# REDUCING SEDENTARY TIME AMONG OLDER ADULTS IN ASSISTED LIVING: INTERVENTION STRATEGIES AND FUNCTIONAL OUTCOMES

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## Dedication

This thesis is dedicated to my family. To my grandparents, Mandy and Pop, who have always been among my biggest supporters. To Pop, for always championing the power of knowledge and education and although you couldn't be here to see me complete this milestone, I know you would be proud, and your journey set me down the road of exercise for health and aging. To Mandy, for your immense love, support, and feedback throughout this project. This would have been much harder without your willingness to test my materials on your fellow residents and always providing a supportive ear.

To my parents, thank you for introducing to me kinesiology as "a major where you play sports" and always teaching me I can do anything I want, as long as I work for it. I would not be where I am today if you had not fostered the curiosity and drive within me. And to Erica, we have grown so close during the last few years and I couldn't be more thankful. I love you all.

**Abstract**

Prolonged daily sedentary time (ST) is associated with increased risk of cardiometabolic disease, impaired physical function, and mortality. Older adults accumulate more ST than any other age group, especially those who live in assisted living residences (ALRs). The purpose of this study was to develop and pilot-test a multi-level intervention to reduce ST within ALRs. "Stand to Strengthen" was developed using a social ecological framework based on a review of literature and consultation with residents and staff at ALRs. A six-week pilot study (n =10) showed the intervention strategies were feasible, and there was a trend towards a decrease in self-reported sitting time (142 minutes/day (p=0.086). Participants with lower physical function at baseline showed clinically meaningful improvements in function over the 6 weeks (p=0.035, Cohen's *d* = 0.89). This study demonstrated that a multi-level intervention to reduce ST could delay functional decline among older adults in assisted living.

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## List of Abbreviations

| | |
|---|---|
| AB | Alberta |
| AC(s) | Activity Coordinator(s) |
| ADLs | Activities of Daily Living |
| ALR(s) | Assisted Living Residence(s) |
| BCT | Behavioural Choice Theory |
| BMI | Body Mass Index |
| CSEP | Canadian Society for Exercise Physiology |
| CVD | Cardiovascular Disease |
| DM | Device-measured |
| DPM | Dual-Process Model |
| EQ-5D | EuroQol – 5 Dimension |
| ET | Empowerment Theory |
| FI | Frailty Index |
| HDL | High Density Lipoprotein |
| HFM | Habit Formation Model |
| HRQoL | Health-Related Quality of Life |
| ICECAP-O | ICEcap CAPability measure for Older People |
| IPAQ | International Physical Activity Questionnaire |
| LASA | Longitudinal Aging Study Amsterdam |
| LDL | Low Density Lipoprotein |
| LPA | Light Physical Activity |
| MDD | Major Depressive Disorder |
| METs | Metabolic Equivalents |
| MOST | Measure of Older Adults' Sedentary Time |
| MVPA | Moderate-to-vigorous Physical Activity |
| NA | Not Applicable |
| NHANES | National Health and Nutrition Examination Study |
| OCP | Operant Conditioning Principles |
| PA | Physical Activity |
| QOL | Quality of Life |
| RCT | Randomized Controlled Trial |
| SBQ | Sedentary Behaviour Questionnaire |
| SCT | Social Cognitive Theory |
| SDT | Self-Determination Theory |
| SEM | Social Ecological Model |
| SIT | Social Influence Theory |
| SPPB | Short Performance Physical Battery |
| SR | Self-Report |
| ST | Sedentary Time |
| TTM | Transtheoretical Model |
| TV | Television |

# Chapter 1: Literature Review

## 1.0 Introduction

Sedentary behaviour is any waking activity in a seated or reclined position with low energy expenditure (≤1.5 Metabolic Equivalents (METS)) (1). Excessive sedentary time is associated with negative health outcomes such as increased risk of cardiovascular disease and all-cause mortality, reduced physical function, and increased risk of frailty (2, 3). Research has shown that over 90% of older Canadians spend more than 8 hours a day in a sedentary position (4, 5).

The negative effects of excessive sedentary time appear to be minimized among people who engage in 60-75 minutes of moderate-vigorous physical activity (MVPA) per day (6). However, less than two in ten Canadian adults achieve even 30 minutes of physical activity per day, and older adults are even less likely to engage in high levels of physical activity (7). Prolonged sedentary time along with physical inactivity appears to compound the associated health risks making this demographic particularly vulnerable (8).

For many older adults, reducing sedentary time or altering the type of sedentary behaviour may be a more feasible goal than increasing MVPA. Although much of the evidence is cross-sectional, regularly interrupting sedentary time is associated with better outcomes than accumulating the same volume of sedentary time in continuous bouts (9, 10). Some social or cognitively stimulating activities have also been shown to have a positive influence on health (11-13) Encouraging higher levels of light physical activity (LPA) may also confer health benefits for older adults due to the dose-response

relationship between health benefits and volume/intensity of physical activity (14). Increased amounts of LPA have been shown to be associated with improved balance, reduced fall risk, and improved self-rated health. Loprinzi et al. (15) noted that older adults in the NHANES 2003-2006 cycle had fewer chronic diseases when engaging in ≥300 minutes per week of LPA and almost 50% of the sample achieved at least 300 minutes of LPA per week. Thus, regularly interrupting sedentary time with standing breaks and/or LPA breaks may prove to be much more feasible for older adults than trying to increase MVPA.

Activities of daily living (ADLs) across household, transportation, and leisure-time domains can provide seniors with opportunities to break up sedentary time (16). As the population ages, increasing numbers of Canadians will be living in collective dwellings that provide supportive living to older adults. While these residences offer many benefits, individuals within these residences may accumulate more sedentary time as many ADLs, such as preparing meals and housekeeping, are done for them. Small reminders to reduce or interrupt prolonged sedentary time by standing, stretching, or moving in these settings could be beneficial, however, to date almost all sedentary behaviour research has focused on school and workplace environments.

### 1.1 Health Risks Associated with Sedentary Time

Prolonged periods of sedentary time have been associated with an increased risk of diabetes, cardiovascular disease and all cause mortality amongst middle-aged adults (9). A systematic review by de Rezende et al. (17) found a similar pattern between prolonged sedentary time and mortality in older adults. The bulk of the research with older adults involved self-reported sedentary time, resulting in weaker associations

between volumes of sedentary time and cardiometabolic health. Sedentary time is also negatively associated with physical function, mental health, cognition, and frailty (18-20).

In older adults, there is an additional concern of the role sedentary time plays in geriatric syndromes. These syndromes are considered impairments that do not fit neatly into other disease categories, such as: impaired mobility, frailty, cognitive impairments, dizziness, urinary incontinence, and depressive symptoms (2). Koroukian et al. (21) found that functional limitations and geriatric syndromes were stronger predictors of poor self-reported health and two-year mortality compared to the presence of chronic conditions such as Type Two Diabetes and cardiovascular disease (CVD).

### 1.1.1 Cardiometabolic Conditions

#### *1.1.1a Cardiovascular Disease*

Buman et al. (22) found that reallocating sedentary time to sleep, LPA, or MVPA lead to significant improvements across numerous biomarkers for CVD risk. Reallocating sedentary time to MVPA resulted in decreased waist circumference, improved HDL cholesterol, triglycerides , plasma glucose, insulin and insulin sensitivity (22). There was a significant beneficial association when sedentary time was substituted for LPA in triglycerides, insulin, insulin sensitivity and ß-cell function, however, these improvements were not as large as those seen with MVPA (22). A meta-analysis of sedentary time among adults (some studies focused on older adults) found standing breaks did not have an effect on blood glucose compared to uninterrupted sitting (10). Light physical activity and MVPA both significantly reduced blood glucose postprandial

response and insulin, thus short movement breaks may be more beneficial for reducing risks of prolonged sedentary time associated with CVD (10).

*1.1.1b Metabolic Syndrome*

Metabolic syndrome is considered central obesity along with two of the following conditions: increased blood pressure, increased triglyceride, low HDL, and increased fasting plasma glucose (23). Cross-sectional studies have shown that increased sedentary time with fewer breaks and longer sedentary bouts are associated with an increased waist circumference, lower HDL, increased triglycerides, and metabolic syndrome (24, 25). The relationship between daily percentage of sedentary time and sedentary breaks remained after adjusting for physical activity (24). A 6-year longitudinal study found that higher levels of subjectively-reported TV time at baseline was associated with increased odds of developing metabolic syndrome (26).

NHANES data from the 2003-2006 cycle indicated that individuals with higher amounts of sedentary time had a higher risk of metabolic syndrome, which in turn increases the risk of developing Type 2 Diabetes (24). These participants also had fewer breaks in sedentary time and longer bouts of sedentary time (24). Type 2 Diabetes is primarily due to insulin resistance and is typically associated with being overweight (27). A study of over 6000 older women (median age of 79 years) found that each one hour increase in sedentary time was associated with an increased odds of Type 2 Diabetes by 21% (28). Those that were more continuously sedentary (i.e. less breaks) also had a higher prevalence of Type 2 Diabetes (28). Hsueh et al. (29) found that total self-reported sedentary time was not associated with Type 2 Diabetes in older adults, but TV viewing

time was. This may be due to the other social behaviours associated with TV viewing, such as eating snacks which may be more processed (29).

*1.1.1c Mortality*

Large systematic reviews and meta-analysis have examined relationships between sedentary time and CVD mortality, cancer mortality, and all-cause mortality (30-33). A meta-analysis by Ekelund et al. (30) noted a 32% increase in risk of CVD mortality for those that sat 8 hours/day compared to the reference group (4 hours/day) in a dose-response pattern. This risk increased to 59% when comparing >5 hours/day of TV watching compared to the reference group (<1 hour/day) (30). There was no clear dose-response pattern between total sitting time and cancer risk but the risk of cancer mortality was the highest in the highest sitting category (30). A dose-response relationship was noted between TV time and cancer mortality however there was no significant increase in risk for the least and most physically active groups (30). More than 5 hours/day of TV time increased cancer mortality in the 2$^{nd}$ and 3$^{rd}$ quartiles of activity (30).

Katzmarzyk et al. (31) found that daily sitting was positively associated with all-cause, CVD-related, and "other" health-related mortality but not cancer-related mortality. The highest risk of death occurred for the highest sitting group across all categories (31). A dose-response relationship was noted for all-cause related death rates in adults >60 years (31). Data from the Australian Longitudinal Study on Women's Health noted a dose-response relationship between sitting time and all-cause mortality whereby sitting 8-11 hours/day resulted in a 45% increased risk of death compared to the reference group (<4 hours of sitting/day) (32). There was a further increase in risk to 65% if individuals sat >11 hours/day (32).

Changing sedentary patterns can alter CVD mortality risk over two years (33). Compared to individuals with unchanging sedentary patterns (high sedentary time), those that increased their sedentary time over two-year follow up had 18% higher risk of CVD mortality. Individuals that reduced their sedentary time and those that were consistently non-sedentary had a 23% and 33% lower risk of CVD mortality, respectively (33).

Interrupting sedentary time with LPA or MVPA appears to be beneficial for reducing risks associated with cardiometabolic conditions. Standing breaks may be sufficient to reduce risk for some risk factors, such as waist circumference and Body Mass Index (BMI). Overall, higher levels of sedentary time are associated with higher levels of risk of chronic conditions and mortality. Although a dose-response curve appears to exist between sitting and mortality, there is not enough research yet to discern this relationship between sitting and other diseases.

### 1.1.2 Geriatric Syndromes

#### *1.1.2a Cognition*

The majority of research examining sedentary time and cognition is cross-sectional although there are a few longitudinal studies. An eight-year longitudinal study found that community-dwelling older adults were more likely to experience cognitive decline if they were more sedentary (19). Cognitive decline was defined as a three-point decrease, or greater, on the Mini-Mental State Examination from baseline (19). A cross-sectional analysis of the 2012 Canadian Community Health Survey examined perceived cognition using the Cognition Attribute of the Health Utilities Index, leisure time sedentary time and leisure time physical activity (34). Participants that were more active

and less sedentary reported better perceived cognition compared to their less active and/or more sedentary counterparts (34). Light physical activity seemed to contribute to better perceived cognitive functioning and mediated the relationship between leisure-time sedentary time and cognitive functioning (34). Analysis of NHANES data from the 1999-2002 cohort demonstrated that meeting MVPA guidelines was independently associated with an increase in cognitive function across all categories of sedentary time (35). Hamer and Stamatakis (36) found that participating in MVPA at least once a week was associated with a higher global score of cognitive function compared to inactive participants.

Isotemporal substitution of sedentary time with sleep, LPA, and MVPA demonstrated that there are some cognitive benefits to exchanging sedentary time with sleep or MVPA (37). Replacing 30 minutes of sedentary time with 30 minutes of sleep improved global reaction time switch cost and reaction time when participants were completing more challenging task-switching tasks (trials requiring switching between tasks or repeating tasks over multiple trials) (37). Substituting sedentary time for MVPA increased accuracy in spatial working memory tasks and lead to a faster reaction time on easier task-switching tasks (one task performed at a time) (37). Both sleep and MVPA improved self-regulatory behaviours which may enable individuals to maintain healthy behaviour changes long term (37). No changes were noted when LPA was substituted for sedentary time indicating that it may not be a large enough stimulus to create a change in cognition (37).

*1.1.2b Frailty*

Frailty is considered a condition where biological systems struggle to maintain homeostasis after a low stressor (38). It leaves individuals more vulnerable to adverse health events, including falls, fractures, disability, and increased chance of morbidity and mortality (39). Research has shown that increased sedentary time and fewer breaks in sedentary time leads to a greater risk of frailty in older adults (20, 39, 40).

Analysis of the 2003-2004 and 2005-2006 NHANES cohorts demonstrated that sedentary time and MVPA are significantly associated with frailty (20). Blodgett et al. (20) created a 46-item frailty index (FI) with 4 categories: non-frail ($FI \leq 0.10$) , vulnerable ($0.10 < FI \leq 0.21$), frail ($0.21 < FI \leq 0.45$), and most-frail ($FI > 0.45$). Each one hour/day reduction in device-measured sedentary time reduced the FI score by 0.016 while a one hour/day increase in MVPA reduced the score by 0.045 (20). The most frail group was consistently inactive and highly sedentary and there may be the potential for improvements with small, incremental increases in movement (20).

del Pozo-Cruz et al. (40) examined associations between device-measured sedentary time and frailty and found that total sedentary time and breaks in sedentary time were significantly associated with frailty. Total time per day, proportion of the day spent in sedentary bouts ≥10 minutes per day, and time spent in sedentary time breaks were all significantly associated with frailty in fully adjusted models. Interestingly, the number of sedentary bouts ≥10 minutes per day and the number of breaks in sedentary time per day were not significantly associated with frailty (40). da Silva et al. (39) observed a relationship between sedentary time and frailty in both sexes and identified sedentary cut-points for predicting frailty in men (>495 minutes/day) and women (>536

minutes/day). Individuals above these cut points were three times more likely to be considered frail. This is concerning as it has been found that older adults accumulate an average of 9.4 hours/day (564 minutes) of sedentary time (41).

Models using isotemporal substitution of 30 minutes/day of sedentary time with MVPA demonstrated that frailty scores (measured by the Frailty Trait Scale) were reduced (42). Light physical activity did not have an effect on frailty scores unless comorbidities (Charlson Comorbidity Index) were considered (42). One in five Canadian adults have at least one of cancer, chronic respiratory disease, heart disease, and Type 2 Diabetes (43). Heart disease and respiratory disease are given a higher weighting by the Charlson Comorbidity Index while Type 2 Diabetes and cancer are given the second highest weighting (42). Older Canadians with these comorbidities may benefit and reduce their risk of frailty by increasing movement and reducing sitting time.

*1.1.2c Mental Health*

Research has started to examine associations between sedentary time and mental health, including health related quality of life (HRQoL) and depression. Vallance et al. (44) examined the associations between self-reported sitting time and HRQoL in older men. Participants reported more occupational sitting time and computer use through the week but higher levels of TV time on the weekends (44). There was significantly higher sitting time on the weekend compared to weekdays and there was a significant negative association between HRQoL and sedentary time when comparing the highest and lowest quartiles of weekend sedentary time (44). Yasunaga et al. (45) examined physical and mental domains of HRQoL among Japanese older adults using the Japanese version of the Medical Outcomes Survey – SF8. Device-measured sedentary time was significantly

and inversely associated with the physical component of the HRQoL score. There was no association between LPA but MVPA was significantly associated with an increased physical score. There was no association between the mental HRQoL and any of the activity levels (sedentary time, LPA, or MVPA). Interestingly, substituting sedentary time with LPA did not result in any significant changes in physical or mental scores although other isotemporal substitutions have shown benefits for frailty and physical function (42, 46). Perhaps the changes seen in frailty and physical function are not substantial enough to have an impact on self-reported HRQoL.

A systematic review noted that evidence of the relationship between HRQoL and sedentary time was not conclusive with 47% of studies finding a negative association (47). A meta-analysis of 18 studies with adults indicated that generally lower levels of sedentary time were associated with higher total, physical, and functional scores of HRQoL (47). However, the associations between sedentary time and general HRQoL, mental, and social domains were not significant (47).

A systematic review of sedentary time and Major Depressive Disorder (MDD) noted that individuals with MDD spent significantly more time engaging in sedentary behaviours than their non-depressed counterparts (48). In this review, participants had already received a diagnosis of MDD thus reverse causality cannot be ruled out. The English Longitudinal Study of Aging noted that higher amounts of TV viewing time were associated higher depressive symptoms while internet usage and reading were associated with lower depressive symptoms (36). Santos et al. (49) examined the combined associations between physical activity and sedentary time. Participants were categorized based on whether they met Physical Activity Guidelines (dichotomized as yes/no) and

into quartiles of sedentary time, resulting in eight categories (49). After adjusting for confounders, inactive participants (<150 minutes/week of MVPA) in the top quartile of sedentary time had significantly higher depression symptoms compared to other participants (49).

*1.1.2d Physical Function*

Physical function relates to the ability to complete various ADLs and reduced physical function is closely related to disability and mortality (46). Physical function is typically measured through tests such as the timed up and go, walking tests (400m walk test or 6 Minute Walk test), grip strength, and chair rise tests (5 chair rises or 30 second sit to stand). Self-reported measures of physical function have typically been measured using the Medical Outcome Survey – Short Form 36 (SF-36).

Gait speed has been determined to be an easy predictor of function and future hospitalization. Studenski et al. (50) found that 41% of slow walkers (walking speed of <0.6m/s) were hospitalized through a 12-month follow up period compared to 26% of intermediate walkers (0.6-1.0m/s) and 11% of fast walkers (>1.0m/s). This demonstrates that a small change in gait speed may have significant, clinically relevant impacts on health outcomes. Greater volumes of sedentary time per day was associated with a greater annual decrease in 6 Minute Walk distances, usual 4m walking pace, and fast paced 4m walking speeds in older adults with Peripheral Artery Disease (51).

Sedentary time may be associated with the risk of experiencing sarcopenia or being pre-sarcopenic in older adults. Increased amounts of sitting time are also inversely associated with lean mass and positively associated with total body fat mass (52). Less

muscle mass and strength would increase the effort required to do various activities requiring light or moderate to vigorous efforts which may result in increased sitting time, resulting in a downward spiral.

Gianoudis et al. (53) found that each 1-hour increase in self-reported sedentary time was associated with a 33% increased risk of having sarcopenia. Volumes of sedentary time tend to increase with age while physical function declines with age, thus, maintaining or making small reductions in sedentary time may have significant impacts on physical function (7, 20). Substituting 60 minutes/day of sedentary time with 0-55 minutes/day of MVPA and 55-60 minutes/day of LPA (maintaining a net 1:1 substitution) resulted in significant improvements in 400m walk time, usual gait speed, and 5 time sit to stand results in older adults (54). Conversely, Yasunaga et al. (46) found that improvements in physical function were found if MVPA was substituted for either sedentary time or LPA but no benefit existed when substituting sedentary time with LPA. Yasunaga et al. (46) used relatively small substitutions (10-minute bouts) which may be more feasible for older adults to achieve and explain why they did not see a difference in substituting LPA where Lerma, et al. (54) did.

As demonstrated earlier, increased breaks in sedentary time can prove beneficial for cardiometabolic health when total volumes of sedentary time remain the same. A similar relationship may exist for physical function. Reid et al. (52) found that participants with higher volumes of device-measured sedentary time had poorer performance on the 30-second sit to stand test while increased breaks in sedentary time were associated with an increase in lower muscle strength. This relationship was attenuated when models were adjusted for stepping time but is consistent with the

findings for a randomized controlled trial (55). Barone Gibbs et al. (55) implemented a 12-week intervention to reduce sedentary time by 1-hour per day and found the intervention group improved the time required to complete five sit to stands compared to the control group. There was no significant difference in total sedentary time, but the intervention group increased their sit to stand transitions through the 12-weeks suggesting this may be a large enough stimulus to improve physical function. Reid et al. (52) also noted that more breaks in sedentary time reduced participants' risk of experiencing pre-sarcopenia and for each 10 sit to stand increase per day, participants had 45% lower odds of being pre-sarcopenic. Similarly, Davis et al. (18) also found each additional break in sedentary time per hour (i.e. A sit to stand transition) was associated with a 0.58-point increase in overall lower extremity function after adjusting for MVPA, sedentary time, and sedentary breaks.

