data entries, so you will not be identified. Only the investigators will know the identity associated with who from the data entries, that information will be kept on a locked location. All anonymous data will be stored in a locked environment at the lab located at UNB. It will remain there for seven years, at which point it will be destroyed. Electronic data will be stored on a password-protected computer. If the results are published, your identity will not be revealed. The research ethics board of UNB will be granted direct access to the study participant's original records for verification of procedures or data to ensure participant rights and confidentiality.

PARTICIPATION AND WITHDRAWAL

Your participation in this study is strictly voluntary. You are free to withdraw at any time.

We would appreciate you noticing Marcus Lees, Dr. Edwards or Dr. Bouchard by email if you want to discontinue your participation at any time. In that same communication, you may ask to have your data removed entirely from analyses.

PARTICIPANT'S QUESTIONS:

Has this study been explained to you? ☐ Yes ☐ No

Have you had an opportunity to ask questions and discuss this study? ☐ Yes ☐ No

Do you understand that you are free to withdraw from this study? ☐ Yes ☐ No

Do you agree to be audio-recorded when interviewing this research? ☐ Yes ☐ No

Do you consent the use of de-identified quotes obtained during the study in the dissemination (i.e. publications/presentations) for this research study? ☐ Yes ☐ No

What is a de-identified quote?

De-identified quotes are quotes taken directly from an interview transcript and used in publications or presentations with all possible data linking to you as the interviewee removed. This means all names, study IDs, personal health information and study data will not be connected to this quote. The quote will be anonymous.

Should you have any questions regarding this project, feel free to address them to Marcus Lees either by email or phone. If you wish to speak to someone not associated with the project, please feel free to contact Dr. Wayne Albert at 506-453-4575 who is the Dean of the Faculty of Kinesiology.

If you wish to volunteer in this study, please complete the next section.

The purpose of this study has been explained to me by _____.

I understand the information, including the risks of participation, and agree to participate in the study. I have been given a copy of the Consent Form, which I have read and understand. I have been allowed to ask questions about the study and my participation, and I understand that I may ask questions at any time.

_____ Name of Participant (Print)	_____ Signature of Participant	_____ Date
_____ Witness (Print)	_____ Signature of Witness	_____ Date

Appendix E: Safe for Physical Activity



Get Active Questionnaire

CANADIAN SOCIETY FOR EXERCISE PHYSIOLOGY –
PHYSICAL ACTIVITY TRAINING FOR HEALTH (CSEP-PATH®)

Physical activity improves your physical and mental health. Even small amounts of physical activity are good, and more is better.

For almost everyone, the benefits of physical activity far outweigh any risks. For some individuals, specific advice from a Qualified Exercise Professional (QEP – has post-secondary education in exercise sciences and an advanced certification in the area – see csep.ca/certifications) or health care provider is advisable. This questionnaire is intended for all ages – to help move you along the path to becoming more physically active.

- ☐ I am completing this questionnaire for myself.
- ☐ I am completing this questionnaire for my child/dependent as parent/guardian.

YES	NO	PREPARE TO BECOME MORE ACTIVE
		The following questions will help to ensure that you have a safe physical activity experience. Please answer YES or NO to each question <u>before</u> you become more physically active. If you are unsure about any question, answer YES .
		1 Have you experienced <u>ANY</u> of the following (A to F) within the past six months ?
		A A diagnosis of/treatment for heart disease or stroke, or pain/discomfort/pressure in your chest during activities of daily living or during physical activity?
		B A diagnosis of/treatment for high blood pressure (BP), or a resting BP of 160/90 mmHg or higher?
		C Dizziness or lightheadedness during physical activity?
		D Shortness of breath at rest?
		E Loss of consciousness/fainting for any reason?
		F Concussion?
		2 Do you currently have pain or swelling in any part of your body (such as from an injury, acute flare-up of arthritis, or back pain) that affects your ability to be physically active?
		3 Has a health care provider told you that you should avoid or modify certain types of physical activity?
		4 Do you have any other medical or physical condition (such as diabetes, cancer, osteoporosis, asthma, spinal cord injury) that may affect your ability to be physically active?
		 ➤ NO to all questions: go to Page 2 – ASSESS YOUR CURRENT PHYSICAL ACTIVITY ➤
		YES to any question: go to Reference Document – ADVICE ON WHAT TO DO IF YOU HAVE A YES RESPONSE ... ➤ ➤

ASSESS YOUR CURRENT PHYSICAL ACTIVITY

Answer the following questions to assess how active you are now.

- 1 During a typical week, on how many days do you do moderate- to vigorous-intensity aerobic physical activity (such as brisk walking, cycling or jogging)? DAYS/
WEEK
 - 2 On days that you do at least moderate-intensity aerobic physical activity (e.g., brisk walking), for how many minutes do you do this activity? MINUTES/
DAY
- For adults, please multiply your average number of days/week by the average number of minutes/day: MINUTES/
WEEK

Canadian Physical Activity Guidelines recommend that adults accumulate at least 150 minutes of moderate- to vigorous-intensity physical activity per week. For children and youth, at least 60 minutes daily is recommended. Strengthening muscles and bones at least two times per week for adults, and three times per week for children and youth, is also recommended (see csep.ca/guidelines).



GENERAL ADVICE FOR BECOMING MORE ACTIVE

Increase your physical activity gradually so that you have a positive experience. Build physical activities that you enjoy into your day (e.g., take a walk with a friend, ride your bike to school or work) and reduce your sedentary behaviour (e.g., prolonged sitting).

If you want to do **vigorous-intensity physical activity** (i.e., physical activity at an intensity that makes it hard to carry on a conversation), and you do not meet minimum physical activity recommendations noted above, consult a Qualified Exercise Professional (QEP) beforehand. This can help ensure that your physical activity is safe and suitable for your circumstances.

Physical activity is also an important part of a healthy pregnancy.

Delay becoming more active if you are not feeling well because of a temporary illness.



DECLARATION

To the best of my knowledge, all of the information I have supplied on this questionnaire is correct.
If my health changes, I will complete this questionnaire again.

I answered **NO** to all questions on Page 1

I answered **YES** to any question on Page 1

Sign and date the Declaration below

Check the box below that applies to you:

- ☐ I have consulted a health care provider or Qualified Exercise Professional (QEP) who has recommended that I become more physically active.
- ☐ I am comfortable with becoming more physically active on my own without consulting a health care provider or QEP.

Name (+ Name of Parent/Guardian if applicable) [Please print]

Signature (or Signature of Parent/Guardian if applicable)

Date of Birth

Date

Email (optional)

Telephone (optional)

With planning and support you can enjoy the benefits of becoming more physically active. A QEP can help.

- ☐ Check this box if you would like to consult a QEP about becoming more physically active.
(This completed questionnaire will help the QEP get to know you and understand your needs.)

CSEP-PATH: PHYSICIAN | PHYSICAL ACTIVITY READINESS CLEARANCE

Dear Physician, _____

Patient Name: _____

Date: _____

Your patient has consulted a Canadian Society for Exercise Physiology (CSEP) – Certified Personal Trainer® (CSEP-CPT) for a physical activity, fitness and lifestyle assessment and/or personal training services.

Although evidence demonstrates that becoming more active is very safe for most people and yields many health benefits, it is important to identify clients who may need a more thorough evaluation before doing a fitness assessment or becoming much more physically active.

During our standardized screening procedures we became aware that your patient:

☐ Answered “Yes” to one or more questions on the CSEP *Get Active Questionnaire* – see copy attached.
Specific concern: _____

☐ Had a Resting Heart Rate of _____ (above the safety cut-off of 99 bpm)

☐ Had a Resting Blood Pressure of _____ / _____ (above the safety cut-off of 160/90 mmHg)

To ensure that your patient proceeds in the safest way possible, they were advised to consult with you about becoming more physically active. Please complete and sign this form, indicating any necessary physical activity restrictions, and have your patient return the form to their CSEP-CPT.