Lee et al. (56) examined the association between device-measured movement patterns and mobility declines over one year follow up among older adults within assisted living residences. Participants were classified into three categories at baseline: "independent" (no assistance to stand from a seated position), "assisted transfer" (staff assistance to stand), and "dependent transfer" (staff and mechanical assistance to stand) (56). "Independent" residents took significantly more steps, engaged in more LPA, and more sit to stand transitions than those considered "assisted transfers" or "dependent transfers" (56). At 12-month follow up, residents that experienced a mobility decline (i.e. regressed to a lower mobility level from baseline) had been more sedentary (21.7 hours vs 19.7 hours per day at baseline), took fewer steps per day, and also completed fewer sit to stand transitions compared to those that maintained their mobility (56). None of these

differences reached significance, however, focusing on increasing standing breaks or LPA may lead to improvements in function among this group that align with the findings of Barone Gibbs et al. (55) or Reid et al. (52) with community-dwelling older adults.

*1.1.2e. Self-Rated Health*

Cross-sectional research has identified a negative association between high amounts of prolonged sedentary time and self-rated health. Wilson et al. (57) found this significant, negative correlation existed after adjustment for covariates and individuals with very good/good self-rated health spent 3.56% and 5.66% less time engaging in sedentary behaviours compared to individuals rating their health as fair or bad/very bad, respectively. In contrast, Buman et al. (58) found no significant associations between device-measured sedentary time and physical or psychosocial health factors in older adults. Physical factors included the number of medical conditions, number of medications, general health rating, self-reported BMI, and lower extremity physical function (58). Psychosocial factors included stress, life satisfaction, isolation, feeling depressed/blue, and pain interference (58).

The type of sedentary behaviour may have an impact of self-rated health. Davies et al. (59) found that higher levels of screen time increased the likelihood that older adults self-rated their health as poor or fair. Higher levels of screen time increased the number of reported “unhealthy days” compared to those with lower levels of screen time, particularly when compounded with no physical activity. Conversely, O’Neill and Dogra (13) found that computer use was associated with increased self-rated health in older adults.

Sedentary breaks and LPA appear to have a greater impact on geriatric syndromes compared to other chronic diseases. Frequently breaking up sedentary time with standing breaks or LPA appears to be associated with improved self-reported cognitive function, reduced frailty, and improved physical function. Self-rated health appears to be associated with the type of sedentary behaviour as some seated behaviours improve feelings of social connectedness. As much of the research is cross-sectional, the association between higher sedentary time and negative outcomes could be due to reverse causality. More longitudinal research should be conducted to determine temporal sequence.

### 1.2 Patterns of Sedentary Time

Some studies have shown that the way in which sedentary time is accumulated can play an important part in associated health risks. The Sedentary Behaviour Research Network considers a sedentary behaviour pattern to be the way sedentary time is accumulated throughout the day or week (i.e. the way in which sedentary bouts and breaks in sedentary time are strung together) (1). Sedentary bouts refer to a period of unbroken sedentary time while sedentary breaks are the period of non-sedentary time between two sedentary bouts (1). Research using accelerometers typically considers one minute of movement above 150 counts per minute to the be the minimum criteria for a sedentary break (60).

Two common patterns of sedentary behaviour have emerged: the “breaker” and the “prolonger” (61). A “breaker” regularly interrupts periods of sitting and typically stands up to move briefly throughout the day while a “prolonger” typically remains seated for a long period of time (61). Regularly interrupting sedentary time is associated

with better health outcomes than accumulating the same volume of uninterrupted time (9, 10).

Healy et al. (9) found that people with more breaks in their sedentary time had a lower waist circumference, BMI, and blood triglycerides. Analysis of NHANES data has shown participants with a higher daily percentage of sedentary time with fewer breaks had a higher risk of metabolic syndrome (24). Sardinha et al. (62) examined seniors' ability to complete ADLs of varying difficulty. They found that individuals with ≤7 breaks in sedentary time per hour were more likely to require help or be unable to complete ADLs such as basic personal hygiene, light household chores, and walk up and down stairs, even after adjusting for MVPA. High volumes of device-measured sedentary time have been negatively associated with cardiorespiratory fitness among Canadian adults while more breaks in sedentary time were positively associated with cardiorespiratory fitness (63). Panten, et al. (64) examined the time balance between leisure physical activity behaviours and leisure sedentary behaviour where a negative balance indicated more sedentary behaviour than physical activity time. For each unit increase (i.e. More leisure physical activity and less leisure sedentary behaviour), participants reported improved self-rated general health, mental health, and fewer physical limitations (64).

It appears that older adults are busiest in the morning, with periods of unbroken sedentary time increasing through the afternoon and evening (20, 65, 66). Schlaff et al. (65) found that participants were sedentary for 57% of their morning, with this percentage increasing to 60% and 68% through the afternoon and evening, respectively. Focus groups with older women identified this pattern as a strategy to manage energy

levels throughout the day (67). While examining sedentary behaviour and frailty, Blodgett et al. (20) found more sedentary individuals are more likely to be physically inactive and do not achieve 10000 steps per day. Active participants tended to rest more in the evenings (i.e. unwind after work or dinner) and on Sundays whereas inactive or unhealthier participants maintained a constant level of inactivity and sedentarism throughout the week (20).

Older adults over the age of 75 years also maintained a pattern of consistent sedentarism whereas their younger counterparts, 65-75 years, were more active through the morning (66). Widowed participants were also more sedentary in the evening that those that were married (66).

### 1.3 Types of Sedentary Behaviour

Sedentary behaviour is present throughout all aspects of life and some activities are unavoidable. The Social Ecological Model highlights the impact of multiple levels of society's influence on health outcomes and behaviours from the individual to higher level policy and environment (68). The model emphasizes four core principles: health behaviours are affected by more than just knowledge or skill level factors; factors affecting health behaviours interact across numerous levels; potential factors influencing health should be identified at multiple levels; and interventions should focus on multiple levels of influence to maximize effectiveness (69).

The Social Ecological Model of Sedentary Behaviour highlights the importance of understanding the behaviour context, and by extension the physical and social contexts, of a given sedentary behaviour (70). Owen et al. (70) identifies four "behavioural

settings" or domains into which sedentary behaviour can be categorized: leisure-time, transport, occupation, and household. Each of these different behavioural settings may have distinct determinants and be affected by different social and cultural norms (70). For example, many living rooms are configured around the TV and leisure-time spent at home may be predominantly spent watching TV or engaging in other screen-based activities. Many occupational settings are built to promote long periods of uninterrupted sitting.

Tam-Seto et al. (16) conducted focus groups with older adults to gain a better understanding of how this Social Ecological Model can be applied to this demographic. The mean age of this study was 74 years so volunteer roles were considered in place of traditional jobs for the occupational domain (16). Generally, participants identified increased interactions and stimulation, enjoyment, and health as motivators to reduce time spent in sedentary behaviour (16). Lack of motivation, enjoyment, physical health, and access were identified as barriers to participating in things that may reduce sedentary time (16). Interestingly, physical health was listed as both a motivator and a barrier indicating that although older adults may understand the benefits of moving more, the associated effort or pain may be too much to overcome. A study with Scottish older adults found similar results (71). Participants routinely mentioned fatigue, health, and enjoyment of some TV programs as a reason to remain sedentary (71).

### 1.4 Perceptions of Sedentary Behaviour

It appears that older adults associate a negative connotation with sedentary behaviour and equate it with "doing nothing" or not being engaged (4). Older adults associate many sedentary behaviours with benefits across the physical, mental, and social

health domains (4, 72). Palmer et al. (72) noted that participants tended to make a distinction between being busy or not busy rather than the distinction between seated and non-seated activities. Social interactions and the benefits of meeting new people through meaningful activities were highlighted as important (4). Participants of the Seniors Understanding Sedentary Patterns Project related being busy to their own cognitive functioning and mental health (72). Mentally stimulating seated activities, such as doing crossword puzzles or socializing with friends, were highly valued compared to seated activities that were considered passive, such as watching TV to pass time (72). McEwan et al. (4) found that community-dwelling participants considered their chosen sedentary behaviour to have physical benefits due to the effort required to prepare for the activity and attend the centre where the activities were offered.

Alley et al. (73) administered an online survey to gain a greater understanding of older adults' knowledge, behaviours, and intentions to change sedentary behaviour. They found that the majority of participants knew that increased sedentary time could increase their risk of various chronic diseases (82% of respondents) and mental health (50%) (73). Participants also acknowledged that their risk of these diseases would remain increased even if they accumulated 30 minutes per day of MVPA (55% and 38% for chronic disease and mental health, respectively) (73). However, less than a quarter of participants intended to sit less while watching TV (24%), using a computer (19%), or participating in other leisure-time activities (24%) (73). This indicates that more than just knowledge is needed in order to alter sedentary behaviour in this demographic.

### 1.4.1 Sedentary Activities and Health Outcomes

There has been some debate about whether all sedentary behaviours are created equal. Older adults have identified that they derive some benefit from engaging in more "mentally active" sedentary behaviours compared to "passive" sedentary behaviours (72).

Kikuchi et al. (11) conducted a survey on Japanese older adults to examine different categories of leisure-time sedentary behaviour and their association with health. Participants were asked about TV viewing time, computer use, reading books or newspapers, seated listening or talking, and sitting around. Based on factor analysis, these were categorized into "mentally-active" (computer use and reading) and "passive" (sitting around, TV, seated listening or talking) sedentary behaviour. Participants self-reported an average of 3.62 hours/day of passive and 1.25 hours/day of mentally-active sedentary behaviours (11). Higher levels of passive sedentary behaviour were associated with higher odds of being overweight (from self-reported height and weight) and having higher psychological distress (K6 scale) (11). There was no association between passive sedentary behaviour and psychological distress after adjustments for MVPA (11). No association was found between mentally active sedentary behaviours and any of the health measures (11).

Ku et al. (12) conducted an eight-year longitudinal study on older adults to examine associations between different SB and subjective well-being. TV watching, social chatting, and reading were significantly associated with subjective well-being after adjustment (12). Listening to the radio and playing chess were not associated with subjective well-being (12). No physical measurements were taken but it is interesting that some activities that would be considered passive and shown to have negative effects on

physical health by Kikuchi et al. (11) had a positive effect on subjective well-being in the study by Ku et al. (12).

Cross-sectional analysis of the Healthy Aging Cycle of the Canadian Community Health Survey identified that computer use and reading were positively associated with good life satisfaction and self-perceived health for men and women over 60 years old (13). Socializing was also associated with a strong sense of belonging to community (13).

Although research has not yet been able to determine the different health risks associated with various types of sedentary behaviours, sitting is ubiquitous and the nuance of different types of behaviours should be acknowledged when creating interventions addressing prolonged sitting. Older adults associated a negative connotation with the term “sedentary behaviour” and the possible benefits of cognitively or socially stimulating sedentary behaviours should be addressed with this population.

### 1.5 Assisted Living

Supportive living is an umbrella term used to describe residences that can provide additional support required by individuals due to age, chronic conditions, and mental or physical disabilities (74). When targeting older adults, supportive living residences are synonymous with retirement communities, assisted living residences or senior living centres. Unfortunately, there is no standard definition or term used across the literature. Assisted living is generally used to describe residences where older adults are assisted with various ADLs, including meal preparation, house keeping, bathing, or medication administration (75).

These residences are not necessarily designed to provide high levels of medical care for more severe chronic conditions. However, nursing homes, which provide specialized medical care, may be included within the same facility or nearby so residents can seamlessly transition between levels if needed. Within these residences, care is provided in a tiered fashion and larger residences may include all tiers.

The 2011 Canadian Census found that approximately 7% and 30% of Canadians ≥65 years and ≥85 years respectively, lived in assisted living residences (ALRs), nursing homes or long-term care hospitals (76). This leaves a growing proportion of the Canadian population that may particularly vulnerable to the effects of sedentarism.

### 1.5.1 Sedentary Time in Assisted Living Residences

To date, very little research has been done on sedentary behaviour in ALRs. The majority of research has focused on physical inactivity, however most of the inactivity is due to residents engaging in sedentary behaviours, such as seated organized activities, using the computer, or socializing with others. Older adults within ALRs have been shown to sit more compared to their community dwelling counterparts (77). Marshall et al. (78) found residents in ALRs spent an average of 9.4 hours in sedentary time per day while men had significantly more sedentary time (9.9 hours compared to 9.2 hours for women) when sedentary time was measured with accelerometers. It has also been found that men experience longer bouts of sedentary time when compared to women (79). Bouts of 10+, 20+, 30+, and 40+ minutes of unbroken sedentary time also increased with age (79). It is hypothesized that this is because women tend to do more housework than men which inadvertently breaks up periods of sitting (79). The health risks associated

with sedentary time in the general older adult population have also been found in the assisted living community highlighting the need to intervene (80-82).

The built environment has a large impact on sedentary time. Research has shown that the person-environment fit (the fit between someone's abilities and the environmental demands), building layout and amenities, and the number of activity residences (exercise space) play an important role in increasing activity and reducing sedentary time (83). Increasing the safety features and accessibility within a building along with creating visually appealing and interesting indoor and outdoor spaces decreased resident passivity (83).

Staffing levels and availability also influenced resident activity. Staff may help to reduce sedentary time by assisting residents with walking or transferring them from bed (83). Conversely, they may also increase these behaviours by encouraging residents sit or rest after a meal. Staff responsible for community programming may also coordinate programs that promote sitting, for example music concerts or book clubs, instead of non-sedentary activities. The important roles that the environment and staff play highlight the need to create multi-level interventions to address sedentary behaviour from all aspects of an ecological model.

### 1.5.2 Health Outcomes in Assisted Living Residences

Seniors in ALRs tend to have more physical and cognitive impairments when compared to their community-dwelling counterparts (80). Interestingly, studies with older adults that are not community dwelling have not found an association between sedentary time and cognition. A study with residents of ALRs found that sedentary time was not

significantly associated with cognitive functioning (80). Leung et al. (80) found no associations between objectively-measured sedentary time and cognition. Cognitive function was measured using the Montreal Cognition Assessment where a score ≤25 indicates cognitive impairment (80).

Rosenberg et al. (82) examined the associations between sedentary behaviour and mental, cognitive, physical, and functional health in ALR residents. Device-measured sedentary time was collected using an accelerometer and participants self-reported sedentary behaviour using the Sedentary Behaviour Questionnaire (SBQ) to provide context (82). The SBQ asks about the frequency and duration of nine sedentary behaviours, including: sitting/lying while watching TV, computer/internet use, reading, talking, in the car or bus, hobbies, group activities, napping, and "Other". Increased device-measured sedentary time was associated with an increased fear of falling and better cognitive functioning. Higher self-reported TV time was associated with worse 400m Walk Test scores but not with any other components of the Short Physical Performance Battery (SPPB). No relationship was noted between sedentary time or different sedentary behaviours with physical health.

Park et al. (81) used latent class analysis to categorize older adults from ALRs into three classes (Class 1: low physical activity, high sedentary behaviour; Class 2: average physical activity and sedentary behaviour; Class 3: high physical activity, low sedentary behaviour) based on device-measured movement patterns. As expected, the biggest differences in health status existed between Class 1 and Class 3 (Cohen's $d \geq 0.8$) while moderate to large effect sizes existed between Classes 1 and 2 (81). Small to moderate effect sizes were found between Classes 2 and 3 indicating that large

improvements in health status may be gained by making moderate changes to physical activity and sedentary behaviour habits (81). Class 1 spent 81% of wear time engaged in sedentary behaviours, 17.4% in LPA, and 0.09% in MVPA and had the lowest quality of life and vitality scores and higher levels of depression, anxiety and fatigue (81).

### 1.6 Interventions to Reduce Sedentary Time

Sedentary behaviour was previously considered equivalent to physical inactivity thus most studies targeted physical activity behaviours and alterations in sedentary time were a by-product. In recent years, research has been conducted to specifically target sedentary time. Martin et al. (84) noted that interventions addressing physical activity alone or a combination of physical activity and sedentary time were not as effective as interventions addressing sedentary time only. This is consistent with the findings of a meta-analysis by Prince et al. (85) and provides support for the idea that sedentary time is a separate construct from physical activity and motivators and barriers are different. Most interventions with adults have targeted altering work environments but a few have started to incorporate the social ecological model as a framework for the intervention (86).

Neuhaus et al. (87) tested a multi-level intervention compared to an environmental intervention and a control group. The multi-level intervention incorporated environmental changes (standing desks) and organizational feedback in for the form of departmental feedback about sitting times compared to the national average (87). Participants also received individualized feedback at baseline that compared them to the amounts of sedentary time in the department (87). The environmental intervention group only received standing desks while the control group continued usual practices (87). They found that sedentary time was reduced by 89 minutes per 8-hour workday in the multi-

level intervention compared to the control group (87). The environmental group experienced a non-significant decrease of 33 minutes per 8-hour workday compared to the control group (87). This indicates that although some environmental changes may alter daily sedentary time, developing an intervention through the lens of the social ecological model may allow it to have a greater impact.

Interventions have also focused on leisure-time behaviours to reduce sedentary time with some success (88). These studies intervened on an individual level by providing participants with goals to reduce TV time, increase standing breaks throughout the day, or reducing total daily sedentary time. Behaviour change strategies such as goal setting, educational sessions or information, and point-of-decision prompts were used (88). A systematic review found that although the duration of the studies included varied greatly (1-hour intervention to 12-months), they appeared to be effective as all studies (n=13) included found a significant change in at least one sitting-related variable (88).

Gardner et al. (89) examined the behaviour change strategies used in sedentary interventions to highlight strategies that may show particular promise. Promising reductions in sedentary time were found in studies that incorporated education, persuasion, environmental restructuring, and training (89). The most commonly used behaviour change strategies included setting behavioural goals, providing social support, and adding objects to the environment (90).

### 1.6.1 Interventions with Older Adults

The majority of the research has been completed with community-dwelling older adults and is cross-sectional in nature (3). A recent international consensus statement

recommended that “older adults should strive to reduce total sedentary time, break up prolonged periods…and move more” and identified research within ALRs as a priority (3).

A search of the literature found 13 interventions in older adults and 2 protocol papers (Table 1.1) (55, 82, 90-102). There were 6 pre-post test interventions, 1 quasi-experimental study, and 7 randomized controlled trials. All interventions addressed individual habits and knowledge. This involved informational booklets about sedentary time, individualized feedback regarding sitting habits, and on-going support over the phone or by email (55, 92, 93, 95, 99, 100, 103). Some interventions also included group-based sessions to promote social support and brainstorming (93, 99, 101). Fanning et al. (94) implemented a home-based exercise program delivered via DVD and provided additional information regarding healthy lifestyle behaviours.

Most of the interventions had a direct impact on sedentary time and noticed a significant reduction in the intervention group (Table 1.1) (90, 92, 93, 95, 97, 100-102). Based on self-report measures, participants achieved these reductions in sedentary time by reducing TV watching and reading. Device-measured sedentary time showed an increase in activities that involved standing, LPA, or MVPA (90, 92, 99, 100, 103). A few interventions noted no significant impact on total sedentary time but found that participants broke up sedentary time more frequently (55, 94, 102, 103). This may be equally as important as total reductions in sedentary time as more frequent breaks in sedentary time have been associated with better health outcomes (9, 24). Barone Gibbs et al. (55) noted that although their intervention did not create significant reductions in sedentary time, participants in the sedentary-focused intervention improved scores on the

chair stand test and Short Physical Performance Battery tests. This is important as some older adults may remain sedentary for large portions of the day because of the effort required to move from a seated to a standing position.

It is important to note that the previously mentioned studies included only samples of community dwelling older adults. Matei et al. (90) included two samples in their study: one from ALRs and one of community dwelling older adults. They noted the community dwelling sample reduced sitting time and habits while increasing walking and moderate activity. However, there were no clear changes in sedentary time or physical activity habits in the assisted living sample and they experienced attrition and adherence rates of 25% and 40%, respectively (90). No sedentary time or physical activity criteria were imposed on the ALR sample due to the assumption that they would be more sedentary. The community dwelling sample was required to self-report ≥6 hours of sedentary time per day and <150 minutes/week of MVPA (90). The ALR group self-reported an average of 4.9 hours/day and 5.8 hours/day of sedentary time on the IPAQ and MOST, respectively. The lack of change noted in sedentary time may be due to a rate of diminishing returns for the ALR group. However, the high attrition rate and low adherence rate suggests interventions directed at ALR residents may require a different approach to be effective.

### 1.6.2 Interventions in Assisted Living Residences

As previously mentioned, Matei et al. (90) did recruit a sample from ALRs but the intervention was not different from that given to the community dwelling sample. Research interventions specifically designed for ALRs appears to fall into two categories: 1) generally promoting more movement and using staff and/or residents to promote the

message; 2) specifically targeting a behaviour (i.e. Sit to stand transitions) and using staff to directly target that behaviour (Table 1.2). The first category seems to be more popular within residences that provide lower levels of care with more independent residents. Successfully intervening at this level of care may prevent rapid declines in function and promote more successful aging.

The RiAT study aims to use Self Determination Theory to increase activity (steps per day) and reduce sitting time over 16 weeks (104). Resident ambassadors will be recruited at each ALR and matched with participants to help investigators deliver the walking intervention (104). These ambassadors will be provided instructions on walk safety, the health benefits associated with increased movement and reduced sedentary time and how to support residents in maintaining motivation through the Self Determination Theory framework (104). Residents in the experimental group will receive similar information but the introduction to Self Determination Theory will be around how they can increase and maintain their own motivation (104). Initially, walks will be encouraged by staff and ambassadors, but participants will be encouraged to organize the walks themselves for the final 6 weeks of the intervention (104). The control group will receive the same information about walk safety and health benefits but will not receive education regarding Self Determination Theory (104).