Based upon my review of the health status of _____, I recommend:

☐ Unrestricted physical activity based on the *Canadian Physical Activity Guidelines* – start slowly and build up gradually

☐ Progressive physical activity:

☐ With avoidance of: _____

☐ With inclusion of: _____

☐ Only a medically-supervised exercise program until further medical clearance

☐ No physical activity



PHYSICIAN NAME (PLEASE PRINT)
SIGNED
DATE (YYYY/MM/DD)
PHYSICIAN/CLINIC STAMP

If you have any questions regarding the CSEP-PATH® assessment, the *Get Active Questionnaire*, or the services provided by the CSEP-CPT, please contact:

CSEP-CPT
EMAIL
PHONE

NOTE: This Physician Physical Activity Readiness Clearance is valid for a maximum of one year from the date it is completed, and becomes invalid if your patient's medical condition worsens.

Appendix F: Self-reports

Perceived Barriers



CSEP-PATH: BARRIERS TO PHYSICAL ACTIVITY

Anyone considering integrating regular physical activity into their lives may face certain obstacles or barriers. From the following list of commonly cited barriers to physical activity, indicate the level of importance to your situation on a scale of 1 to 10 by circling the relevant number.

	NOT IMPORTANT					VERY IMPORTANT				
Previous negative experiences with physical activity	1	2	3	4	5	6	7	8	9	10
Lack of time	1	2	3	4	5	6	7	8	9	10
Have other areas in my life that I feel must take priority in my day	1	2	3	4	5	6	7	8	9	10
Costs	1	2	3	4	5	6	7	8	9	10
Lack of energy	1	2	3	4	5	6	7	8	9	10
Lack of knowledge	1	2	3	4	5	6	7	8	9	10
Lack of motivation	1	2	3	4	5	6	7	8	9	10
Lack of skill	1	2	3	4	5	6	7	8	9	10
Feeling uncomfortable or intimidated in a gym	1	2	3	4	5	6	7	8	9	10
Fear of injury or re-injury	1	2	3	4	5	6	7	8	9	10
Fear of making an existing condition worse	1	2	3	4	5	6	7	8	9	10
How I see my body	1	2	3	4	5	6	7	8	9	10
Failure to reach goals in past attempts	1	2	3	4	5	6	7	8	9	10
Know that I cannot achieve the goals I want so why bother	1	2	3	4	5	6	7	8	9	10

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Canadian Society for Exercise Physiology

Prepared exclusively for marcus.lees123@gmail.com Transaction: SP1262

	NOT IMPORTANT					VERY IMPORTANT				
Lack of access to opportunities such as nearby facilities	1	2	3	4	5	6	7	8	9	10
Keep talking myself out of it	1	2	3	4	5	6	7	8	9	10
Lack of safe places	1	2	3	4	5	6	7	8	9	10
Lack of child care	1	2	3	4	5	6	7	8	9	10
Lack of partner	1	2	3	4	5	6	7	8	9	10
Lack of available and suitable exercise programs at my level	1	2	3	4	5	6	7	8	9	10
Lack of support from others	1	2	3	4	5	6	7	8	9	10
Lack of transportation	1	2	3	4	5	6	7	8	9	10
Lack of ability to work at a level for it to be worthwhile	1	2	3	4	5	6	7	8	9	10
Find that other people pressure me and that bothers me	1	2	3	4	5	6	7	8	9	10
Other	1	2	3	4	5	6	7	8	9	10

Additional Demographic Questions

1. What is your age? _____.
2. Gender? _____.
3. Ethnicity:
 - First Nations, Inuit, or Métis
 - African Canadian, African American, or Black
 - Hispanic, Latino, or Spanish
 - Asian
 - White
 - Other

How would you describe yourself? _____.

4. Level of education obtained:
 - Less than a high school diploma
 - High school degree or equivalent (e.g. GED)
 - Diploma or Certificate
 - University
5. Income:
 - Less than \$20,000
 - \$20,000 to \$34,999
 - \$35,000 to \$49,999
 - \$50,000 to \$74,999
 - \$75,000 to \$99,999
 - Over \$100,000

Appendix G: Exercise Protocol

Home Steps Program



Contact:

Marcus Lees

Phone number: (506) 458-7034 if you have any questions

Email: mlees@unb.ca

Exercise Protocol

All sessions will begin with completing 5 stepping patterns. Each week, you are to accumulate at least ≥ 150 -minutes of square-stepping exercise. You must reach at least ≥ 10 -minutes before stopping a square-stepping exercise session. You are to use the provided square-stepping exercise mat and materials that can be found in your home to complete the exercise program. Twice a week, you are to complete two rounds of resistance exercises.