The REACH Trial aims to promote “moving more” by providing ALR staff with three interactive workshops which will in turn influence resident activity (105). Four domains will be targeted: incorporating movement into social and leisure activities, providing opportunities to engage in “meaningful” activities, promote independent and supervised resident movement, and encourage residents to do as much of their own self

care and instrumental ADLs as possible (105). The aims are intentionally vague to allow for flexibility between the various ALRs. Improvements in device-measured activity levels, cognitive impairments, mood, and self-reported health will be compared to usual care over twelve-month follow up (105).

Interventions designed to be specifically delivered by staff seem to be targeted for higher levels of care (i.e. nursing homes) and have used health care aides and staff to promote movement among older adults with dementia. Restorative care focuses on restoring and maintaining the highest level of function possible in individuals while considering their individual needs, physical status, and comorbidities (106). Examples of restorative care include providing step by step cues for the resident to transfer themselves from one surface to another or encouraging use of assistive mobility devices rather than moving the resident without allowing them the chance to engage in the movement. Resnick et al. (106) educated practice nurses on how to incorporate restorative care into daily tasks with residents suffering from dementia over a 12-month intervention period. Residents experienced a significant improvement in mobility and balance from baseline to 4-month follow up. The intervention group also experienced less decline in gait at 12-months. This may be significant as preventing declines in physical function could be relevant and important in maintaining quality of life and independence.

A study using health care aides to promote sit to stand transitions during daily care routines also found that residents with dementia experienced less decline in mobility and functional fitness over 6-months compared to control (107). Residents in the intervention group also decreased the amount of time it took to complete one sit to stand

transition at follow up. Reducing the effort to stand out of a chair may make it easier for individuals to break up sitting time more frequently.

Grönstedt et al. (108) are completing a similar trial to Slaughter et al. (107) but not specifically targeted at older adults experiencing dementia. Residents ≥75 years within nursing homes will participate in a clustered randomized controlled trial to examine the impact of sit to stand transitions and a high protein oral supplement over 12-weeks. The intervention will also be delivered to residents via care staff by encouraging between one and ten sit to stand transitions (as able) per session. The target is for residents to complete at least four sessions a day, seven days a week, during various care activities such as dressing, toileting, and transfers. The authors expect to see a change similar to Slaughter, et al. (107) but hope to see it within a shorter time frame (three months compared to twelve months) (108).

There are a growing number of studies addressing sedentary time within ALRs. Findings from community-dwelling interventions should be considered, such as the success of educational interventions, goal setting, and on-going health coaching support, when developing these studies. Staff engagement within assisted living may be particularly important given the instrumental support provided to residents by the staff. Research within higher levels of care have demonstrated that staff can be engaged with success to deliver interventions and improve outcomes, such as physical function. Including multiple strategies (i.e. Staff engagement and resident education) may lead to more efficacious interventions.

## 1.7 Conclusion

The number of older adults worldwide is growing rapidly, with an estimated two billion older adults by 2050 (3). This will theoretically lead to more older adults living within ALRs and an increased risk of the aforementioned chronic diseases.

Sedentary behaviour and physical activity are independent constructs with different barriers and motivators which require different interventions to be effective. In recent years, there have been numerous public health campaigns to improve physical activity rates (i.e. the resurgence of ParticipACTION), however, very few Canadians are meeting Physical Activity Guidelines (7). Cross-sectional and longitudinal studies indicate that there are some health benefits to reducing and interrupting sedentary time. Replacing sedentary time with movement is beneficial with greater improvements seen when sedentary time is replaced with MVPA. Interventions specifically targeting sedentarism appear to be effective in reducing sedentary time, increasing standing time, or increasing sit to stand transitions.

Altering the focus from large exercise interventions to “micro-interventions” focused on small bouts of activity and regular standing or stretching breaks to address prolonged sedentary time may offer a novel way to prevent health declines associated with aging (61). Assisted living provides a new challenge as these residents are not required to do many housekeeping chores which would contribute to LPA and natural breaks in sedentary time. More interventional research with older adults, and specifically in ALRs, needs to be conducted to determine which approaches have the most impact on reducing sedentary time and improving health outcomes.

## 1.8 Hypothesis and Purpose

While there is a growing body of research around sedentary time, there remains limited evidence around successful interventions to reduce sedentary time in older adults. Even fewer studies have examined strategies to reduce sedentary time for older adults residing within ALRs. Cross-sectional research has demonstrated a link between increased amounts of sedentary time and a number of chronic diseases and comorbidities, including CVD, mortality, and geriatric syndromes. Given that higher physical function is seen in both physically active and less-sedentary older adults, addressing high rates of sedentary time may provide an efficacious strategy to improve physical function and health outcomes among older adults. Multi-level interventions have proven to create larger reductions in sedentary time within desk-based workplace environments but research in older adults, both community dwelling and within ALRs, have yet to include a multi-level design (109).

The purpose of this thesis was to develop and pilot a multi-level intervention to reduce sitting time within assisted living residences using an iterative process. It was expected that the 6-week pilot intervention would alter sedentary time by: reducing sedentary time and long bouts (>30 or >60 minutes) of sedentary time; increase sit to stand transitions and breaks in sedentary time. No significant changes in quality of life or physical function are expected due to the short intervention period.

Following this review of the scientific literature on sedentary behaviour in older adults, particularly those residing in assisted living residences, the experimental research conducted as part of this thesis project will be presented in two separate chapters. Chapter Two describes the multi-stage, participatory process used to develop the Stand to

Strengthen program. Chapter Three describes the implementation and findings of a 6-week pilot of Stand to Strengthen. Chapter Four will summarize the results as a whole.

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Table 1.1 Study Characteristics of Interventions to Reduce Sedentary Time in Community-Dwelling Older Adults

| Study | n | Study Design | Intervention (Framework) | Measure of ST | Changes in Movement | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Steps | ST (min) | ST (%) | ST Breaks | MVPA (min) | MVPA (%) |
| Ashe et al. (110) | 26 | RCT | Group based education & social support; Fitbit; PA prescription (SEM) | DM | ↑ | | | | | |
| Barone Gibbs et al. (55) | 38 | RCT | Meet PA guidelines or reduce ST by 1h per day (NA) | SR/DM | | | | | | |
| Burke et al. (92) | 375 | RCT | Information, exercise equipment & pedometer; phone & email support (NA) | SR | | | | | | |
| Chang et al. (93) | 48 | Pre-post | Education, group discussion, exercise program (ET) | SR | | | | | | |
| Fanning et al. (94) | 307 | RCT | DVD exercise program & additional healthy living information (NA) | DM | Ø | ↔ | ↔ | ↑ | Ø | Ø |
| Fitzsimons et al. (95) | 24 | Pre-post | Individual consultation about SB (NA) | SR/DM | | | | | | |
| Gardiner et al. (102) | 59 | Pre-post | Education (goal setting, identification of motivators & barriers) tailored feedback (SCT; BCT) | SR | Ø | ↓ | ↓ | ↑ | ↑ | ↑ |
| Gine-Garriga et al. (96) | 1338 | RCT Protocol Paper | Exercise classes or exercise classes plus information about PA & SB (NA) | SR/DM | NA | NA | NA | NA | NA | NA |

| Study | n | Study Design | Intervention (Framework) | Changes in Movement | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Measure of ST | Steps | ST (min) | ST (%) | ST Breaks | MVPA (min) | MVPA (%) |
| Kallings et al. (97); Sjogren et al. (98) | 101; 42 | RCT | Exercise prescription, information about reducing sitting, counselling (NA) | SR/DM | | | | | | |
| King et al. (111) | 36/59 | Pilot/ RCT | Feedback via an app using 1 of 3 theories (SCT, SIT, OCP) | SR/DM | | | | | | |
| Lee & King (99) | 103 | RCT | Phone & mail intervention to increase aerobic fitness & muscular strength (SCT, TTM) | SR | | | | | | |
| Lewis et al. (100) | 27 | Pre-post | Individualized feedback about SB, goal setting, normative data, follow up phone calls (SDT) | SR/DM | | | | | | |
| Maher et al. (101) | 42 | RCT | Informational video about reducing SB & a group discussion or information about reducing social isolation (DPM) | SR | Ø | ↓ | Ø | Ø | Ø | Ø |
| Matei et al. (90) | 23 | Pre-post | Information booklet about SB and PA (HFM) | SR | Ø | ↓ | Ø | Ø | ↑ | Ø |
| Rosenberg et al. (103) | 23 | Pre-post | 5 health coaching phone calls & individualized feedback (SCT) | SR/DM | ↑ | ↓ | ↔ | ↔ | ↑ | Ø |

Note: Gine-garriga, et al. is a protocol paper with the studies currently being conducted. Matei, et al. included a community dwelling and an assisted living sample in their study, the findings of the assisted living sample are in Table 1.2.

Abbreviations: SR (self-report); DM (device-measured); SEM (Social Ecological Model); SDT (Self Determination Theory); SCT (Social Cognitive Theory); ET (Empowerment Theory); BCT (Behavioural Choice Theory); SIT (social influence theory); OCP (operant conditioning principles); TTM (transtheoretical model); DPM (dual process model); Habit Formation Model (HFM); NA (not applicable); RCT (randomized control trial); ↑ (increase); ↔ (no change); ↓ (decrease); Ø (not measured)

Table 1.2 Study Characteristics of Interventions to Reduce Sedentary Time in Assisted Living Residences

| Study | n | Study Design | Intervention (Framework) | Measure of ST | | Changes in Movement | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Self-Report | Device Measured | Steps | ST (min) | ST (%) | ST Breaks | MVPA (min) | MVPA (%) |
| Forster et al. (105) | ~120 | RCT Protocol Paper | Interactive workshops for staff to promote "moving more" to increase activity and reduce ST | | | NA | NA | NA | NA | NA | NA |
| Graham et al. (112) | 120-150 | RCT Protocol Paper | "Skillful Care Training Package" given to staff to improve posture and mobility among residents | Ø | Ø | NA | NA | NA | NA | NA | NA |
| Gronstedt et al. (108) | 120 | RCT Protocol Paper | Staff facilitate sit to stand transitions daily (4-40 transitions/day) while helping residents complete ADLs; Participants will also take a high protein oral supplement | Ø | Ø | NA | NA | NA | NA | NA | NA |
| Matei et al. (90) | 12 | Pre-post | Information booklet about SB and PA (HFM) | X | | Ø | ↔ | Ø | Ø | ↔ | Ø |

| Study | n | Study Design | Intervention (Framework) | Measure of ST | | Changes in Movement | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Self-Report | Device Measured | Steps | ST (min) | ST (%) | ST Breaks | MVPA (min) | MVPA (%) |
| Resnick et al. (106) | 487 | RCT | Health care aides encouraged residents to complete more ADLs and self-care activities rather than doing them to the resident | Ø | Ø | Ø | Ø | Ø | ↑ | Ø | Ø |
| Slaughter et al. (107) | 111 | RCT | Health care aides facilitated sit to stand transitions during daily care routines for residents in nursing homes | Ø | Ø | Ø | Ø | Ø | ↑ | Ø | Ø |
| Thorgersen-Ntoumani et al. (104) | 210 | RCT Protocol Paper | Resident ambassadors to promote walking, information about walk safety, and benefits of reducing ST | X | X | NA | NA | NA | NA | NA | NA |

Note: Thorgersen-Ntoumani et al., Forster et al., Graham et al. and Gronstedt et al. are protocol papers with the study currently being conducted. Matei et al. included a community dwelling and an assisted living sample in their study, the findings of the community-dwelling sample are in Table 1.1. Resnick, et al. and Slaughter, et al. did not measure ST but found significant changes in mobility and physical function after the intervention period. NA (not applicable); RCT (randomized control trial); ↑ (increase); ↔ (no change); ↓ (decrease); Ø (not measured)

## Chapter 2: Developing Stand to Strengthen


### Abstract

Prolonged sedentary time (ST) is associated with increased risk of cardiometabolic disease, impaired physical function, and mortality. Older adults accumulate large amounts of ST and low amounts of physical activity, which may compound the associated health risks. There is a dearth of research examining strategies to reduce ST among older adults, especially among those within assisted living residences (ALRs). The purpose of this study was to develop an evidence-informed intervention to reduce ST within ALRs. Stand to Strengthen was developed in three phases: 1) literature review 2) discussions with AL residents 3) consultation with ALR staff. The literature review suggested a multi-level approach would be more effective, incorporating all four levels of the Social Ecological Model (individual, social, physical environment, and organizational). Discussions with AL residents were conducted to gain an understanding of resident perspectives of ST as well as motivators and barriers to reducing ST. There was a common belief that not all sitting was "bad" for health. Pain and lack of opportunity were common barriers; a lifelong habit of moving and social engagement were considered motivators. Based on the results of 1 and 2, a list of potential intervention strategies were developed and presented to ALR staff to gather feedback about feasibility. The resulting Stand to Strengthen intervention is evidence-based and co-created, with good potential for low-cost implementation and scale-up. Future research will examine effectiveness and optimal implementation strategies.

## 2.0 Introduction

Sedentary behaviour is defined as activities completed while in a seated or reclined position with low energy expenditure (≤1.5 METs) while awake (1). A high volume of time spent sedentary is associated with an increased risk of numerous chronic conditions, including cardiovascular disease, metabolic disease, and all-cause mortality (2, 3). High amounts of sedentary time have been associated with reduced physical function and quality of life in older adults (2).

Sedentarism tends to increase with age and over 90% of older Canadians spend more than 8 hours a day engaging in sedentary behaviours (4). It appears that older adults are busiest in the morning, with periods of unbroken sedentary time increasing through the afternoon and evening (5-7). Schlaff et al. (5) analyzed device-measured sedentary time and found that participants spent 57% of their morning in sedentary behaviours with this percentage increasing to 60% and 68% through the afternoon and evening, respectively. Engaging in more than an hour per day of moderate to vigorous physical activity (MVPA) has been shown to mitigate the negative health effects of sedentary time (8). Canadians are highly physically inactive and older Canadians even more so as only 13% of older Canadians achieve 30 minutes of physical activity per day (9).

Given the current inactivity levels of older adults, it may not be feasible to increase MVPA above the 60-minute per day threshold that appears to be necessary to reduce the health impacts associated with prolonged sedentary time (8). Cross-sectional research has demonstrated that individuals who break up their sedentary time more frequently or engage in shorter bouts of sedentary time have lower health risks compared to their counterparts engaging in prolonged sedentary time, even if the total volume of

sedentary time remains the same (10-12). Therefore, addressing prolonged sedentary time by reducing the total volume of sedentary time or encouraging more frequent breaks may be a more feasible approach for improving health outcomes in this demographic.

The number of older adults worldwide is expected to grow by 56% between 2015 and 2030 with the global population reaching almost 2.1 billion by 2050 (13). Costs associated with providing long term care increased by 4.8% annually between 2005 and 2011 in European countries (14). The aging worldwide population will likely result in these costs rising and a larger demand for assisted living options. Older adults in assisted living residences (ALRs) may be more prone to experiencing the deleterious effects of prolonged sedentary time, compounded by low volumes of physical activity, due to the services (i.e. housekeeping and meal preparation) provided by residences.

There is a paucity of research examining successful interventions to reduce sedentary time in residents of assisted living (i.e. assisted living residences, retirement communities, or nursing homes). Gaining a better understanding of how to successfully reduce prolonged sitting and ultimately improve health outcomes, including a reduced risk of chronic disease and improved physical function, is needed. The purpose of this chapter is to outline the development process for Stand to Strengthen, an intervention to reduce sedentary time in assisted living residences.

## 2.1 Intervention Development Process

The development of Stand to Strengthen was completed in three phases: 1) reviewing the literature; 2) gaining resident input and perspectives; 3) discussing preliminary intervention ideas with assisted living staff.

### 2.1.1 Literature Review

A review of interventions with older adults was conducted during Summer 2018 (Chapter 1). Interventions were included if they specifically targeted sedentary behaviour or sedentary time (i.e. not a physical activity or exercise intervention) in older adults (≥60 years). Both community-dwelling and assisted living samples were included as well as protocol papers outlining studies currently underway.

A total of 21 intervention studies were found (community dwelling: n = 15; assisted living: n = 7) (Table 1.1, Table 1.2). Of the assisted living studies, four were protocol papers with results currently unavailable. The three remaining papers included one study within an ALR while the other two were conducted in residences providing higher levels of care (i.e. nursing homes).

The literature review demonstrated that sedentary behaviour and sedentary time need to be addressed specifically in order to have an effect. Interventions addressing physical activity that hope to reduce sedentary time as a by-product do not appear to be as effective (15). Interventions to reduce sedentary time in older adults have traditionally focused on changing individual behaviours (Table 1.1).

A variety of theoretical frameworks have been used to alter behaviour among community-dwelling older adults with the most common being Social Cognitive Theory (n = 4) (16-19). Other theoretical frameworks included the Social Ecological Model (20), Self-Determination Theory (21), Behavioural Choice Theory (18), Social Influence Theory (16), Transtheoretical Model (17), Operant Conditioning Principles (16), Dual

Process Model (22), and the Habit Formation Model (23). Six studies did not identify a specific framework (24-29).

Due to the lack of research among assisted living residents, office-based workplace studies were also briefly examined. Assisted living residents may be analogous to desk-based employees as they have control of their immediate space (i.e. suite or cubicle) but interpersonal dynamics may influence resident life satisfaction and the likelihood of joining activities (i.e. social support). Company policy may dictate the wider physical environment and social norms within the workplace/residence.

*2.1.2a Multi-Level Interventions*

Office workplace research is starting to examine the effects of multi-level interventions on prolonged sitting time. A meta-analysis by Chu et al. (30) found that multi-level office-based interventions resulted in a 90-minute per 8-hour workday reduction in sitting which was approximately 15 minutes more per day than environment-only strategies. Reductions were also significantly greater than interventions utilizing individual behaviour change alone (15 minutes per 8-hour workday) (30). Multi-level interventions employ a Social Ecological Model to address multiple levels of influence on health behaviours and these influences interact across the levels; multi-level interventions should be the most effective at altering behaviour but these interventions or models should be behaviour specific (31). Stokols' (32) Social Ecological Model for Health Promotion considers individual behaviours but acknowledges the influence of the physical environment, social environment, and broader policy on the individual. The Ecological Model of Sedentary Behaviour considers the interplay of individual factors, social environment, physical environment, and policy in the domains of leisure time,

transportation, household activities, and occupation (33). For example, although it may be possible to have standing or walking meetings, social norms may dictate that meetings occur while seated. The conference room may be configured with a standard table that requires people sit instead of the table being a higher height that may allow some individuals to stand and take notes if they wish.

Health promotion interventions typically address the lower levels of the Social Ecological Model (individual behaviour and social domains) (34). Only 20% and 6% of health promotion studies included in the review by Golden et al. (34) (n = 157) included community or policy level strategies, respectively. This trend is consistent with the interventions conducted with community dwelling older adults.

Conversely, research within higher levels of care (i.e. nursing homes) appear to exclusively deliver interventions through staff. Resnick et al. (35) focused on increasing the amount of restorative care delivered by health care aides to residents with dementia. This involved providing residents with step by step instructions to complete self care activities rather than the health care aide doing the action to the resident (35). This resulted in improvements in mobility and balance and less decline in gait speed (35). Another intervention where health care aides assisted with sit to stand transitions during care routines resulted in less decline in mobility and functional fitness over 6-months compared to control in residents with dementia (36).

*2.1.1b Individual Behaviour Change Strategies*

Consistent with the findings of Golden et al. (34), research with community dwelling older adults tends to focus exclusively on altering individual behaviour through

education and/or social support. The majority of studies utilized Social Cognitive Theory to bring about these changes. Social Cognitive Theory is one of the most commonly used behaviour change strategies used in health promotion (37). There are three main components to this theory: self-monitoring, self-judgment, and self-evaluation (38). Individuals tend to selectively attend to behaviour and self-select behaviours they feel are important (38). Paying attention to behaviour allows individuals to notice recurrent patterns and self-regulate; judging a behaviour as important or unimportant can impact whether steps are taken to alter the behaviour (38). Providing social comparisons for individual behaviour can increase motivation to initiate or continue a change in behaviour (38). Self-evaluation helps direct behaviour and noticing improvements or progress towards goals increases motivation which improves self-efficacy (38). Sitting is ubiquitous across many domains and activities of daily living and so increasing awareness of these behaviours is an important aspect of reducing or breaking up sedentary time. Thus, we chose to use Social Cognitive Theory to direct the development of some intervention components.

Tougas et al. (37) found that across health promotion interventions, self-monitoring was typically completed through providing feedback, highlighting success or progress towards goals, valuing behaviours, and focusing on things within the individuals' locus of control. Self-judgment occurred by providing norms (group or national), comparing the individual's current and past behaviour, and identifying role models (37). Self evaluation occurred through rewards (external or internal) and self-satisfaction (37).

These findings are consistent with interventions used in studies among community dwelling older adults. King et al. (16) developed various phone apps that would provide information and feedback to participants to alter movement behaviour. The app based on Social Cognitive Theory and provided colourful meters shown on the phone to indicate how close the participant was to reaching their movement goal (30 minutes per day of MVPA) or sedentary goal (less an 8 hours per day) (16). Rosenberg et al. (19) incorporated graphical feedback from activPALs regarding sitting, standing, and stepping time from the past week and review of goals throughout the intervention to promote self-monitoring. Gardiner et al. (18) provided participants with feedback charts comparing individual, self-reported data with national norms for daily sedentary time. Ongoing goal setting throughout the intervention was used in all four studies. King et al. (16) facilitated goal setting through the mobile app while the other three studies used health coaches to facilitate individualized goal setting sessions (17-19).

A systematic review by Gardner et al. (39) noted that strategies involving goal setting, providing social support, and altering the environment showed particular promise when targeting sedentary behaviour. These strategies align with how current interventions are seeking to address sedentary time. Educational sessions with older adults have been shown to significantly increase step count over 3-6 months (20) and significantly decrease weekly sedentary time (22). Gardiner et al. (18) provided study participants with a general sheet of strategies to reduce sedentary time and encouraged participants to choose strategies that resonated with them. This resulted in a 3.2% decrease in sedentary time and a 4% increase in sedentary breaks over the following week (18). Goal setting is

a common component of these education sessions and has resulted in self-reported reductions in sitting time between 532 and 837.8 minutes per week (22, 40).

Maher et al. (22) used group-based education founded on the Dual-Process Model to reduce self-reported sedentary time. Education sessions included an informational video and group discussion and resulted in a 132 minute/day decrease in self-reported sedentary time. Lewis et al. (21) and Fitzsimons et al. (28) provided individuals with feedback based on activPAL data to increase self-awareness and facilitate goal setting around reducing sedentary time. Lewis et al. (21) provided additional follow up via phone calls to continue goal setting and accountability over 6-week follow up. Both studies saw reductions in device-measured sedentary time at follow up and an increase in standing and stepping time (21, 28). Matei et al. (23) included both community-dwelling and assisted living samples in their study to reduce sedentary time. They provided both groups with an educational booklet including information about sedentary time and strategies to reduce sedentary time based on the Habit Formation Model (23). The community-dwelling sample reduced their self-reported sedentary time while the people in assisted living increased their sitting time. This suggests that additional support or alternate strategies may be required to address the assisted living setting.

*2.2.1c Social Environment Strategies*

Van Nassau et al. (41) found a significant association between device-measured sedentary time and self-reported social network size; community-dwelling older adults with a larger network accumulate less sitting time. Conversely, Shaw et al. (42) found no associations between social support (social contacts, emotional support, practical support, social support or perceived support) and sedentary time in community-dwelling older

adults. Assisted living residences may promote a larger social network due to the collective dwelling, however, staff have reported that there are social dynamics that sometimes prevents residents from coming to activities (43).

Community-dwelling studies have delivered educational content in a group environment to promote social support and these have successfully reduced self-reported sitting time (22). Thorgersen-Ntoumani et al. (44) are building social support by forming walking groups within residences to reduce sedentary time and promote movement. Residents will be recruited to lead the walking groups within various residences and trained to maintain motivation among other participants that are not in a leadership role.

*2.2.1d Physical Environment Strategies*

The type of dwelling and location have also been correlated with sedentary time. Living in an apartment or flat has been associated with higher amounts of sedentary time compared to a standard house (42, 45). Greater natural space within the neighbourhood was associated with decreased sedentary time in community-dwelling older adults however this did not remain significant after adjustment for covariates (42). Negative feelings about the area, poorer neighbourhood social cohesion, and a perceived absence of services were also associated with increased sedentary time and this remained significant after adjustment for covariates (42). An environmental study of ALRs and their surrounding environment in the United States found that residences tended to be built near busy roadways and there was a lack of safe walking paths (i.e. Continuous sidewalks) along these roadways (46). Given most ALRs are built to model an apartment building and are likely in less walkable areas, other strategies need to considered to alter the physical environment of existing residences.

Signs and point of decision prompts are commonly used in workplace interventions to remind employees to stand or break up their sitting. Point of decision prompts are placed in locations where individuals are faced with a choice between two behaviours and one behaviour is considered more favourable (i.e. taking the stairs instead of the elevator). Larouche et al. (47) compared two different types of point of decision prompts against control to reduce occupational sitting. One point of decision prompt simply stated “time to stand!” while the other condition provided 40 unique prompts that targeted various components of Social Cognitive Theory (47). Eight prompts were sent throughout the day (between 9am and 6pm) and times were randomized to avoid participant anticipation. There was a significant decrease in sitting time in both prompt conditions compared to control, however, the reduction in sitting time was only 12-15 minutes (47). Sitting bouts >30 minutes declined the most compared to control (22-30 minutes). These changes were much smaller than other interventions incorporating environmental strategies (47), so it may be that point of decision prompts alone are not sufficient to promote changes in sedentary behaviour.

Lang et al. (48) provided oral point of decision prompts during a physical activity conference inviting conference attendees to stand and break up sitting during some presentations compared to no announcement at other conference sessions. There was a relative 60% increase in the number of people standing during presentations where an announcement was made compared to control (48). However, less than one in five session attendees were standing on average in the intervention sessions where the attendees were already of aware of the benefits of movement and reducing sedentary

behaviour (48). Thus, additional strategies to demonstrate support or endorsement of this change in behaviour may be needed in order for point of decision prompts to be effective.

*2.2.1e Organization/Policy Strategies*

Interventions focusing on the organizational domain of the Social Ecological Model have been successful in nursing homes by engaging staff to facilitate sit-to-stand transitions and standing breaks (Table 1.2). Slaughter et al. (36) and Resnick et al. (35) focused on increasing resident movement by having health care aides facilitate sit to stand transitions or increasing the number of self-care activities the residents completed. Although these studies did not measure total sedentary time, both studies reported less decline in gait speed and physical function over 12-month follow up, compared to control. Engaging and encouraging residents to complete more activities of daily living and self-care activities independently has also been shown to improve mobility among older adults with dementia (35).

The Stand and Move at Work intervention was developed to address occupational sedentary time and increase light physical activity (49). This study is currently ongoing, and results are not yet available. The MOVE+ intervention aims to increase light physical activity to ≥30 minutes per 8-hour workday while the STAND+ intervention includes the light physical activity goal along with trying to achieve a 50/50 split of desk sitting and standing time (49). The two interventions are similar except that the STAND+ group will also receive a standing workstation (49). Each site will have a "leader", which is a senior management employee that is the gatekeeper for the site, and an "advocate" who will be the primary contact point for the research team and help to implement a number of the strategies (49). Quarterly emails will be sent by the leader and formal approval of

employees participating in the study and engaging in 5-minute movement breaks per hour will be given by the leader (49). Employees will also receive a newsletter and one on one coaching to assist with goal setting and receive goal setting sheets (49). Signs and point of decision prompts will also be added to the workspace to provide information about sedentary behaviour and visual cues to remind people to sit less (49).

Interventions with older adults have successfully reduced sedentary time by addressing either individual behaviour or altering staff processes. Sedentary behaviour research within office workplaces has successfully shown that addressing aspects of the environment and organizational policy can reduce occupational sedentary time (50, 51). Combining the individual-level strategies of education and goal setting with staff engagement and including built and social environment components translated from office workplace research may create more effective interventions and greater reductions in prolonged sitting in ALRs. Multi-level interventions within ALRs may be feasible and all levels of the Social Ecological Model should be addressed when developing strategies.

### 2.1.2 Resident Input

We met with residents at six residences across Lethbridge, Alberta. All residences were considered Supportive Living 2 and are based on a social model of assisted living (52). Supportive Living 2 residences provide some housekeeping is provided for residents, meals are delivered in a group-based setting, and social activities are also provided both on- and off-site (52). Residences providing on-site medical care, such as nursing homes, were excluded from this study. Residents are able to have community-based organizations come to the facility to deliver medical care, but it is separate from the services delivered by the facility (52).

The purpose of these meetings was to determine residents' understanding and awareness of sedentary behaviour, as well as identify barriers and motives to reducing time spent sedentary. These insights would provide a starting basis to determine what strategies may be well received by residents in reducing prolonged sedentary time. We also created some educational materials in the form of posters and handouts (Appendix B) to gain feedback about what participants found interesting and relevant. Ethics approval for these conversations with residents was obtained from the Human Research Ethics Board at the University of Alberta (Protocol Number: 00075411). Informed consent was obtained from all residents that participated in the discussions.

*2.1.2a Resident Perceptions of Sedentary Behaviour*

Residents associated the term "sedentary behaviour" with sitting idle or doing nothing. A negative connotation was associated with sedentary behaviour and participants highlighted the need for balance (i.e. everything in moderation) and the benefits of some seated activities, such as socializing with friends, reading the news or a good book, or viewing an educational television program. Passive seated activities, such as mindlessly watching television, were considered detrimental to health. This indicated that it would be important to validate the beneficial aspects of social and cognitive stimulating behaviours when discussing sedentary behaviour and ways to reduce or interrupt prolonged sitting with the residents.

*2.1.2b Common Barriers to Reducing Sedentary Behaviour*

Poor weather conditions, an aging attitude, lack of motivation, and health were identified as the most common barriers to reducing sedentary time. Poor weather, such as

rain, extreme cold, and snow, left residents feeling confined to the facility and feeling like there were few other options for movement. A lack of opportunity or reason to move was highlighted, particularly during evenings and weekends. Residents described a lack of activities in the evening and on weekends which led them to remain in their respective suites engaged in more passive sedentary activities. Fewer staff are at the residences on evenings and weekends thus an activity that could be set up during standard work hours for residents to engage with autonomously would be needed to address this gap.

Sitting as an easy option and a feeling that they were unable to be as active as they were before due to age were frequently cited barriers to reducing sedentary time. Health problems including pain, fatigue, and reduced mobility were also cited as barriers. Sitting was a way to manage fatigue or recover from more active periods throughout the day. Residents highlighted the importance of listening to their bodies and not pushing themselves to be more active if they didn't have the energy. Walking for long periods without opportunities to rest was of concern, particularly among participants with reduced mobility. Moving between their individual suite and the main lounge area for activities seemed like too much effort for some residents, which resulted in these residents staying in their suites and not participating in activities, sedentary or otherwise. Sit to stand transitions were identified as a painful movement and residents indicated that this was a barrier to moving from a seated position.

*2.1.2c Common Motives to Reducing Sedentary Behaviour*

Enjoyment of non-seated activities, health related benefits of moving, and social interactions were the most commonly reported motivators for residents to reduce their sedentary time. Participants that identified a lifelong habit of being physically active and

a genuine enjoyment for non-seated activities felt they needed to “move it or lose it” and do these activities while they still had the mobility and health to enjoy them. Health benefits related to independence and mobility seemed to resonate more with participants compared to a reduced risk of chronic disease as most of the participants were already experiencing a number of comorbidities.

A desire to reduce pain and maintain physical function were also motivators. Many residents highlighted they had previously had an “activity buddy” that helped them stay active by walking or going to exercise classes together; there was a desire to find this type of companion again. The social environment during activities both within and outside of the facility almost motivated residents to break up sitting time. Although the actual activity or event may have been sedentary, residents were motivated to leave their own suite and attend the activity which would interrupt prolonged sitting.

*2.1.2d Message Feedback*

Messages developed for the focus groups were shown to participants for feedback. Four iterations of these messages were shown to residents (Appendix B). The messages contained the same content in the form of facts about sedentary behaviour and/or tips to reduce sedentary time. Two of the messages were in poster form, one was in infographic form, and one was a four-page booklet. The infographic and four-page booklet included a sedentary behaviour questionnaire. Residents reacted positively to the tips provided and felt they could implement them into their daily lives within the residence. The residents also liked the Sedentary Behaviour Questionnaire that was included on some of the materials (53).

Generally, residents within ALRs know the benefits of moving more but believe there are benefits to seated activities that are socially or cognitively engaging. The term "sedentary behaviour" is perceived with a negative connotation. The nuance of different types of sedentary activities and associated health outcomes should be acknowledged when discussing sedentary behaviour with this population. Materials that are engaging and provide feasible strategies were preferred by this group.

### 2.1.3 Staff Consultation

A list of potential intervention ideas was developed after receiving resident input and shown to staff to refine the strategies. The staff consultations took place at the same six residences as the resident discussions. The purpose of these sessions was two-fold: gain an understanding of staff perspectives of barriers and motives to reducing sedentary time among residents and gather feedback on the feasibility of different intervention strategies. A guide of questions used during the staff consultation can be found in Appendix C. Staff included the activity coordinators (AC) of six different residences, managers (two of the six residences), and kitchen and housekeeping staff (five of the six residences). Five of the six residences were operated by the same organization. Ethics approval for the staff consultation was obtained from the Human Research Ethics Board at the University of Alberta (Protocol Number: 00075411). Informed consent was obtained from all staff members that participated in the study (Appendix A).

#### *2.1.3a Perceptions of Resident Sedentary Behaviour*

Like the residents, staff also defined sedentary behaviour as "sitting idle" or "doing nothing". Staff identified that residents engaged in a large amount of sitting and

seated behaviours, but they felt if the sedentary activities were in common areas or in a social setting, they were more favourable. Staff associated being sedentary with residents that tend to stay within their individual suites rather than coming to common lounge areas to engage with other residents. Thus, it seemed that for many of the staff the social context of the seated activities influenced their perceptions of the behaviour.

*2.1.3b Perceived Resident Motives and Barriers to Reducing Sedentary Behaviour*

Staff identified challenges in getting some residents to leave their room and the ACs highlighted the need to create a variety of programs to try and appeal to as many residents as possible. Forgetfulness about events and a lack of staff to remind residents about activities was also highlighted. Activity coordinators and managers noted that they often have to knock on doors immediately before an event to encourage participation. Some residents need to be walked to the event which is time consuming and causes delays which can lead to other residents leaving the activity before it has started. Staff echoed the sentiment expressed by the older adult participants that the residences are quiet on evenings and weekends but viewed it from the perspective that residents were not interested in coming to planned events after dinner rather than there being a lack of opportunity. This may be related to the perceived effort by the residents that is required to come back to the common area from their individual suites.

*2.2.3c Feedback About Potential Intervention Strategies*

Staff were given a list of potential intervention strategies (Table 2.1) and asked to rate them as feasible, not feasible, may be feasible, or not necessary (i.e. something similar was already in place in the facility). These strategies were created based on

commonly used strategies in other studies with older adults (i.e. education sessions, goal setting, providing feedback about sitting time) or workplace studies (i.e. standing table is similar to a sit stand desk). Other strategies came from the prior discussions with the residents that identified gaps or barriers that could possibly be addressed through an intervention. For example, residents identified a wish for an activity buddy so a buddy system was one of the suggested strategies.

Overall, staff reported that individual behaviour change strategies such as providing residents with education and goal setting to reduce their sitting time was feasible. Group based education was thought to be more effective than providing written material as they noted many don't read those types of materials. Increasing social support through the creation of a buddy system (i.e. Accountability partner) or providing information to family were deemed by most of the staff to be feasible and important strategies. Placing point of decision prompts around the facility was also considered an easy strategy to increase awareness of sitting behaviours and prompt residents to make a different choice.

Staff felt that some organizational strategies were feasible, but staff may be limited by their role in terms of what they could help implement. For example, kitchen staff noted they do not have much resident interaction compared to the ACs, managers, or housekeeping so it would likely be harder for them to remind residents to take standing breaks. All staff expressed no concerns promoting movement around the facility. Activity coordinators felt they could easily incorporate standing breaks into current seated activities, like bingo. Support staff, such as housekeeping and kitchen staff, felt they could be more active in reminding participants about different activities or programs

taking place in the lounge. It was acknowledged that although the residents may be seated during these activities, they would at least accumulate some light physical activity while walking to or from the event. Support staff also thought they could take residents for walks after their shifts (a different type of buddy system) or ask residents to help them with small tasks to promote movement, for example, helping them refill the sugar, salt, and pepper at the tables in the dining room. These suggestions are consistent with previous research that has shown the importance of staff engagement for changing movement behaviours in residential care (35, 36).

Some suggested strategies were considered not feasible by the majority of staff; these fell into the categories of the changes to the physical environment or organization. One suggested strategy was to provide firm chairs with arm rests to make it easier for residents to transition from a seated to standing position, but managers indicated that it was difficult to find chairs like that and they tended to be quite heavy which precluded residents from being able to move them around as needed. Furthermore, some activities or programs were not considered appropriate for table shuffles or standing breaks. Meals were considered a time when the space would be too hectic and a table shuffle or standing break would be difficult. A few residences identified that they did have buffet style meals for special events throughout the year so this strategy may be feasible if conceptualized in a different way. The social networks within the residences made table shuffles during card games, etc. seem not feasible as staff felt it would not be perceived well by residents who wanted to engage in these activities with specific friends, or the sessions would be too crowded to do this safely. A one-minute stand and stretch break

with residents staying at the same table was identified as a better alternative to break up sitting time during these activities.

Some of the strategies that were discussed were deemed unnecessary by staff because they are already part of the routine at some residences. For example, one facility already incorporated a semi-regular scavenger hunt around the building to encourage resident movement. The AC reported that the residents enjoyed going in groups to find the clues and answers. Other residences did not already have this type of an activity in place, so it provided good evidence that a scavenger hunt could be successful in the other residences. This demonstrates the importance of having a variety of different strategies for staff and the activity coordinators to choose from, as they can use the ones that are most appropriate for their particular residence. Other residences reported on strategies they use to promote activity using incentives. For example, residents could be entered into a draw to win a prize if they attended one of the active, non-sedentary activities, such as lawn bowling. This facility also had a buddy system in place to help new residents' transition into the facility by having the buddy bring them to activities and help orient them to the space. However, this buddy system was to promote inclusion rather than movement, but it appeared to promote attendance at activities. Staff indicated that adding a component to the buddy system around movement would be possible.

### 2.2 Development of Stand to Strengthen

Stand to Strengthen is a collection of different strategies that target different levels of behavioural influence to promote less sitting time. The strategies were designed to be implemented in assisted or supportive living residences where residents are able to move independently, but many could be adjusted and adopted across the accommodation

spectrum. It was clear from resident focus groups and staff discussions that each facility is unique and thus Stand to Strengthen would need to be flexible with a number of components or a "menu" of choices which could be implemented in tandem or individually to address prolonged sitting time.

The following strategies were selected as they received positive feedback from staff and it was felt that they addressed some barriers to reducing sedentary time that were identified by assisted living residents. There was evidence indicating the effectiveness of many of these strategies in existing research with community dwelling, assisted living or desk-based workplace research.

### 2.2.1 Individual Strategies

1. **Education:** An education session will be delivered in a group setting, accompanied by written materials in the form of a workbook (Appendix D). The goal of the education session is to increase awareness of sedentary behaviour and the associated risks and answer participant questions about sedentary behaviour. Based on feedback from the resident focus groups, a list of strategies and questionnaires participants could engage with were included in the workbook. Educational materials were developed using Social Cognitive Theory (38) and focus on increasing self-monitoring by providing individual feedback about movement patterns from the activPALs and facilitating goal setting. Self-judgment will be addressed through a group discussion of movement patterns, group norms from the Stand to Strengthen baseline data (i.e. aggregated means), and national normative data.

2. **Goal setting:** Goal setting will be included in the education session to help participants modify the strategies provided in the workbook to fit their individual lifestyle. Participants will also be asked to identify barriers that may prevent them from completing their goals and create a relapse prevention plan to address these barriers. Conversation with study staff and other participants in the group will help to refine these goals, relapse prevention plans, and further explain the concept of sedentary behaviour.
3. **Individualized feedback:** Information about individuals' own sedentary time either from a self-report questionnaire or a movement tracking device such as activPAL4 inclinometers will be provided to increase self-awareness of sitting behaviours and assist with goal setting.

### 2.2.2 Social Environment Strategies

1. **A Buddy System:** Many residents described previously having a friend they would walk with prior to moving to the ALR and expressed a desire for this type of companion again. Residents within the intervention will be offered the opportunity to be paired with a "movement buddy" to increase social support and companionship. Movement buddies may or may not be part of the official intervention depending on the facility and input by management.
2. **Scavenger Hunt:** A scavenger hunt was popular at one residence; however, it was completed during weekdays when staff and other programs were occurring. This scavenger hunt will be proposed as a weekend activity to promote autonomous, purposeful activity amongst the residents. The scavenger hunt will be themed based on any holidays or events occurring at the time. For example, at

Easter the scavenger hunt could be a series of eggs placed around the facility. Each egg has a number on it and residents must sum the numbers to successfully complete the scavenger hunt. Entries into the scavenger (i.e. the correct sum) will be provided to the AC as proof that the scavenger hunt was be completed, and a small prize draw will happen after the hunt to incentivize residents to participate.

### 2.2.3 Physical Environment Strategies

1. **Point of Decision Prompts**: Point of decision prompts have been used in workplace research with some success (47). Two point of decision prompts were created to be placed in common areas at the residences (Appendix E). One was developed to be used in the lounge prompting people to "stand and chat" at the standing table while the other was placed in the common area near the TV reminding people to break up sitting time by standing during commercial breaks.
2. **Standing Table:** Standing workstations have been used with some success to reduce occupational sedentary time. A sturdy, standing height table will be provided as an alternative to the traditional seated tables in the lounge. The stand and chat point of decision prompt will be placed on the table to remind residents of the alternative.