Square-stepping Exercise

Warmup

5 stepping sequences

Level

Light

10-minute bout

Exercise between 10-50-minutes per session

Moderate

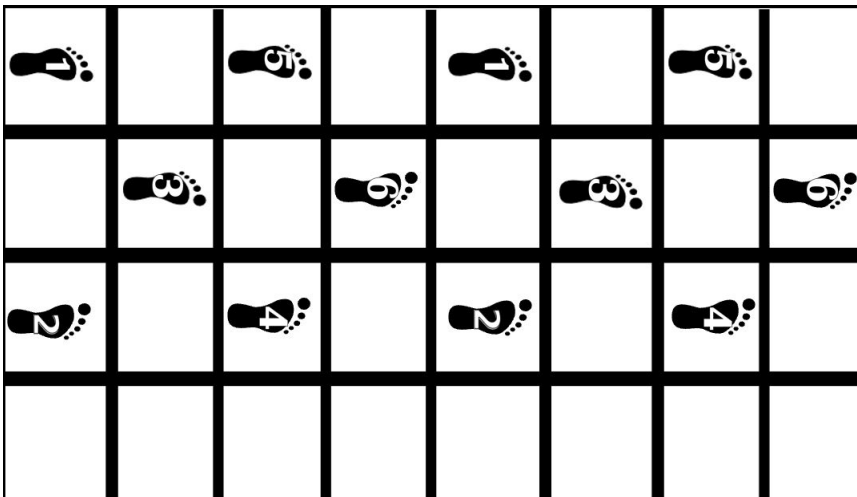
Cooldown

2-minute walk around mat (stay standing)

Very light

TIPS:

- **Secure the mat to the floor in your home with tape.**
- Use a stopwatch
- Step with both feet and follow the sequence of steps
- Start with slow steps working to a faster stepping speed
- Remember to stay balanced and close to a wall for support



Resistance Exercises	Rest between exercise	Reps
1. Squat to Chair	30 seconds	10-15
2. Bicep Curl	30 seconds	10-15
3. Push Up	30 seconds	10-15
4. Triceps Dip	30 seconds	10-15
5. Calf Raise	30 seconds	10-15

TIPS:

- You will complete exercises 1 to 5 to complete 1 round. You will complete exercise 1 to 5 again for a second round.
- Body weight exercises will be completed on 2 days for the week and always after square stepping exercise.

Squat to Chair



Standing in feet shoulder-width apart, arms crossed and hands at shoulder level, seat the lower body to the front of the chair **positioned in a corner of a wall**. Remember to bend at the ankles and knees by having the knees come forward over your toes. Keep your head straight and looking at the wall in front. Press into the floor with the heels rather than the toes to stand up.

Bicep Curl



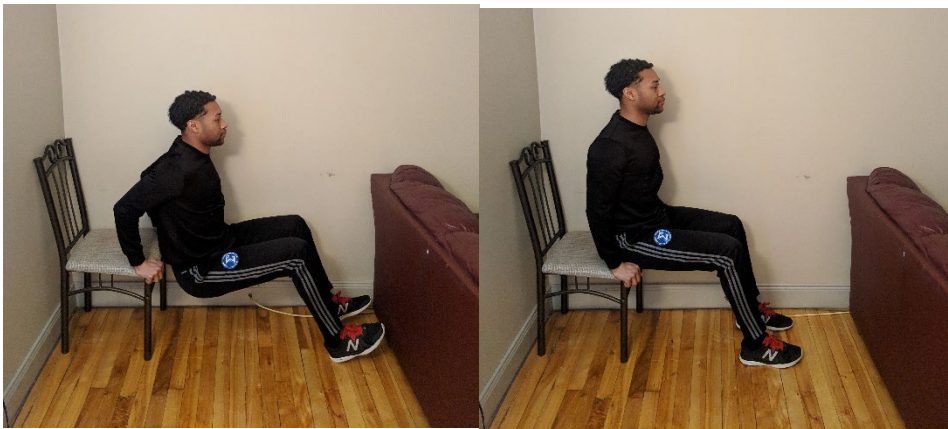
Standing or seated, hold a backpack or similar object in both hands positioned in level with the center of the chest. Stand tall with feet should width apart, a lower object near your waist, elbows are close to your ribs. Bring the object back to the chest level. Remember to keep the chest raised and shoulders pulled back.