### 2.2.4 Organizational Strategies

1. **Staff Education:** There was some ambiguity about the meaning of "sedentary behaviour" by staff so providing educational information to staff would also be an important strategy. An education session for staff will ideally be delivered in a group setting; written materials will also be provided. The information provided will cover the risks of prolonged sitting, the importance and benefits of breaking

up sitting with even small amounts of standing and moving, and tips and ideas for how staff can encourage residents to sit less and move more throughout their daily life.

2. **Standing breaks during organized, primarily seated activities:** Standing breaks during programming were considered feasible in certain situations. Staff, particularly the ACs, will be encouraged to incorporate standing breaks during prolonged activities, such as crafts. This can be done by explicitly introducing a standing break (i.e. pausing the activity and asking everyone to stand up and walk around the space) or by altering the way an activity is delivered. For example, card bingo and cribbage are quite popular in the residences we visited for the focus groups. Instead of one large group game, creating a tournament format for either of these games that create more opportunities for sit to stand transitions and walking breaks will be suggested.
3. **Stand to Strengthen Ambassador:** A Stand to Strengthen ambassador(s) will be selected from the staff at each site to encourage residents to break up sitting time by standing or taking a short walk during unplanned time. For example, if residents have been seated and socializing in the lounge for an extended period, the ambassador would facilitate a break in sitting.

## 2.3 Discussion

Residents in assisted living face unique challenges regarding sedentary time as they do not have the same need to complete many household chores as their community-dwelling counterparts (52). A multi-level intervention was developed using a participatory method to ensure the intervention components would be relevant to assisted

living residents. The strategies were chosen as they have been used successfully in previous studies in various settings, and then staff were consulted to ensure feasibility from their perspective.

Many studies conducted within both office workplace settings and with community-dwelling older adults have used education and goal setting-based strategies to effectively reduce sedentary time. Community-dwelling studies have resulted in reductions of approximately 30 minutes per day of device-measured sedentary time (18, 28) while self-reported reductions have ranged from 76 to 142 minutes per day (22, 40). Maher et al. (22) conducted goal setting in a group environment following education and a group discussion while other studies provide one on one goal setting with a health coach (28, 54).

To our knowledge, no other studies have incorporated strategies like the scavenger hunt, however, creating an interesting indoor environment has been recommended to promote movement within assisted living residences (46). Focus groups with residents at the ALR where the scavenger hunt was a regular activity spoke highly of the activity and stated that it broke up sitting without them having to think about it (43). The scavenger hunt was a fun, social event and each iteration was unique so they were also cognitively engaged while figuring out the clues provided during the activity (43). Focus groups by Gine-Garriga et al. (55) noted that residents wanted to feel autonomous and able to do activities on their own without burdening others. The scavenger hunt allows the residents to engage in the activity autonomously without requiring a great deal of assistance from the AC or staff. Thorgersen-Ntoumani et al. (44) are currently using an intervention using resident-led walking groups in the RiAT to create a social, supportive

environment that will hopefully reduce sedentary behaviour. The groups are created by study staff so this may be similar to the buddy system conceptualized for Stand to Strengthen. The RiAT study has the additional component of the walk ambassador which is more similar to the Stand to Strengthen Ambassador role in the present study. Buman et al. (49) has also created the role of an "advocate" within an office workplace intervention where they will help implement environmental and organizational changes within the office. Both of the interventions proposed by Thorgersen-Ntoumani et al. (44) and Buman et al. (49) are currently underway and have not yet published results. The use of advocates or ambassadors may increase peer modelling and peer support within the residence which in turn may promote regular movement and reduce prolonged sitting.

Older adults have identified that having a flexible environment that allowed for easy standing options to complete simple activities, such as reading the newspaper, promoted reductions in sedentary time (54). Height adjustable workstations have been shown to reduce occupational sitting time between 30 and 100 minutes per 8-hour workday (50, 56). A standing height table placed within the common area of a residence may act similarly to a height-adjustable workstation and provide an easy alternative. The visual of the table may also act as a prompt for residences to remember they can stand for some activities, rather than always sitting. Point of decision prompts have been effective at reducing sitting time within office workplaces when delivered via email over the course of a workday (47). Sending emails or other electronic communication may not reach all residents as not all have computers or mobile phones. Instead, large, colourful posters placed near the TV lounge and at the standing table may be enough to remind residents to stand. Community-dwelling older adults have previously reported using post-

it notes within their living spaces to remind them to move which may be similar to the signs created for Stand to Strengthen (54).

A number of studies are currently underway targeting sedentary time in assisted living residences and contain strategies similar to the organizational domain of Stand to Strengthen. The REACH study aims to increase resident movement and reduce sedentary time having staff focus on the message of "moving more" (57). "Moving more" was determined to be intuitive to staff and will be delivered through four main domains: 1) incorporating movement in social and leisure activities; 2) promoting independent and supervised movement of residents; 3) providing opportunities to engage in "meaningful" activities; 4) encouraging residents to do as much of their own self-care as possible (57). No specific guidelines will be given to the staff to allow flexibility between sites. Brainstorming around potential strategies and how to implement them will be completed at workshops delivered to staff on-site. Graham et al. (58) are focusing on mobility and posture in the PATCH study by improving staff skills to promote movement by facilitating "activating behaviours" and promoting functional posture. Improving functional posture is thought to reduce pain and increase mobility, thereby reducing the effort required to move more frequently. Grönstedt et al. (59) are delivering an intervention similar to that of Slaughter et al. where staff will encourage residents to complete sit to stand transitions while assisting with activities of daily living. The goal is for participants to complete between one and ten transitions at a time, at least 4 times per day, 7 days a week as able (59). No results are available for these studies, so the efficacy of these interventions are not known, however, the popularity of these types of strategies

in current interventions may indicate that these strategies are generally considered feasible and to have promise.

Some strengths of this study include the multi-step and participatory process through which the Stand to Strengthen was developed. The literature review ensured the initial materials provided to residents for feedback were evidence-informed and built on the findings of previous research. Discussions residents provided us with insights to resident perceptions of sedentary behaviour, their motivators and barriers to reducing sedentary time which directly impacted how the intervention strategies were created. Feedback on the preliminary messages also helped to inform future materials that were provided to facility staff for review. Consultations with staff strengthened the intervention strategies by ensuring they would be appropriate for a variety of residences.

A relatively small percentage of our sample required a wheelchair or motorized device to assist with movement. These participants indicated that some of the materials did not resonate with them as they were unable to walk freely but we were unable to recruit a large enough sample to better understand how we could effectively interrupt prolonged sitting. Family was mentioned by both staff and residents as being a helpful resource, but we were unable to consult with family. Including more mobility impaired participants and family members in future research may make interventions and resulting strategies more generalizable. All the residences recruited were created based on a similar model and provided a consistent level of care. Although the clientele is slightly different at each site, our findings are limited to this specific type of assisted living facility. More research with a more diverse group of residences is required to understand how these

strategies may be altered or applied to reduce prolonged sitting across a range of accommodation settings.

## 2.4 Conclusion

Stand to Strengthen is an evidence-informed multi-level intervention that was developed with consultation with staff and residents of assisted living residences. Future implementation of a pilot intervention will allow for the evaluation of Stand to Strengthen's efficacy.

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Table 2.1 Intervention Suggestions Presented to Residence Staff

| Suggestion | Feasible | Not Feasible | May Be Feasible | Not Necessary |
|---|---|---|---|---|
| Signs around the facility to encourage residents to stand | 13 | | 4 | |
| Small games with prizes that encourage walking around the facility | 15 | | 1 | |
| "Lunch and Learn" with staff about sedentary behaviour | 9 | | 5 | |
| Identification of a "stand to Strengthen ambassador" at each facility<br>• Assist residents with 1-2 extra sit to stand transitions per day | 7 | 1 | 7 | 1 |
| Written information provided for all staff | 15 | | | 1 |
| Educational brochures containing information on benefits of reducing sedentary time available throughout the facility | 14 | | 2 | |
| Tips and strategies from previous information sessions included in newsletters, central bulletin boards, etc. | 13 | | 2 | 1 |
| Information session with residents about sedentary behaviour | 12 | | 3 | 1 |
| Provide chairs with appropriate arm rests so that older adults can get in and out of chair without assistance | 11 | | 3 | 2 |
| Recreational programming or exercise leaders introduce "standing breaks" at group events and activities | 8 | | | 2 |
| *For Example:*<br>• Standing breaks at meals | 6 | 3 | 6 | 1 |
| • Standing exercises in exercise classes for those able to stand and move independently | 14 | | 1 | 1 |
| • Encourage 1-2 sit to stand transitions during exercise classes for those that need to do majority of the exercises seated | 12 | 1 | 2 | 1 |
| • Standing breaks during craft events | 11 | | 3 | 1 |
| • Table shuffle during games (ie. Bingo) to encourage 1-2 sit to stand transitions | 12 | 1 | 3 | |

| Suggestion | Feasible | Not Feasible | May Be Feasible | Not Necessary |
|---|---|---|---|---|
| Including family by: | | | | |
| • Encouraging them to take residents on walks during visits | 14 | | 2 | |
| • Informational handouts or sessions for family members | 12 | | 4 | |
| Resident buddy system | 11 | | 4 | 1 |

## Chapter 3: Stand to Strengthen: A 6-week feasibility trial to reduce sitting time in assisted living residences


### Abstract

The population of older adults is rapidly growing world-wide which will result in greater numbers of older adults in assisted living residences (ALRs). Sedentary behaviour (waking time spent seated or lying down ≤1.5 METs) has been identified as a health risk and sedentary time increases with age while physical activity participation decreases. Reducing sedentary time may have health benefits for older adults, however, there is limited research examining strategies to reduce sedentary time within ALRs. The purpose of this study was to test a multi-level intervention, called Stand to Strengthen, that targets sedentary time in ALRs by promoting individual behaviour change, modifying the social and built environment, and encouraging organizational changes. Ten residents from 2 different ALRs participated in a 6-week pilot study of Stand to Strengthen (82.2 ± 8.7 years; 90% female; BMI = 30.4 ± 5.9). Before and after the intervention, participants completed assessments of physical function (grip strength and Short Performance Physical Battery (SPPB)), quality of life (QOL) (EQ-5D, ICECAP-O questionnaires), and daily movement behaviour (activPAL4 and self-report). Paired sample t-tests in the whole group showed no significant change in physical function or QOL, however, participants in the residence with lower function at baseline (n=5) demonstrated a significant and clinically meaningful increase SPPB score over 6-weeks (p = 0.035). There were no significant changes in device-measured sedentary time, standing time, sit to stand transitions, or bouts of sitting. There was a trend towards a decrease in self-reported weekday sitting time (142 minutes/day (p=.086). Consultation with staff and residents confirmed that Stand to Strengthen is feasible for use in residences; results

suggest that with a longer intervention period it could reduce sedentary time and improve physical function among older adults.

## 3.0 Introduction

Sedentary behaviour is defined as activities completed in a seated or reclined position with a low energy expenditure while awake (1). Older adults (>60 years of age) are a highly sedentary demographic with 90% of older Canadians engaging in 8+ hours of sedentary time per day (2).

Although regular physical activity may attenuate the negative effects of sedentary time, older adults tend to have low physical activity participation and it may be difficult to motivate older adults to achieve the 60-75 minutes per day of moderate-to-vigorous physical activity (MVPA) required (3, 4). Low amounts of physical activity combined with high volumes of sedentary time can be especially detrimental to health (5). Currently 15% Canadians achieve physical activity guidelines of 150 minutes of MVPA per week while this drops to 13% of older Canadians (4). On average, older Canadians accumulate 14.5 minutes (17 minutes for men, 12 minutes for women) of MVPA per day which is insufficient to attenuate the impacts of high levels of sitting (4).

Reducing or regularly interrupting sedentary time has been associated with a lower risk of various diseases and better function (6, 7). Data from NHANES demonstrated that a greater number of breaks in sedentary time is associated with a reduced risk of metabolic syndrome, lower waist circumference, body mass index (BMI), and blood triglycerides (6, 8). Breaks in sedentary time have also been associated with improvements in physical function, self-rated health, and mental health (9). Sardinha et al. (10) found that older adults with ≤7 breaks per hour of sedentary time were more likely to require assistance or be unable to complete various activities of daily living compared to those with > 7 breaks per hour.

Due to the dose-response nature of physical activity, health benefits can still be achieved at lower volumes and intensities of physical activity. Substituting sedentary time with light physical activity (LPA) also shows some promise for reducing the risk associated with sedentary time (11, 12). Increased levels of LPA have been associated with improved balance, reduced risk of falls, and increased lower extremity strength (13). Accumulating ≥300 minutes of LPA per week was associated with a reduced risk of chronic disease, better body composition (lower waist circumference and BMI), and improved blood lipid profile and insulin resistance in older adults (14). The average older Canadian accumulates an average of 207 minutes per day of LPA which may mean increasing minutes of LPA per day is a more feasible goal compared to increasing MVPA (4).

There is a growing body of literature targeting sedentary time in community-dwelling older adults. These studies typically seek to change sitting time by providing information about the detriments of sedentary time, increasing self-awareness of sitting behaviours, and facilitating goal setting to change behaviour (15-19). These studies have shown some success with reductions in self-reported sedentary time between 76 and 132 minutes per day (16, 17). Studies reporting device-measured sedentary time, typically from ActiGraphs and activPALs, have indicated a 3% decrease (~25 minutes per day) (15, 18, 19). These studies have also been successful in breaking up sedentary time which confers health benefits. Barone Gibbs et al. (20) found that participants that increased sit to stand transitions significantly improved chair rise scores in the Short Performance Physical Battery and also reported a higher quality of life after a twelve week intervention, even when there were no significant changes in total sedentary time.

Gardiner et al. (18) also noted a 4% increase in sit to stand transitions with an individual behaviour change intervention.

Although interventions have been successful at reducing sedentary time in community dwelling older adults, there is little interventional research targeted at residents of assisted living residences (ALRs). Interventions have been conducted at higher levels of residential care, such as nursing homes, and with individuals experiencing dementia. Slaughter et al. (21) asked health care aides to facilitate sit to stand transitions with residents at least twice a day while assisting with personal care tasks, and found a slower decline in physical function over six months, even though total sedentary time did not change. Resnick et al. (22) promoted more movement by using restorative care whereby health care aides provided greater instruction and encouragement for residents with dementia to complete various ADLs and self-care for themselves, rather than completing the activities for the resident. This resulted in a significant improvement in balance and mobility over 4-month follow up with less decline in gait speed at 12-month follow up (22).

The number of older adults worldwide is increasing and expected to reach 2.1 billion by 2050 (23). As the worldwide population grows, a larger number of older adults will reside within ALRs resulting in a need to understand how to reduce prolonged sedentary time within this demographic. The Social Ecological Model considers behaviours to have multiple levels of influence: individual attributes and choices, social environment, the built environment, and organizational/policy factors (24). These domains are nested within each other and the interplay between them must be considered when seeking to change behaviour (24). Research on workplace sedentary behaviour has

used the Social Ecological framework to intervene beyond individual behaviour change strategies. Neuhaus et al. (25) compared an environmental intervention (standing desks) to a multi-level intervention incorporating the environmental intervention as well as individual feedback to participants and support from management. The multi-level intervention resulted in more significant reductions in sedentary time in an 8-hour workday compared to the environmental-only group (25).

Assisted living residences may be similar in some ways to workplaces as the residents are not in control of the built environment or overarching policies but can control individual behaviour and their private space (i.e. their suite). To our knowledge, very little research with older adults has sought to reduce sedentary time by targeting all four levels of the Social Ecological Model. The Stand to Strengthen intervention was developed to reduce sedentary time among residents in assisted living using a Social Ecological framework. Because all ALRs are unique, Stand to Strengthen was designed to be flexible with a number of components or a “menu” of choices which could be implemented in tandem or individually to address prolonged sitting time. The purpose of this study was to examine the acceptability, feasibility, and effectiveness of the Stand to Strengthen intervention over 6-weeks on physical function, quality of life, and sedentary behaviour patterns.

## 3.1 Methods

### 3.1.1 Procedures

Invitation letters were sent to the activity coordinators (AC) of two local ALRs in Southern Alberta who both agreed to participate (Site A and Site B). Both residences were considered to provide the same level of care and offer meals, housekeeping and activities within the facility and residents are required to be independently mobile (26). Additional medical care is accessed through community-based clinics or home care; a physician or medical staff is not present at the facility (26).

A meeting was held with management at the residences to provide an overview of the intervention, discuss the support needed from the ACs, and schedule study sessions. An information recruitment session was held at both residences (Site A: n = 47; Site B: n = 115) to provide interested residents with information about the study (Figure 3.1). A total of 17 residents attended the information sessions between the two residences (Site A n = 7; Site B n = 10). Thirteen residents signed up for the study and completed the informed consent, with one withdrawing from the study before baseline data collection, leaving a final sample of n = 12 (91% female, 82.7 ± 7.9 years) at the beginning of the study.

*3.1.1a Study Design*

Before the intervention, assessments were conducted over two sessions (Table 3.1). At the first session participants completed a questionnaire package and were fitted with an activPAL™ inclinometer (PAL Technologies, Glasgow, Scotland). One week later the activPAL™ was collected and participants completed assessments of physical

function. The Stand to Strengthen intervention strategies were then implemented and 6 weeks later all assessments were repeated (Table 3.1). All study sessions took place at the respective residences to ensure there would be no barriers regarding transportation to study participation. All study procedures were approved by the University of Lethbridge Human Subject Research Committee, Protocol #2019-001 and participants provided informed consent prior to completing assessments (Appendix F).

### 3.1.2 Measures

*3.1.2a Participant Demographics*

Participant information regarding marital status, age, gender, and how long they had been living in the lodge was collected at baseline.

*3.1.2b Quality of Life*

Quality of life was measured with the EQ-5D-5L and the ICEpop CAPability measure for Older People (ICECAP-O) (Appendix G). The EQ-5D-5L is a generic measure of health status that defines health in terms of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression along a five-point scale (no problems, slight problems, moderate, severe, and unable to do the action/extreme) (27). It also includes a visual analogue scale for overall health anchored between 0 (worst health imaginable) to 100 (best health imaginable) (27). The EQ-5D-5L has a discriminatory power of 0.68 and a test-retest reliability of 0.69 (28). The visual analogue scale of the EQ-5D-5L has a convergent validity between 0.90 and 0.99 (28).

The ICECAP-O provides a broader measure of quality of life compared to the EQ-5D (29). The ICECAP-O measures attachment (love and friendship), security

(thinking about the future without concern), role (doing things that make you feel valued), enjoyment (enjoyment and pleasure), and control (independence) (29). Each construct is measured on a four-point capability scale (none to all) (29).

*3.1.2c Sedentary Time*

Sedentary time was measured through the Longitudinal Aging Study Amsterdam (LASA) Sedentary Behaviour Questionnaire (Appendix G) and an activPAL4™ inclinometer. The LASA measures self-reported sedentary time by asking participants about time (hours:minutes) spent in 10 sitting behaviours on an average weekday or weekend day (30). The questionnaire has a test-retest reliability of 0.71 (95% CI 0.57-0.81), but may underestimate total sedentary time by as much as 2.1 hours (30). The LASA was intended to provide additional information regarding the context and type of behaviours participants are engaging in. Visser and Koster (30) found the six domains of napping, reading, listening to music, watching TV, engaging in seated hobbies, and talking to friends had the highest correlation with device-measured sedentary time. Thus, we only included these six domains when calculating self-reported sedentary time.

The activPAL4™ inclinometers measure movement patterns 24 hours per day and eliminate recall bias. Inclinometers also monitor body positions which makes them useful for measuring sedentary time as they can distinguish between sitting and standing. activPALs have been found to be valid and reliable when comparing them to direct observation ($R^2 = 0.94$) (31). The activPAL4s were waterproofed using a nitrile sleeve and affixed to participants using Tegaderm (3M Medical, USA). Participants were given extra pieces of Tegaderm and a log sheet in case they had to remove the activPAL4™.

Participants and the AC were also shown how to replace the activPAL4™ on their leg in case they needed to remove it during the week.

*3.1.2d Physical Function*

Prior to the physical assessments, participants completed the Get Active Questionnaire (Appendix H) and resting heart rate and blood pressure were taken with an automated blood pressure cuff (UA-787, Life Source A&D Medical, Mississauga, Ontario) to ensure participants were safe to complete the protocol. Height and weight were also measured for all participants using a stadiometer (Seca, Hamburg, Germany) and scale (Seca, Hamburg, Germany). Grip strength was measured using a dynamometer (Creative Health Products Inc, USA) following CSEP testing guidelines (32). Grip strength is associated with mortality risk as well as functional autonomy and quality of life (33).

The SPPB (Appendix I) is an objective assessment tool for evaluating lower extremity functioning in older adults and it includes assessments of gait speed (4 m walk), standing balance (in 3 stances: side by side, semi-tandem, and tandem), and 5 timed chair rises (34). The SPPB has been shown to have high validity and reliability in measuring physical function in older adults (35) and is also predictive of mobility impairment (36). A change of 0.5 is considered to be a small meaningful change in physical function while a 1-point change is considered to be a substantial meaningful change (37). The entire battery of tests was conducted in a circuit format that took approximately 20 minutes to complete.

*3.1.2e Feedback*

We collected feedback from residents via feedback forms post-intervention (Appendix L) to gain an understanding of which strategies participants used most frequently and how much they liked or disliked the different intervention components. We also interviewed the ACs to receive staff-level feedback about ways we could improve the program for future iterations (Appendix N). All staff provided informed consent prior to the interview (Appendix M).

## 3.2 Intervention

The full Stand to Strengthen program was envisioned to be a menu from which ALRs could select strategies to fit their residence and needs. An initial meeting with the ACs at either site helped to determine which Stand to Strengthen strategies (Chapter 2) were implemented through the 6-week pilot. The same strategies were implemented at both sites throughout the 6-weeks to ensure consistency.

### 3.2.1 Individual Strategies

Individual behaviour components included a one-hour, group-based education session during the first week of the intervention. An information booklet was given to participants (Appendix D) that included information about the health risks associated with prolonged sitting, a short questionnaire to increase self-awareness of sitting time, and strategies to reduce or break up sitting time. Information about goal setting and barrier identification was also provided and facilitated by study staff. Participants were encouraged to set up to three goals based on the information discussed. Study staff

worked with participants to refine goals and ensure they were specific, measurable, attainable, realistic, and had a timeline.

Barriers were identified and plans were made to allow participants to overcome these barriers. This section was also used to reinforce the idea that participants did not have to attend exercise class or increase exercise time specifically but that they could achieve health benefits by breaking up sitting time or taking short moving breaks.

### 3.2.2 Social Environment Strategies

The social component of the intervention was delivered through the implementation of a weekend scavenger hunt. Activity coordinators were provided with instructions and five playing cards that created a cribbage hand (Appendix J). The scavenger hunt was set up on a Friday afternoon before the AC left for the weekend. Residents were encouraged to look for the cards over the weekend and provide the AC with the answer (i.e. What the cribbage hand was) on Monday. Residents that completed the scavenger hunt and had the correct answer were entered into a draw to win a $10 gift card.

### 3.2.3 Physical Environment Strategies

The physical environment was altered by providing a standing table which was placed in the lounge at each site. The table was placed there during the first week of the intervention and referenced during the education session. Point of decision prompts were placed at the standing table and in the TV lounge (Appendix E). These encouraged residents to “Stand and Chat” at the standing table or to incorporate standing/moving breaks during TV commercial breaks.

### 3.2.4 Organizational Strategies

Organizational components included obtaining support for the intervention plans from each facility's manager and AC. Activity coordinators were given the same educational booklet (Appendix D) that was provided to participants and they were encouraged to increase standing breaks and/or sit to stand transitions during activities that may involve prolonged sitting (i.e. Crafts, card games, bingo).

## 3.3 Analysis

The activPAL™ results were analysed using the CREA – beta algorithm in the PALbatch software (v8.10.6.33, PAL Technologies, Glasgow, Scotland). This algorithm considers 24-hour wear time and classifies lying time as primary (i.e. during the night) or secondary (i.e. during the day). Both primary and secondary lying time was excluded from consideration for "sedentary time" as it is unknown whether the participants were asleep during these periods or simply reclining. All statistical analyses were completed in SPSS Statistics 24 (v 24.0.0.1 IBM). The data were found to be normally distributed, thus baseline differences between sites were examined used independent sample t tests. Paired-sample t-tests were used to compare changes over the 6-week intervention. Pooled data were analyzed and although sample sizes were small, given the pilot nature of the study, analyses were also conducted in each site separately.

## 3.4 Results

Twelve participants started the study; one participant was lost to follow up due to medical complications unrelated to the study and another participant was unable to attend the education session and one session of baseline data collection, so was excluded from the analysis. This left ten participants with complete data for analysis.

### 3.4.1 Baseline Differences

Independent sample t tests were conducted to examine differences in age, years the residents had resided in the lodge, quality of life, physical function, and self-reported and device-measured sedentary time. Chi-squared tests were used to examine differences in marital status between the two sites. There were no significant differences between Site A and B in marital status or in how long participants had resided in the facility prior to starting the intervention (Table 3.2). There was a significant difference in age with participants at Site B being significantly older, on average, than at Site A (Site A: 76.2 ± 8.3, Site B: 88.2 ± 3.5, t = -2.974, p = 0.018) (Table 3.2). There were no significant differences in movement patterns between the sites, although significant differences existed in total SPPB scores (Site A: 5.2 ± 2.17, Site B: 9.8 ± 1.48, t = 3.92, p = 0.004) due to slower gait speed (Site A: 0.73 ± 0.26, Site B: 0.89 ± 0.14, t = -2.36, p = 0.046) and chair rises (Site A: 34.15 ± 17.77, Site B: 14.05 ± 35, t = -2.67, p = 0.029) among participants at Site A (Figure 3.2; Figure 3.3; Table 3.8). Significant differences also existed for self-reported quality of life (ICECAP-O) (t = -3.38, p = 0.010), with Site B having higher scores, but there were no significant differences in self-reported sedentary time or EQ-5D scores.

### 3.4.2 Changes Pre- and Post- Intervention

Overall, there was no significant change in quality of life in either the EQ-5D or the ICECAP-O questionnaires over 6-weeks (Table 3.3). Pooled analysis showed there was a trend towards improvement in physical function, as measured by the SPPB score, although this did not reach significance (p = 0.086, Cohen's *d* = 0.18). One participant was excluded during analysis of self-reported sedentary time due to invalid data (sum of

values exceeded 24 hours) leaving n = 9. When considering the six domains of napping, seated reading, listening to music, watching TV, seated hobbies, and talking to friends, there was a 142.2 minute/day decrease in weekday sedentary time which trended towards significance (t = 1.96, p = 0.086, Cohen's *d* = 0.90) (Table 3.4). There was no significant difference in device-measured total sedentary time, standing time, average steps, sit to stand transitions, or number of bouts of sitting >30 minutes (Table 3.6).

Paired sample t tests were completed for each site to examine if the intervention results differed between sites. Due to the small sample size at each site (n=5), these analyses are under-powered, and results should be viewed with caution. However, as this was a pilot study, we felt it would be beneficial to still examine results by site to determine if Stand to Strengthen was promising. There remained no significant differences in quality of life (Table 3.3). Site A experienced statistically and clinically significant changes in physical function (Figure 3.3) with improvements in tandem balance time (Pre: 5.08 ± 2.62, Post: 8.54 ± 2.19, t = -2.966, p = 0.041, Cohen's *d* = 1.43) and overall SPPB score (Pre: 5.2 ± 2.17, Post: 6.8 ± 1.3, t = -3.138, p = 0.035, Cohen's *d* = 0.89). There were no changes in physical function at Site B although changes in some measures approached moderate effect sizes (Table 3.8). There were no significant changes in device-measured movement at either Site post-intervention (Table 3.5).

Paired sample t tests were completed with pooled data to examine differences between weekday and weekend movement patterns. At baseline, there appeared to be a trend towards more self-reported sitting on weekdays compared to weekends (Weekdays: 622.2 ± 182.4, Weekends: 492.0 ± 209.4, t = -2.159, p = 0.063) (Table 3.4), however, there were no significant differences in device-measured movement patterns between

weekdays and weekends (Table 3.6). There were no significant changes in pre-post weekday or pre-post weekend movement (Table 3.6). Post-intervention there were significantly more sit to stand transitions (Weekdays: 49.2 ± 10.9, Weekends: 44.1 ± 9.3, $t = 6.216$, $p < 0.001$) and stepping time (Weekdays: 79.6 ± 65.1, Weekends: 68.5 ± 53.6, $t = 2.414$, $p = 0.039$) on weekdays compared to weekends (Table 3.7). There was a trend towards a greater number of steps on weekdays compared to weekends (Weekdays: 6391 ± 6965, Weekends: 5318 ± 5474, $t = 2.030$, $p = 0.073$) post-intervention.

By site, there were significantly more sit to stand transitions at Site A at baseline on weekdays compared to weekends (Weekdays: 51.4 ± 10.7, Weekends: 44.4 ± 10.0, $t = 3.380$, $p = 0.028$) (Table 3.7). There were no significant differences between weekends and weekdays at Site B at baseline. There was no significant difference in weekday movement patterns post-intervention from baseline at Site A (Table 3.7). There was a trend towards a greater number of weekday sitting bouts >30min (Pre: 384.7 ± 205.3, Post: 393.8 ± 179.0, $t = -2.716$, $p = 0.053$, Cohen's $d = 0.05$) post-intervention at Site B (Table 3.7). Trends indicated an increase in weekend stepping time at Site A (Pre: 65.8 ± 58.6, Post: 84.7 ± 75.3, $t = -2.452$, $p = 0.070$, Cohen's $d = 0.28$) and a decrease at Site B (Pre: 64.1 ± 17, Post: 52.4 ± 11.4, $t = 2.463$, $p = 0.069$, Cohen's $d = 0.80$). At Site B, this was combined with a trend towards a decreased total step count on weekends (Pre: 4619 ± 1156, Post: 3707 ± 735, $t = 2.310$, $p = 0.082$, Cohen's $d = 0.94$).

### 3.4.3 Resident Feedback

Participant feedback was gathered via anonymous surveys post-intervention (Appendix L) to determine satisfaction with the intervention and inform future research. Participants ranked the different strategies in order of preference, and it appeared they

liked the group education session and goal setting the most, followed by the list of individual tips and strategies and point of decision prompts (Table 3.9). Participants indicated that every day they used the strategy of "choosing to move" and taking moving breaks during prolonged sitting (Table 3.10). The participants indicated that they felt they learned a lot and that they could adapt the strategies to match their own lifestyle. One participant indicated they would have liked more check-ins and contact with staff throughout the program and another indicated they would have liked the program to last longer. The participants received three contacts over the course of the intervention (excluding data collection appointments) in the form of the education session and two check in phone calls during weeks four and six of the intervention.

### 3.4.4 Staff Feedback

The Activity Coordinators (ACs) at both sites gave informed consent (Appendix M) and were interviewed for their perspectives after the intervention (Appendix N). The ACs reported that the participants in the study didn't seem to be discussing their goals of moving more or sitting less with others. The standing table was used at both sites, although not frequently through the six weeks. They suggested that perhaps some kind of puzzle, etc. that needed to be completed at the table would promote engagement and standing. Interest and motivation through the six weeks also seemed to wane so a greater amount of engagement may be required. The AC at Site A recommended using tangible rewards or reminders to promote sustained behaviour (i.e. Logbooks, gold sticker system). The scavenger hunt was the most successful intervention strategy in terms of resident engagement and excitement. Site A had never done a scavenger hunt before and the AC stated she would be continuing the activity after the study was over. Site B had

completed scavenger hunts before but for the purposes of the study they implemented our materials and set up the scavenger hunt over the weekend. The AC indicated some residents participated but did not say how it compared to regular participation.

Both ACs indicated that they did not make any changes to the way in which they implemented regular programming to reduce or interrupt prolonged sitting and felt that more staff knowledge and engagement would be necessary. The ACs were provided with a copy of the educational materials that were given to the residents, however, more specific suggestions of ways the AC could reduce resident sitting within their role may be more helpful in the future. During the follow up interview, the AC at Site B continually referenced demonstrating exercises or physical activities to the residents when we were discussing sedentary behaviour specifically which may indicate that we did not effectively educate the staff on the difference between sedentary time and physical activity. Creating educational sessions or booklets specifically for staff would likely improve the delivery of the Stand to Strengthen program.

## 3.5 Discussion

Stand to Strengthen is a novel intervention developed to reduce sedentary time in assisted living. It was designed to address all four levels of the Social Ecological Model through a participatory framework. To our knowledge, this is the first intervention within ALRs to consider individual behaviours, social environment, built environment, and organization/policy. While this 6-week pilot study did not demonstrate any significant changes in physical function or quality of life, Stand to Strengthen was feasible and well-received by both residents and staff of the ALRs.

Pooled data indicated no significant changes in device-measured movement patterns, physical function, or quality of life post-intervention, however, there was a trend towards decreased self-reported weekday sitting time. Although changes in physical function were not statistically significant, some trends in the results, specifically at Site A, showed promise. Participants at Site A demonstrated a significant and clinically meaningful increase in SPPB scores over 6-weeks and a trend towards more post-intervention weekend stepping.

### 3.5.1 Physical Function

Even small changes in physical performance, such as what we observed at Site A could have meaningful effects. Studenski et al. (38) noted slow walkers (<0.6 m/s) had an increased chance of hospitalization through 12-month follow up compared to intermediate walkers (0.6-1.0m/s), and a gait speed of 1.0m/s was associated with the lowest number of hospitalizations (38). Participants in the present study were close to the 0.6m/s cut off at baseline but increased to 0.68m/s at 6-week follow up. A longer intervention may result in further improvements and allow them to reach the target of 1.0m/s.

Total SPPB scores among participants at Site A increased from 5.25 to 7.0 and gait speed improved (0.58 m/s pre-intervention; 0.63 m/s post-intervention) over 6-week follow up. SPPB scores at Site B did not change over the intervention, however, gait speed improved from 0.89m/s to 0.93 m/s. These changes could be important; a cross sectional study found that women with a gait speed <0.78 m/s and a total SPPB score ≤6 were at an increased risk of falling compared to participants with a score between 10-12 (39). Site B was at a lower risk of falling, per Veronese et al. (39), but improvements or

maintenance in physical function are still relevant to promoting independence and quality of life (40).

Taking longer than 16.7 seconds to complete five chair rises and an inability to hold the semi-tandem balance position for >10 seconds has previously been associated with an increased risk of falling (39). Although our participants did not have a statistically significant change in chair rise scores, the mean chair rise time decreased from 20.12 seconds to 17.23 seconds which may be clinically relevant and is closer to the 16.7 second cut-off. Site A experienced a 12 second reduction in chair rise time (34.2 seconds at baseline; 22.6 seconds post-intervention) while Site B reduced their chair rise time by 1.16 seconds. A fear of falling has been identified as a barrier to reducing sitting time (41, 42), thus improving these physical function measures could increase confidence and feelings of safety, which may result in older adults being less sedentary.

Participants at Site A increased their daily sit to stand transitions by 11% which could account for the improvement in physical function scores, particularly for the chair rise test. Sardinha et al. (10) found higher physical function was associated with increased breaks in sedentary time. Furthermore, studies in older adults with dementia found that focusing on sit to stand transitions and increased completion of self-care activities was sufficient stimulus to prevent physical function declines over 12-month follow up (21, 22).

Notably, Site A had a much lower physical function score at baseline compared to Site 2, despite being an average of 10 years younger. Site A also experienced much greater improvements in physical function through the 6-weeks compared to Site 2. This may be because Site A had much more to gain and the small stimulus of increased

walking and sit to stand transitions was enough to cause physiological overload, resulting in improved lower extremity strength.

### 3.5.2 Quality of Life

Overall, there was very little change in quality of life which was expected given the short duration of the intervention. There was a slight, non-significant increase in the attachment domain on the ICECAP-O and a slight decrease in the security domain over 6 weeks. The EQ-5D indicated slight reductions in the ability to complete usual activities and an increase in anxiety/depression over 6-week follow up. However, these differences were not significant and could be due to acute events in the participants' day to day lives.

Site A had a 7-point increase in "Health Today" as measured by the EQ-5D, while Site B had a 5-point decrease, although these were not significant. Barone Gibbs et al. (20) reported an improvement in quality of life after a 12-week intervention to reduce sedentary time due to a reduction in pain. It was hypothesized the improvement was because the intervention group increased their sit to stand transitions. The increased number of sit to stand transitions may have acted as strength training and possibly improved lower extremity strength, which can reduce pain associated with arthritis (43). Site A in Stand to Strengthen saw an 11% increase in daily sit to stand transitions which may be have been enough to improve lower extremity strength, similar to the improvements seen by Barone Gibbs et al (20).

### 3.5.3 Sedentary Time

*3.5.3a Self-Reported Sedentary Time*

Self-reported sedentary time was close to device-measured values and indicated reductions in both weekday and weekend sitting although they were not significant (Tables 3.5, 3.6). The reductions in sitting time are consistent with those reported by Maher et al. (17) after a 12-week intervention targeting individual behaviour change (132.6 minutes/day). Chang et al. (16) reported a decrease of 76 minutes/day after participant education and goal setting. Our finding of a decrease of 142 minutes/weekday and 89 minutes/weekend day would be considered a meaningful difference that could impact health; however, it did not reach statistical significance, perhaps due to the small sample size.

Baseline device-measured data suggested there was more sitting time on weekdays compared to weekends (30 minutes per day) although these differences were not statistically significant. There was a trend towards more daytime lying on weekend days however, this time was excluded from consideration for "total sedentary time" as it was unknown whether participants were awake during this time. Although these differences did not reach statistical significance, they are consistent with the findings from focus groups conducted previously with residents that suggested there may be some differences in weekday and weekend sitting time due to many planned activities occur through the week when ACs are on-site. Self-report data suggested a trend towards more sitting time on weekdays compared to weekends at baseline. There was also a trend towards a reduction in self-reported weekday sitting post-intervention.

We compared time spent in specific sedentary behaviour because the type of sedentary behaviour may have an impact on the associated health risks. Site B reported significantly less weekend reading post-intervention compared to baseline. Sebastiao, et al. (44) found in a cross-sectional study, assisted living residents spent approximately 45% of their sedentary time reading (19%) or watching TV (26%) which is consistent with our findings (10 hours of total daily sedentary time). Stand to Strengthen participants reported slightly less sedentary time post-intervention than the findings by Sebastiao et al. (44) although we summed six of the ten domains and computer use was not included in the total. Computer use was the second highest seated activity in the present study after watching TV.

The Healthy Aging Cycle of the Canadian Community Health Survey found that computer use and reading were positively associated with good life satisfaction and self-perceived health for older adults (45). Socializing was associated with a strong sense of belonging to community (45). In contrast, Ku et al. (46) found that higher levels of passive sedentary activities ("sitting around", watching TV, and seated listening or talking) were associated with higher odds of being overweight (self-reported height and weight) and higher psychological distress. In the present study, changes in self-reported weekday sitting time were due to less time listening to music and completing weekday hobbies. There was a slight increase in self-reported napping on weekdays (8 minutes/day) which is aligned with an increase in daytime lying from device-measured activity patterns. There was a decrease in night-time lying (i.e. Sleeping) so daytime lying may have increased to compensate for a reduction in sleep post-intervention. Similarly, there was a 10 minute/day increase in weekend napping with a reduction in weekend

reading, seated talking, TV watching, listening to music. Older adults tend to identify sedentary activities as "active" or "passive" rather than by posture (41, 47). "Active" activities include activities with a cognitively engaging or social component, such as reading a book, watching the news, or engaging with friends and family (47). "Passive" activities are those that are used to pass the time and aren't necessarily cognitively or socially stimulating (47). For example, sitting alone or watching TV that is more frivolous are considered passive activities and have a more negative connotation associated with them. More research is required to better understand the nuances between different types of sedentary activities and their impact on health outcomes.

*3.5.3b Device-Measured Sedentary Time*

The post-intervention reduction in device-measured sedentary time at Site A was consistent with findings in community-dwelling older adults (4). It appears that a one hour per day decrease in sedentary time results in a clinically meaningful change in mobility in older adults. Each 30-minute increase in sedentary time was associated with a 17% increase in rates of major mobility disability in community-dwelling older adults (48). Each additional hour of sedentary time resulted in slower 400m walk times and a lower score on the SPPB among older adults residing in assisted living (49). Interventions within community-dwelling older adults have reported device-measured reductions in sitting of approximately 30-minutes per day (15, 18, 19). Residents in the current study increased their steps by approximately 800 steps per day (15%) resulting in a 13% increase in stepping minutes (7 minutes per day) which is consistent with the findings of Fitzsimons et al. (15). A 500 step per day increase has been associated with lower risk of major mobility disability (48). Participants in the current study also experienced a 4%

increase in sit to stand transitions which is also consistent with Gardiner et al (18). Reid et al. (50) found for each 10-unit increase in daily sit to stand transitions there was a 45% lower risk of experiencing pre-sarcopenia in community dwelling older adults.

Site A experienced greater reductions in sedentary time and a greater improvement in steps and sit to stand transitions. Sitting time decreased by 39 minutes/day, with a 2079 step per day increase. Residents also had a 10% increase in sit to stand transitions. Site A had one participant that was more active than the other residents at baseline but was not considered a statistical outlier. They were included in the analysis but magnified the increase in steps and slightly increased the reduction of sitting time at Site A. A comparison of the findings both including and excluding this participant at Site A and overall can be found in Appendix K.

The lower baseline physical function score at Site A may contribute to the intervention success at Site A. Given that a 30-minute increase in sedentary time is associated with an increased risk of mobility impairment, the 39-minute/day reduction in sedentary time may have been a large enough stimulus for participants at Site A to experience changes in mobility over the 6-week intervention. This is reflected in their improvements in gait speed and chair rise time post-intervention. A decrease in required or perceived effort to rise from a chair and walk may have promoted greater movement.

*3.6.3c Weekly Activity Patterns*

Research has demonstrated a difference between weekday and weekend sedentary time in older adults (51). Assisted living residents reported few planned activities during evenings and weekends which left them unmotivated to move (41). At baseline, residents

reported an extra three hours of sitting on weekdays compared to weekends through the LASA Sedentary Behaviour Questionnaire. At follow up, residents reported the same volume of sitting on weekdays and weekends. Self-report questionnaires are known to underestimate total sedentary time and studies have found participants will self-report as few as 4 to 6 hours of sitting time when device-measured sedentary time is found to be 8+ hours (2). Our participants over-reported sedentary time on weekdays and weekends both pre- and post- intervention, compared to device measured values. The gap between self-reported and device measured sedentary time decreased at follow up. There was a larger amount of daytime lying on weekend days which was excluded from sedentary time as it is unknown whether the participants were awake or asleep during that time, whereas the LASA questionnaire includes a question about napping.