Push Up



With the **support of a wall**, position the body at an angle with arms holding the chest away from the wall. Remember to stay positioned on toes, feet shoulder-width apart, and keep back straight.

Triceps Dip



Sit and lower your buttocks to a chair **position in a corner of the wall**, use your arms to position the buttocks off the support by holding your body. Resting on your heels and hands, elevate your body downwards and upwards.

Calf Raise



Standing on the floor, **lean forward against a wall focusing on support.** Extend upwards using toes to elevate your body. Raise into maximum extension and then return to a starting position.

Appendix H: Semi-Structured Interview Guide

Thank you for participating today. The purpose of this interview is to investigate your experience with becoming more active. As a participant in this study, please take your time, don't feel rushed. If you are having a tough time finding the words, describe the situation or take a moment to think about it. You can ask to stop the interview at any time. There is no right/wrong answer, I am trying to gain insight into your experiences, and you are the expert. The interview will be audio recorded so please speak clearly. I will not be taking many notes. Let's begin.

Participating

1. Can you please explain your reasons for increasing your physical activity level?

Probe: Describe what being physically active means to you?

Exercise Program

2. What made you come back to the Home Steps Program for all visits?

Probe: Would you require visits to continue Home Steps?

3. What role would you say phone calls played for you during the week with no visit?

Probe: Would you require communication to continue Home Steps?

4. Can you explain the Home Steps weekly goal to someone interested in knowing more about the program? Is the square-stepping exercise new to you?

Probe: What made it easy or hard to understand?

5. Was maintaining 10-minutes of square-stepping exercise hard or easy?

Probe: What helped you continue after 10-minutes? What stopped you from reaching 10-minutes and more? What feelings come to mind about square-stepping exercise?

6. Can you describe how you scheduled reaching the weekly goal to accumulate your minutes?

Probe: What things made exercising at home easier? What things made exercising at home harder?

7. Can you tell me about your experience with exercise protocol?

Satisfaction

8. Are there benefits to your overall physical activity with completing the Home Steps Program? Did you combine other exercises?

Probe: What do you like/enjoy about exercising at home?

9. Are there drawbacks to your overall physical activity with completing the Home Steps Program? Did it make you stop other activities?

Probe: What do you dislike/hate about exercising at home?

10. To what extent did the materials you used at home help or hinder your ability to complete the Home Steps Program?

Probe: Explain how you would use materials in your home for long-term exercise? Would you try being more creative with your materials?

Safety

11. Did you feel you were going to fall at any point in the Home Steps program?

Probe: Can you recall a time and please describe the moment with as much detail as possible?

12. Did you experience any pain/injury at any point in the Home Steps Program?

Probe: Can you recall a time and please describe the moment with as much detail as possible?

13. On a scale of 1-10 how comfortable are you completing the Home Steps program to reach the weekly goal?

14. Do you have anything you want to add?

Appendix I: Summary of Results

Hello _____,

Thank you again for participating in this study! Your contribution is greatly appreciated and highly valuable to the overall findings. On the last page, you will find the current Canadian Physical Activity Guidelines (CPAG) as set out by the Canadian Society of Exercise Physiology for your reference. The following document consists of a summary of the results. This includes information from the first week of testing and the three weeks of the exercise program. A heart rate (HR) monitor will be used to measure intensity in beats per minute (bpm) and to record max HR and mean HR. We used your resting HR to calculate an individualized intensity to reach moderate aerobic activity. Heart rate reserve (HRR), more specifically, the equation is $(\text{max HR} - \text{resting HR}) \times .40 + \text{resting HR}$.

Your heart rate should be between your moderate and vigorous intensity:

- Moderate intensity, your HR should be _____ bpm
- Vigorous intensity, your HR should be _____ bpm

On behalf of everyone involved in the study, I would like to thank you once again for choosing to participate in the Home Steps Program. Please continue seeking information on physical activity. If you have any concerns with your assessment, please contact your family doctor. For any questions directly involved with the study, contact me at mlees@unb.ca.