Focus group research revealed that older adults associate a negative connotation with sedentary time and define it as “doing nothing” or “sitting idle” (47). If fewer group activities are offered on weekends, residents may perceive they are more sedentary as they are not “doing anything” (i.e. Not engaged in social activities, crafts, etc.) when there is no real difference between total sitting time on weekdays or weekends. The difference may lie in whether this sitting time is considered passive or active.

### 3.5.4 Intervention Feedback

Community dwelling interventions have used similar strategies to individual level components of Stand to Strengthen. Greenwood-Hickman et al. (52) conducted semi-structured interviews with overweight and obese older adults to gather feedback about a sedentary behaviour intervention with individual behaviour change strategies similar to Stand to Strengthen. Their intervention included individualized feedback from an

activPAL that was mailed to participants, self-monitoring logs, an educational workbook, goal setting sheets, and five calls with a health coach to assist with goal setting (52). Participants felt the health coaching sessions were supportive and preferred conducting the sessions one-on-one over the phone (52). Phone calls reduced the barrier of a set meeting time between everyone in the intervention and the need for transportation (52). Stand to Strengthen education sessions took place at the respective residences, thus eliminating the need for transportation. Participants reported to Greenwood-Hickman et al. (52) that the goal setting was challenging and difficult to do as sitting is ubiquitous but if appropriate goals were set then they were motivating and helped facilitate reductions in sitting. The workbook was viewed positively and participants felt it was a useful tool that helped keep them on track and provided practical ideas of ways to reduce sedentary time (52).

The idea of "sitting less" seemed to resonate with Stand to Strengthen participants during the education session although the message of "moving more" appeared to connect with the ACs. The message of "moving more" is being implemented by Forster et al. (53) as a ALR staff-delivered intervention to address prolonged resident sitting as staff indicated a more intuitive understanding of that message compared to "sitting less". Stand to Strengthen participants indicated they used the "choose to move" or "moving breaks" strategies the most during the intervention period. This iteration of Stand to Strengthen focused predominantly on "sitting less" and breaking up sitting more frequently, but the message of "moving more" or "move more frequently" may need to be highlighted to both staff and residents in future iterations of Stand to Strengthen. Attending staff meetings or creating a staff workshop like the one delivered to the

residents with strategies pertaining to what each staff role could do to reduce prolonged resident sitting may be beneficial. Including a questionnaire to measure self-reported sedentary time during the staff workshop may also serve to increase staff awareness of sitting behaviours and facilitate a discussion around the benefits and drawbacks of prolonged sitting and how that fits within the context of assisted living.

### 3.5.5 Strengths and Limitations

Some strengths of this intervention include the participatory nature through which Stand to Strengthen was developed. Receiving feedback from stakeholders (assisted living residents and staff in various positions) ensured the feasibility of the program and appropriate fit for the residence. The use of activPAL™ inclinometers allowed for more accurate measurement of behaviour changes and reduced the risk of recall bias. We also included numerous assessments to provide a comprehensive measure of physical function. Another strength of the study is that it was conducted in a relatively short period of time when weather was consistent in Southern Alberta. Therefore, the changes noted are likely due to changes in resident self-awareness and behaviour rather than a seasonal change in outdoor activity.

Some limitations include the lack of balance between males and females in the sample and the low response rate which resulted in a small sample size, which may reduce generalizability of our findings. The small sample size provided limited power to examine the data by site. Although the results suggest that the intervention was more successful at Site A than Site B, a larger sample would allow for a better understanding of these differences. The inclusion of a control group in future studies would also strengthen the scientific rigor of the trial. Six weeks is likely too short to see significant changes in

behaviour and health outcomes and a longer intervention may result in greater findings. Although the intervention was conceptualized to include staff involvement, there was little day-to-day staff involvement once the intervention was implemented which also may have reduced the impact of the intervention.

## 3.6 Conclusion

Stand to Strengthen is a novel, multi-level intervention that sought to reduce sedentary time in assisted living residences. Individual behaviour, the social and built environments, and organizational policy were targeted through intervention strategies developed in a participatory manner. Trends in site data indicate improvements in physical function and reductions in sitting time demonstrating the potential efficacy of Stand to Strengthen. Feedback from study participants and assisted living staff indicate the intervention was acceptable and easy to implement. Residents particularly liked the goal setting session and the strategies that were not used may have been due to constraints in to the social or physical environment. These strategies may be better suited to components of the organizational level in future studies.

Increasing the focus on interventions strategies involving staff and friends or family not residing within the facility may also improve intervention effectiveness. The small, predominantly female sample makes it difficult to generalize the results of the intervention. A larger, multi-site trial would allow for a better understanding of how interventions need to be tailored to address the needs of specific residences. Including a formal qualitative component after the intervention may also allow for a better understanding and greater context for the intervention results.

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Table 3.1 Study Timeline

| | Study Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Resident Recruitment** | **Screening** | **Baseline Assessment** | **Intervention Period** | | | | | | **Follow Up Assessment** |
| Timepoint | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Enrollment:** | | | | | | | | | | |
| Informed Consent | X | | | | | | | | | |
| Get Active Questionnaire | | X | | | | | | | | |
| **Interventions:** | | | | | | | | | | |
| Education Session | | | | X | | | | | | |
| Point of Decision Prompts | | | | X | X | X | X | X | X | |
| Standing Table | | | | X | X | X | X | X | X | |
| Information to Staff | | | | X | | | | | | |
| Follow Up Phone Calls | | | | | | X | | | X | |
| Weekend Scavenger Hunt | | | | | | | | X | X | |
| **Assessments:** | | | | | | | | | | |
| Resting Heart Rate | | | X | | | | | | | X |
| Resting Blood Pressure | | | X | | | | | | | X |
| Grip Strength | | | X | | | | | | | X |
| SPPB | | | X | | | | | | | X |
| LASA SBQ | | | X | | | | | | | X |
| ICECAP - O | | | X | | | | | | | X |
| EQ-5D | | | X | | | | | | | X |
| activPAL4 | | | X | | | | | | | X |

SPPB, Short Performance Physical Battery; LASA SBQ, Longitudinal Aging Study Amsterdam Sedentary Behaviour Questionnaire; ICECAP – O, Icepop Capability measure for Older People

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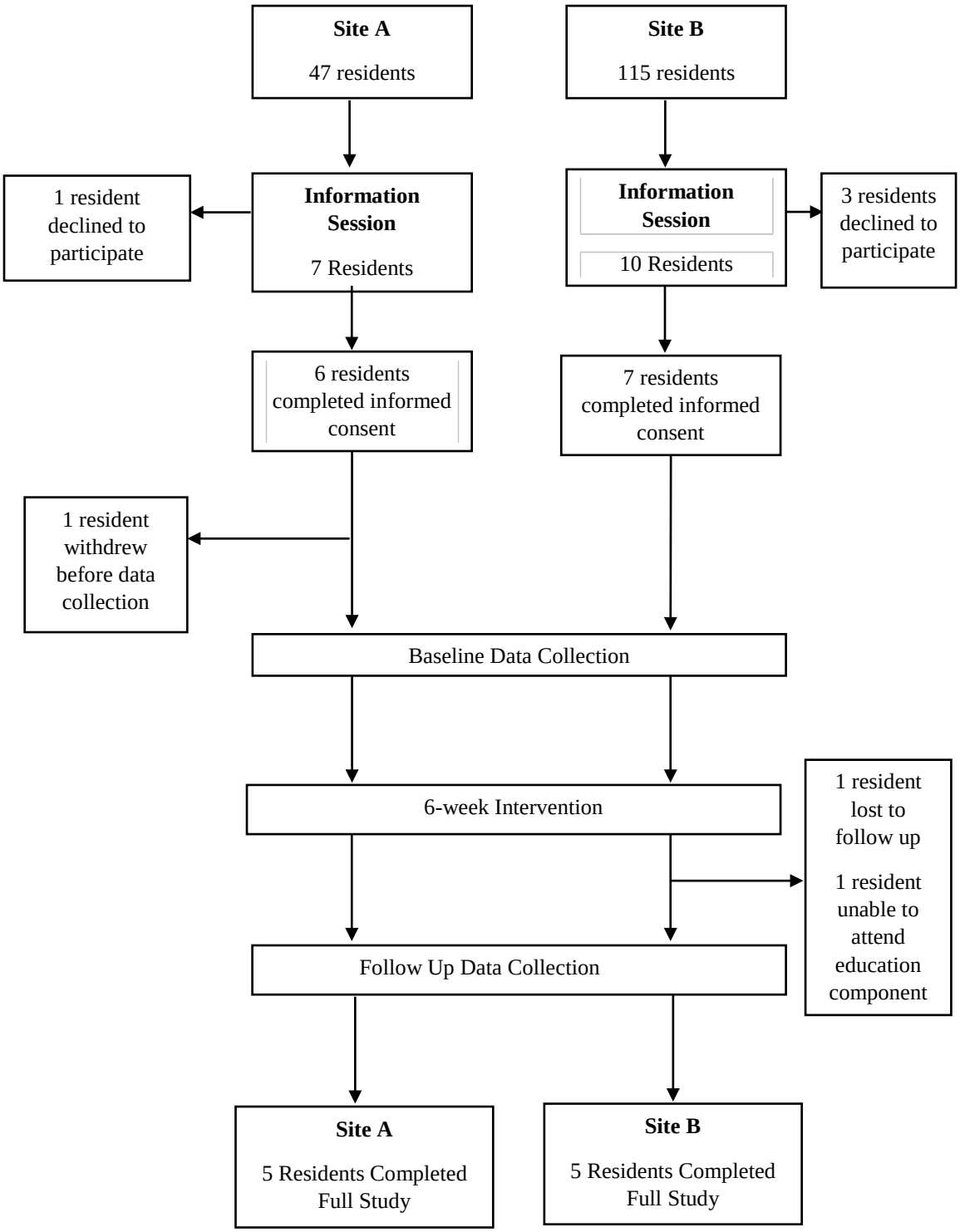


Figure 3.1 Recruitment for Stand to Strengthen

Table 3.2 Baseline Characteristics

| Variable | Site A | Site B | Difference between sites t (p) | Overall |
|---|---|---|---|---|
| N (%female) | 5 (80%) | 5 (100%) | - | 10 (90%) |
| Age | 76.2 ± 8.3 | 88.2 ± 3.5 | -2.974 (0.018)* | 82.2 ± 8.7 |
| Years in Facility | 3.11 ± 4.0 | 2.9 ± 2.1 | 0.108 (0.917) | 3.0 ± 2.9 |
| Marital Status | | | 2.500 (0.287)¥ | |
| Widowed | 3 (60%) | 5 (100%) | | 8 (80%) |
| Divorced | 1 (20%) | 0 | | 1 (10%) |
| Never Married | 1 (20%) | 0 | | 1 (10%) |
| BMI | 30.9 ± 5.3 | 29.7 ± 7.1 | 0.308 (0.766) | 30.4 ± 5.9 |
| LASA – Weekday (hours per day) | 14.5 ± 4.63 | 14.6 ± 3.71 | -0.047 (0.964) | 14.6 ± 3.9 |
| LASA – Weekend (hours per day) | 10.3 ± 3.61 | 11.5 ± 4.67 | -0.435 (0.677) | 10.9 ± 4.0 |
| EQ-5D Health Index | 0.6392 ± 0.21 | 0.8402 ± 0.09 | -1.947 (0.087) | 0.7397 ± 0.19 |
| EQ-5D Health Today | 70.0 ± 12.74 | 85.0 ±11.2 | -1.978 (0.083) | 77.5 ± 13.8 |
| ICECAP-O | 0.7403 ± 0.10 | 0.9187 ± 0.06 | -3.376 (0.010)* | 0.8295 ± 0.12 |
| SPPB Score | 5.2 ± 2.17 | 9.8 ± 1.48 | -3.916 (0.004)* | |
| Sitting Time (minutes/day) | 614.6 ± 132.3 | 578.4 ± 237.7 | 0.297 (0.774) | 596.5 ± 182.4 |
| Minutes in seated bouts >30minutes | 363.9 ± 144.1 | 388.3 ± 204.0 | -0.218 (0.833) | 376.1 ± 167.0 |
| Sit to Stand Transitions per Day | 49.2 ± 10.4 | 41.0 ± 5.7 | 1.546 (0.161) | 45.1 ± 9.0 |
| Steps Per Day | 5762 ± 5789 | 4585 ± 1273 | 0.444 (0.669) | 5173 ± 3999 |

All values expressed as mean ± standard deviation; SPPB, Short Performance Physical Battery; LASA SBQ, Longitudinal Aging Study Amsterdam Sedentary Behaviour Questionnaire; ICECAP – O, Icepop Capability measure for Older People; ¥ $\chi^2$ test conducted to compare means for marital status. * p< 0.05; **p<0.001

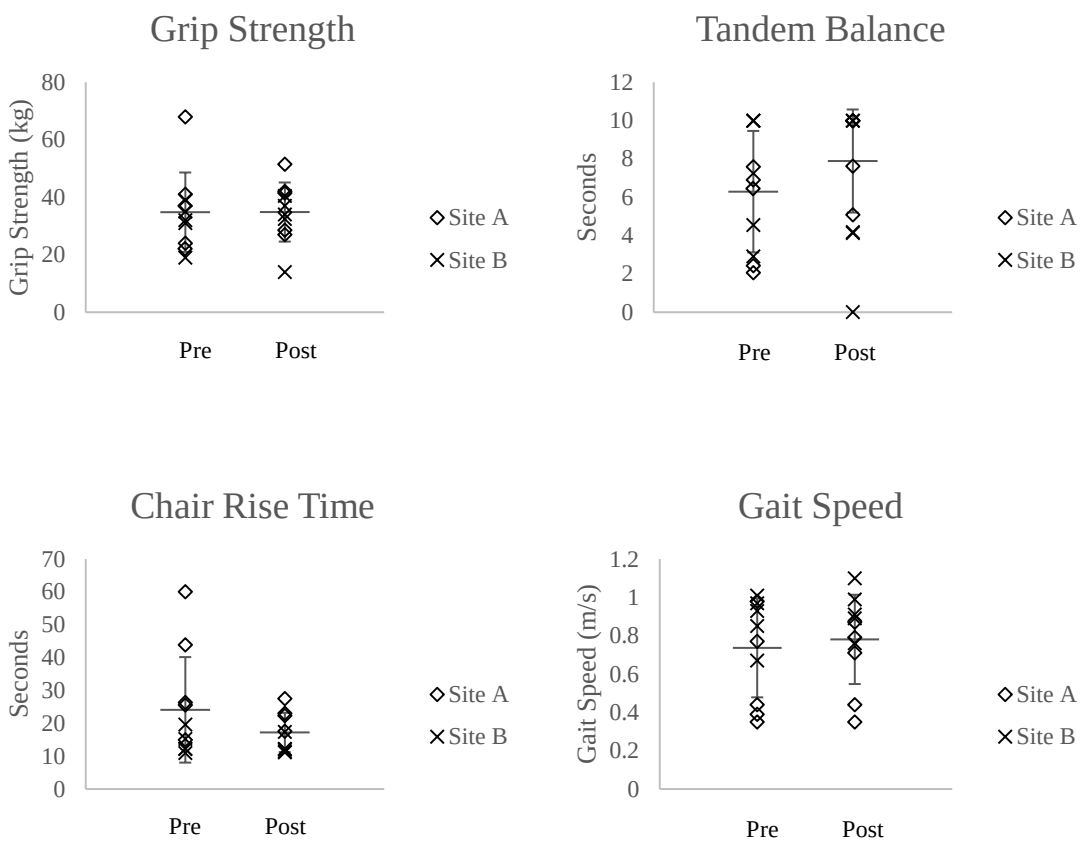


Figure 3.2 Changes in Physical Function Pre- and Post- Intervention, Overall Means ± Standard Deviation and Individual Data Points

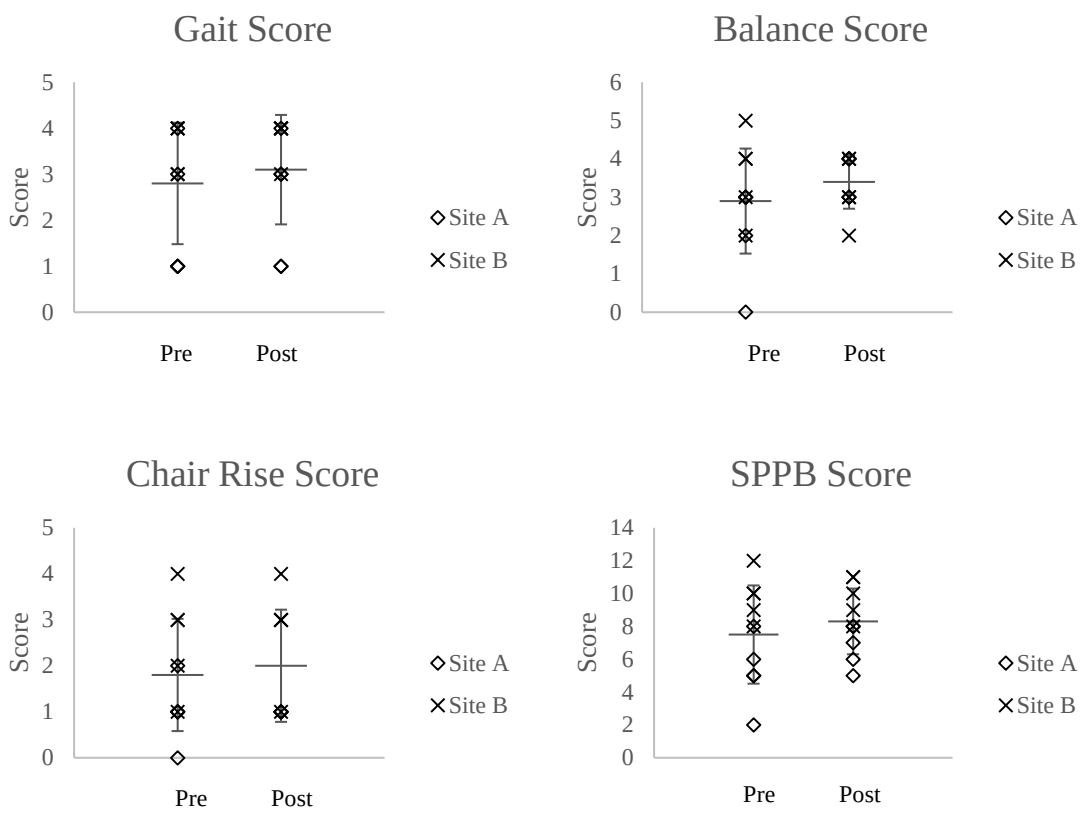


Figure 3.3 Changes in SPPB Components Pre- and Post- Intervention, Overall Means ± Standard Deviation and Individual Data Points

Table 3.3 Quality of Life Changes over 6-Week Follow Up

| Scale | Site A | | | Site B | | | Overall | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Pre** | **Post** | **Cohen's *d*** | **Pre** | **Post** | **Cohen's *d*** | **Pre** | **Post** | **t (p)** | **Cohen's *d*** |
| ICECAP-O | 0.74 ± 0.10 | 0.72 ± 0.17 | 0.14 | 0.92 ± 0.06 | 0.89 ± 0.08 | 0.42 | 0.82 ± 0.12 | 0.80 ± 0.15 | 0.992 (0.347) | 0.14 |
| EQ-5D Health Index | 0.64 ± 0.21 | 0.65 ± 0.14 | 0.06 | 0.84 ± 0.09 | 0.81 ± 0.03 | 0.44 | 0.74 ± 0.19 | 0.73 ± 0.13 | 0.393 (0.703) | 0.06 |
| EQ-5D – Health Today | 70.0 ± 12.7 | 77.0 ± 19.2 | 0.43 | 85.0 ± 11.1 | 80.0 ± 12.2 | 0.43 | 77.5 ± 13.8 | 78.5 ± 15.3 | -0.159 (0.877) | 0.07 |

All values expressed as mean ± standard deviation; ¥moderate effect size; §large effect size; ¤very large effect size

Table 3.4 Changes in Total Self-Reported Sedentary Time

| Variable | Time point | Site A | | Site B | | Overall | |
|---|---|---|---|---|---|---|---|
| | | **Weekday** | **Weekend** | **Weekday** | **Weekend** | **Weekday** | **Weekend** |
| Total sedentary time – all domains (minutes per day) | Pre | 870 ± 277.8 | 618 ± 228.6 | 882 ± 222.6 | 690 ± 280.8 | 876 ± 231.6 | 654 ± 241.8 |
| | Post | 696 ± 210 | 756 ± 315 | 714 ± 267 | 588.6 ± 251.4 | 708 ± 228.6 | 666 ± 277.2 |
| | Cohen's *d* | 0.71¥ | 0.51¥ | 0.68¥ | 0.38 | 0.73¥ | 0.05 |
| LASA – 6 domains (minutes per day) | Pre | 616.2 ± 203.4 | 436.2 ± 142.8 | 627 ± 188.4 | 537 ± 258 | 622.2 ± 182.4[a,b] | 492 ± 209.4[a‡] |
| | Post | 480 ± 147 | 415.2 ± 250.2 | 480 ± 129 | 393.6 ± 141 | 480 ± 128.4[b‡] | 402.6 ± 182.4 |
| | Cohen's *d* | 0.77¥ | 0.10 | 0.91§ | 0.69¥ | 0.90§ | 0.46 |