Sincerely,

Marcus Lees

Measure	Optimal ratings	Results	Norms for your age group
Vital Signs and Body Composition			
Resting Heart Rate (bpm) Lower is better meaning the heart will pump fewer times in a minute	Below 99		
Blood Pressure (mmHg) Below 120/80 is associated with a lower risk of heart disease, check it several times per week for a consistent pattern	Below 120/80		
Body Mass Index (BMI) Outside the optimal rating can indicate increased risk for developing health conditions such as hypertension	Between 18.5 and 25		
Self-report			
Barriers to Physical Activity Anyone considering integrating regular physical activity into their lives may face certain barriers	n/a		n/a
Composite Physical Function Low functioning may indicate you are at risk for losing physical independence	Moderate or high function		
Physical Function Tests			
2-minute stepping test Marching for 2-minutes with marking on a wall in front. This assessed your aerobic endurance.			

8 Foot Up and Go Quickly standing from a chair and walking around the marker on the floor to return seated. This assessed your agility and dynamic balance			
30 Second Chair Stand Standing repeatedly from a chair with arms across the chest in 30-seconds. This assessed lower body strength.			
Arm Curl While seated, arm fully extends weight to the ground and up to the chest in 30-seconds. This assessed upper body strength.			
Unipedal Stance Test Whilst on one foot with arms crossed at should stand up to 45 seconds with eyes open and closed. This assessed balance			
Physical activity	Pre	Post	
Average total step/day			10,000
Average MVPA time/day			30minutes
Reached MVPA in SSE (final visit)			n/a

Canadian Physical Activity Guidelines

FOR OLDER ADULTS - 65 YEARS & OLDER

Guidelines



To achieve health benefits, and improve functional abilities, adults aged 65 years and older should accumulate at least 150 minutes of moderate- to vigorous-intensity aerobic physical activity per week, in bouts of 10 minutes or more.



It is also beneficial to add muscle and bone strengthening activities using major muscle groups, at least 2 days per week.



Those with poor mobility should perform physical activities to enhance balance and prevent falls.



More physical activity provides greater health benefits.

Let's Talk Intensity!

Moderate-intensity physical activities will cause older adults to sweat a little and to breathe harder. Activities like:

- Brisk walking
- Bicycling

Vigorous-intensity physical activities will cause older adults to sweat and be 'out of breath'. Activities like:

- Cross-country skiing
- Swimming

Being active for at least 150 minutes per week can help reduce the risk of:

- Chronic disease (such as high blood pressure and heart disease) and,
- Premature death

And also help to:

- Maintain functional independence
- Maintain mobility
- Improve fitness
- Improve or maintain body weight
- Maintain bone health and,
- Maintain mental health and feel better

Pick a time. Pick a place. Make a plan and move more!

- ☒ Join a community urban poling or mall walking group.
- ☒ Go for a brisk walk around the block after lunch.
- ☒ Take a dance class in the afternoon.
- ☒ Train for and participate in a run or walk for charity!

- ☒ Take up a favourite sport again.
- ☒ Be active with the family! Plan to have "active reunions".
- ☒ Go for a nature hike on the weekend.
- ☒ Take the dog for a walk after dinner.

Now is the time. Walk, run, or wheel, and embrace life.



CURRICULUM VITAE

Candidate's full name:

Marcus Lees

Universities attended (with dates and degrees obtained):

Bachelor of Recreation Sport Studies in Kinesiology, University of New Brunswick 2016

Conference Presentations:

Potential benefits of a novel home-based exercise program for inactive older adults: An exploratory case study Atlantic Provinces Exercise Scientists and Socioculturalists (APES+), 2020

Potential benefits of a novel home-based exercise program for inactive older adults: An exploratory case study NBHRF Research Conference, 2019

Potential benefits of a novel home-based exercise program for inactive older adults: An exploratory case study NBKA Annual Conference and AGM, 2019

Potential benefits of a novel home-based exercise program for inactive older adults: An exploratory case study Atlantic Provinces Exercise Scientists and Socioculturalists (APES+), 2017