All values expressed as minutes per day (means ± standard deviations); LASA – 6 domains: sum of napping, reading, music, watching TV, seated hobbies, and talking to friends. ‡ indicates a trend towards significance pre-post intervention; * p< 0.05; **p<0.001; superscript letter indicates values that are trending or significantly different from each other; ¥moderate effect size; §large effect size; ¤very large effect size

Table 3.5 Changes in Self-Reported Sedentary Time by Domain

| Variable | Time point | Site A | | Site B | | Overall | |
|---|---|---|---|---|---|---|---|
| | | **Weekday** | **Weekend** | **Weekday** | **Weekend** | **Weekday** | **Weekend** |
| Napping (minutes per day) | Pre | 37.8 ± 57 | 37.8 ± 57 | 45 ± 15 | 45 ± 15 | 41.4 ± 36.6 | 41.4 ± 36.6 |
| | Post | 37.8 ± 57 | 60 ± 84.6 | 60 ± 21 | 45.6 ± 20.4 | 49.8 ± 39.6 | 52.2 ± 54.6 |
| | Cohen's *d* | 0.00 | 0.31 | 0.82[§] | 0.03 | 0.22 | 0.23 |
| Reading (minutes per day) | Pre | 105 ± 133.2 | 52.8 ± 51 | 96 ± 25.2 | 120 ± 42.6[d] | 100.2 ± 1.39 | 90 ± 56.4 |
| | Post | 120 ± 97.8 | 105 ± 133.2 | 72 ± 50.4 | 36 ± 0.89[d]* | 93.6 ± 1.24 | 66.6 ± 1.62 |
| | Cohen's *d* | 0.13 | 0.52[¥] | 0.60 | 1.74[¤] | 0.08 | 0.29 |
| Listening to Music (minutes per day) | Pre | 120 ± 109.8 | 45 ± 90 | 60 ± 84.6 | 24 ± 33 | 86.4 ± 95.4[c] | 33.6 ± 60.6 |
| | Post | 30 ± 60 | 15 ± 30 | 24 ± 0.89 | 24 ± 53.4 | 26.4 ± 52.8[c‡] | 19.8 ± 42.6 |
| | Cohen's *d* | 0.01 | 0.45 | 0.51 | 0.00 | 0.78 | 0.26 |
| Watching TV (minutes per day) | Pre | 135 ± 102.6 | 157.8 ± 66.6 | 204 ± 100.2 | 168 ± 130.2 | 173.4 ± 101.4 | 163.2 ± 100.8 |
| | Post | 135 ± 2.22 | 52.8 ± 51 | 192 ± 50.4 | 192 ± 98.4 | 166.8 ± 93.6 | 130.2 ± 106.2 |
| | Cohen's *d* | 0.00 | 1.77 | 0.74 | 0.21 | 0.07 | 0.32 |
| Seated Hobbies (minutes per day) | Pre | 135 ± 75.6 | 120 ± 84.6 | 96 ± 92.2 | 48 ± 78 | 113.4 ± 81.6 | 79.8 ± 84.6 |
| | Post | 75 ± 75.6 | 120 ± 2.44 | 72 ± 98.4 | 48 ± 78 | 73.2 ± 83.4 | 79.8 ± 112.2 |
| | Cohen's *d* | 0.79[§] | 0.00 | 0.25 | 0.00 | 0.49[¥] | 0.00 |
| Talking to Friends (minutes per day) | Pre | 84 ± 106.8 | 24 ± 27.6 | 126 ± 96 | 132 ± 78 | 106.8 ± 96.6 | 84 ± 81 |
| | Post | 82.8 ± 66.6 | 62.4 ± 82.8 | 60 ± 60 | 48 ± 54.6 | 70.2 ± 60 | 54.6 ± 64.2 |
| | Cohen's *d* | 0.13 | 0.62 | 0.82[§] | 1.24 | 0.46 | 0.40 |
| Computer Use (minutes per day) | Pre | 150 ± 142.8 | 105 ± 102.6 | 144 ± 124.2 | 96 ± 109.2 | 146.4 ± 124.2 | 100.2 ± 99.6 |
| | Post | 105 ± 2.36 | 123.6 ± 142.8 | 96 ± 57.6 | 78 ± 78 | 100.2 ± 96 | 98.4 ± 106.2 |
| | Cohen's *d* | 0.32 | 0.15 | 0.50[¥] | 0.19 | 0.42 | 0.02 |
| Administrative Tasks (minutes per day) | Pre | 105 ± 1.71 | 67.8 ± 78.6 | 60 ± 84.6 | 6 ± 13.2 | 79.8 ± 90 | 33.6 ± 43.8 |
| | Post | 45 ± 57.6 | 107.4 ± 85.8 | 42 ± 58.2 | 48 ± 78 | 43.2 ± 54.6 | 74.4 ± 82.8 |
| | Cohen's *d* | 0.72 | 0.48[¥] | 0.25 | 0.75 | 0.49[¥] | 0.62 |

| Variable | Time point | Site A | | Site B | | Overall | |
|---|---|---|---|---|---|---|---|
| | | **Weekday** | **Weekend** | **Weekday** | **Weekend** | **Weekday** | **Weekend** |
| Transportation (minutes per day) | Pre | 30 ± 34.8 | 30 ± 34.8 | 24 ± 25.2 | 27.6 ± 21.6 | 26.4 ± 27.6 | 28.8 ± 26.4 |
| | Post | 52.8 ± 51 | 34.8 ± 57.6 | 42 ± 40.2 | 15 ± 15 | 46.8 ± 42.6 | 24 ± 38.4 |
| | Cohen's *d* | 0.52[¥] | 0.10 | 0.54[¥] | 0.68 | 0.57[¥] | 0.15 |
| Church (minutes per day) | Pre | 30 ± 34.8 | 15 ± 30 | 36 ± 53.4 | 36 ± 49.2 | 33.6 ± 43.8 | 26.4 ± 40.8 |
| | Post | 15 ± 30 | 30 ± 34.8 | 57 ± 65.4 | 54 ± 61.2 | 38.4 ± 54.6 | 43.2 ± 49.8 |
| | Cohen's *d* | 0.46 | 0.46 | 0.35 | 0.32 | 0.10 | 0.37 |

All values expressed as minutes per day (means ± standard deviations); [‡] indicates a trend towards significance pre-post intervention; * p< 0.05; **p<0.001; superscript letter indicates values that are trending or significantly different from each other; [¥]moderate effect size; [§]large effect size; [¤]very large effect size

Table 3.6 Device Measured Movement Variables Pre- and Post- Intervention

| Variable | Site A | | | Site B | | | Overall | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Cohen's *d* | Pre | Post | Cohen's *d* | Pre | Post | t (p) | Cohen's *d* |
| Sitting time | 614.6 ± 132.3 | 577.5 ± 157.9 | 0.25 | 578.4 ± 237.7 | 602.3 ± 232.8 | 0.10 | 596.5 ± 182.4 | 589.9 ± 188.0 | 0.310 (0.746) | 0.04 |
| Stepping time | 70.5 ± 54.1 | 93.1 ± 84.8 | 0.16 | 63.7 ± 18.9 | 57.2 ± 13.6 | 0.16 | 67.1 ± 38.4 | 75.2 ± 60.3 | -0.914 (0.385) | 0.16 |
| Standing time | 186.5 ± 81.8 | 197.9 ± 67.5 | 0.15 | 242.6 ± 163.4 | 207.3 ± 108.9 | 0.30 | 214.5 ± 125.4 | 202.6 ± 85.6 | 0.541 (0.601) | 0.11 |
| Upright time | 256.9 ± 127.3 | 290.9 ± 142.1 | 0.25 | 306.2 ± 162.6 | 264.5 ± 110.5 | 0.25 | 281.6 ± 140.1 | 277.7 ± 120.8 | 0.150 (0.884) | 0.03 |
| Sitting time in bouts >30min | 363.9 ± 144.1 | 320.4 ± 193.1 | 0.25 | 388.3 ± 204.0 | 413.9 ± 185.8 | 0.13 | 376.1 ± 167.0 | 367.2 ± 185.4 | 0.291 (0.776) | 0.05 |
| Steps per Day | 5761 ± 5788 | 7840 ± 9032 | 0.27 | 4584 ± 1273 | 4083 ± 757 | 0.78[¥] | 5173 ± 3999 | 5962 ± 6358 | -0.935 (0.374) | 0.20 |
| Sit to Stand Transitions per Day | 49.2 ± 10.4 | 54.6 ± 7.1 | 0.60[¥] | 41.0 ± 5.7 | 39.4 ± 5.8 | 0.28 | 45.1 ± 9.0 | 47.0 ± 10.1 | -0.720 (0.490) | 0.15 |

All values expressed as mean ± standard deviation; All times are expressed as minutes per day; [‡] indicates a trend towards significance pre-post intervention; * p< 0.05; **p<0.001; [¥]moderate effect size;
[§]large effect size; [¤]very large effect size

Table 3.7 Weekday and Weekend Movement Variables Pre- and Post- Intervention

| Variable | Time point | Site A | | Site B | | Overall | |
|---|---|---|---|---|---|---|---|
| | | **Weekday** | **Weekend** | **Weekday** | **Weekend** | **Weekday** | **Weekend** |
| Sitting time (min/day) | Pre | 624.1 ± 142.3 | 582.4 ± 132.4 | 585.6 ± 224.7 | 564.3 ± 260.0 | 604.8 ± 178.5 | 573.4 ± 194.8 |
| | Post | 587. 4 ± 119.3 | 562.5 ± 226.3 | 596.9 ± 223.7 | 610.4 ± 247.7 | 592.2 ± 169.1 | 586.5 ± 225.1 |
| | Cohen's *d* | 0.28 | 0.11 | 0.05 | 0.18 | 0.07 | 0.06 |
| Stepping time (min/day) | Pre | 70.8 ± 49.2 | 65.8 ± 58.6[a] | 63.2 ± 20.6 | 64.1 ± 17.0[d] | 66.9 ± 35.8 | 64.9 ± 40.7 |
| | Post | 98.7 ± 91.3 | 84.7 ± 75.3[a‡] | 60.5 ± 16.9 | 52.4 ± 11.4[d‡] | 79. 6 ± 65.1[g] | 68.5 ± 53.6[g]* |
| | Cohen's *d* | 0.38 | 0.28 | 0.06 | 0.80[§] | 0.24 | 0.08 |
| Standing time (min/day) | Pre | 185.1 ± 72.4 | 181.5 ± 102.3 | 241.8 ± 158.5 | 242.8 ± 173.7 | 213.4 ± 119.9 | 212.2 ± 138.2 |
| | Post | 194.6 ± 71.2 | 202.8 ± 70.6 | 207.5 ± 117.0 | 207.2 ± 102.2 | 201.0 ± 91.5 | 204.9 ± 82.8 |
| | Cohen's *d* | 0.13 | 0.24 | 0.25 | 0.25 | 0.12 | 0.06 |
| Upright time (min/day) | Pre | 255.9 ± 107.5 | 247.3 ± 157.7 | 304.4 ± 160.3 | 306.9 ± 170.7 | 280.1 ± 131.2 | 277.1 ± 158.1 |
| | Post | 293.3 ± 148.2 | 287.5 ± 137.5 | 267.9 ± 117.3 | 259.6 ±107.0 | 280.6 ± 126 | 273 ± 117.1 |
| | Cohen's *d* | 0.29 | 0.27 | 0.26 | 0.33 | 0.00 | 0.03 |
| Sitting time in bouts >30min (min/day) | Pre | 359.5 ± 138.6 | 373.8 ± 165.5 | 384.7 ± 205.3 | 393.7 ± 203.2[e] | 372.1 ± 165.7 | 383.8 ± 175.0 |
| | Post | 324.6 ± 166.4 | 314.1 ± 239.5 | 393.8 ± 179.0 | 444.1 ± 207.2[e‡] | 359.2 ± 166.9 | 379.1 ± 221.9 |
| | Cohen's *d* | 0.23 | 0.29 | 0.05 | 0.25 | 0.08 | 0.02 |

| Variable | Time point | Site A | | Site B | | Overall | |
|---|---|---|---|---|---|---|---|
| | | Weekday | Weekend | Weekday | Weekend | Weekday | Weekend |
| Steps per Day | Pre | 5985 ± 5707 | 5294 ± 6065 | 4559 ± 1390 | 4619 ± 1156 | 5164 ± 3682 | 4957 ± 4131 |
| | Post | 8447 ± 9878 | 6929 ± 7772 | 4335 ± 1002 | 3707 ± 735 | 6391 ± 6965[h] | 5318 ± 5474[h‡] |
| | Cohen's *d* | 0.31 | 0.23 | 0.18 | 0.94[§] | 0.22 | 0.07 |
| Sit to Stand Transitions per Day | Pre | 51.4 ± 10.7[b,c] | 44.4 ± 10.0[c]* | 42.9 ± 6.6 | 40.0 ± 10.8 | 45.1 ± 9.0 | 47.0 ± 10.1 |
| | Post | 57.6 ± 7.9[b]* | 50.8 ± 6.7 | 41.0 ± 5.9[f] | 37.4 ± 5.9[f]* | 49.3 ± 10.9[i] | 44.1 ± 9.3[i]** |
| | Cohen's *d* | 0.66[¥] | 0.75[¥] | 0.30 | 0.30 | 0.41 | 0.29 |

[‡]indicates a trend towards significance pre-post intervention; * p< 0.05; **p<0.001; superscript letter indicates values that are trending or significantly different from each other; [¥]moderate effect size; [§]large effect size; ¤very large effect size

Table 3.8 Physical Function Changes Pre– and Post– Intervention

| Variable | Site A | | | Site B | | | Overall | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Pre** | **Post** | **Cohen's *d*** | **Pre** | **Post** | **Cohen's *d*** | **Pre** | **Post** | **t (p)** | **Cohen's *d*** |
| Grip Strength | 38.4 ± 18.44 | 38.1 ± 10.27 | 0.02 | 31.2 ± 7.5 | 31.6 ± 10.30 | 0.04 | 34.8 ± 13.8 | 34.9 ± 10.3 | -0.023 (0.982) | 0.004 |
| Chair Rise Time | 34.15 ± 17.77 | 22.63 ± 4.05 | 0.56¥ | 14.05 ± 3.5 | 12.91 ± 2.55 | 0.37 | 24.1 ± 16.06 | 17.23 ± 5.97 | 1.571 (0.155) | 0.33 |
| Chair Rise Score | 1.25 ± 0.50 | 1.00 ± 0.00 | n/a | 2.6 ± 1.14 | 2.8 ± 1.09 | 0.18 | 1.8 ± 1.22 | 2.0 ± 1.22 | 0.00 (1.00) | 0.00 |
| Tandem Balance Time | 5.08 ± 2.62 | 8.54 ± 2.19 | 1.43¤ | 8.63 ± 2.73 | 7.08 ± 3.37 | 0.42 | 6.29 ± 3.17 | 7.89 ± 2.69 | -1.007 (0.343) | 0.42 |
| Tandem Balance Score | 2.9 ± 1.37 | 3.4 ± 0.699 | 1.40¤ | 3.6 ± 1.14 | 3.2 ± 0.84 | 0.40 | 3.6 ± 1.14 | 3.2 ± 0.84 | -1.246 (0.244) | 0.46 |
| Gait Time | 7.98 ± 3.17 | 7.14 ± 2.92 | 0.28 | 4.61 ± 0.82 | 4.37 ± 0.61 | 0.33 | 6.29 ± 2.82 | 5.75 ± 2.46 | 1.183 (0.267) | 0.20 |
| Gait Score | 2.0 ± 1.41 | 2.4 ± 1.34 | 0.29 | 3.6 ± 0.54 | 3.8 ± 0.45 | 0.40 | 2.8 ± 1.32 | 3.1 ± 1.19 | -1.406 (0.193) | 0.23 |
| Gait Speed | 0.73 ± 0.26 | 0.78 ± 0.23 | 0.18 | 0.89 ± 0.14 | 0.93 ± 0.13 | 0.31 | 0.73 ± 0.26 | 0.78 ± 0.23 | -1.266 (0.237) | 0.31 |
| SPPB Score | 5.2 ± 2.17 | 6.8 ± 1.3 | 0.89ǂ | 9.8 ± 1.48 | 9.8 ± 1.30 | 0.00 | 7.5 ± 2.99 | 8.3 ± 2 | -2.058 (0.070) | 0.18 |

All values expressed as mean ± standard deviation; ¥moderate effect size; ǂlarge effect size; ¤very large effect size

Table 3.9 Intervention Strategy Usage

| Strategy | Daily | A few times a week | Once or twice over 6 weeks | Didn't use it |
|---|---|---|---|---|
| Walk and Talk | 6 | 3 | 1 | 1 |
| Change Your Chair | 6 | 1 | 0 | 3 |
| Moving Break | 7 | 2 | 1 | 0 |
| Move Every Hour | 3 | 2 | 1 | 4 |
| Need or Want | 3 | 2 | 4 | 1 |
| Choose to Move | 7 | 2 | 1 | 1 |
| Re-arrange Your Space | 4 | 2 | 1 | 4 |

Table 3.10 Participant Intervention Feedback

| Strategy | Liked it a lot | Liked it a little | Neutral | Disliked it a little | Disliked it a lot |
|---|---|---|---|---|---|
| Group education session | 6 | 2 | 2 | 0 | 0 |
| Goal setting | 9 | 1 | 1 | 0 | 0 |
| Strategies to reduce sitting time | 4 | 2 | 2 | 0 | 0 |
| Signage | 4 | 3 | 2 | 1 | 1 |
| Standing table | 3 | 3 | 3 | 1 | 1 |
| Scavenger hunt | 3 | 2 | 3 | 1 | 1 |

# Chapter 4: General Discussion

## 4.0 Introduction

High amounts of sedentary time have been associated with numerous health risks for older adults. Breaking up sedentary time has been associated with better health outcomes, including a decreased risk of cardiovascular and metabolic diseases (1, 2), and improved physical function and health status (3-5). Given the prevalence of physical inactivity among older adults (6), aiming to sit less and move more may improve health outcomes and be more feasible than increasing moderate to vigorous physical activity. Community-dwelling older adults report breaking up sedentary time often in order to complete different activities of daily living (i.e. household chores, meal preparation) (7, 8). However, as the population of older adults grows worldwide, there will be increasing demand for residential care options, such as retirement communities, care homes, assisted living residences (ALRs), and nursing homes.

Physical function tends to decrease with age (9) and residential care can provide a safe environment for individuals with varying degrees of mobility and cognitive impairments. Most older adults within assisted living require assistance with at least one activity of daily living while 50% require assistance with ≥3 activities of daily living (10). Providing support for self-care and matching various supports with an individual's needs can improve independence and quality of life (11). However, the services provided by these residences can also remove the need for individuals to complete their own self-care activities and moving to assisted living has been associated with a decline in physical function. Resnick et al. (12). showed that increasing the number of self-care activities completed by residents can mitigate functional decline over 12-month follow

up. Continued engagement in social and leisure activities, as well as instrumental activities of daily living, has also been associated with improved quality of life and life satisfaction among older adults in assisted living. (10).

Qualitative research with older adults living in the community (8) and in assisted living (13) revealed that older adults feel social and cultural pressure to remain seated most of the time. Assisted living residents may be particularly affected by this attitude; residents reported that the expectation to sit was built into the environment and culture at the residences (13). Furthermore, they may be unable to easily access community-based activities (i.e. difficulty accessing transportation) that would promote movement, leaving them to participate predominantly in activities at the residence (14). Exercise classes are offered at most residences, however, they are not well attended and it appears that most of the classes are based around seated exercises (14). This was confirmed in our consultation with staff, as they indicated that seated exercises were completed due to safety concerns and a lack of staffing to assist individuals that may need extra assistance to complete standing exercises safely. In general, low staff availability is associated with lower resident engagement and physical activity (15). This combination of factors culminates in very high levels of sedentary time. In the present study, residents of assisted living accumulated an average daily sitting time of almost 10 hours per day, which is consistent with previous research that found 10 hours of self-reported sedentary time in a retirement community (16).

Research with community-dwelling older adults suggests individual behaviour change strategies can induce meaningful reductions in self-reported and device-measured sedentary time (17-22). Specifically targeting sit to stand transitions and self-care

activities of daily living also shows promise in improving physical function among residents of nursing homes (12, 23) however, there is a lack of research examining ways to reduce prolonged sitting within lower levels of care (i.e. assisted living). Successfully intervening at lower levels of care may promote healthier aging and prevent or delay functional decline among residents. The overarching goal of this thesis was to develop and test an intervention to specifically reduce prolonged periods of sitting in an assisted living environment.

### 4.1 Development of Stand to Strengthen

The strategies developed for Stand to Strengthen combine elements from a variety of studies within community-dwelling older adults and workplace environments. Discussions with residents and the consultation with staff indicated the need for the intervention to be flexible as each residence has a slightly different culture and clientele. It also became apparent that intervening across the levels of the Social Ecological Model may be more effective and allow for greater flexibility with the intervention. Occupational research provided some insight into how a multi-level intervention could be developed and delivered (24, 25). Environmental and organizational strategies were developed for Stand to Strengthen based on those used by Neuhaus et al. (24) and Larouche et al. (26). For example, altering the physical environment by providing standing workstations has successfully reduced sedentary time in an occupational setting (25, 26), so this strategy was adapted to assisted living by providing a standing table in residence lounges.

Social support can be promoted through the creation of walking groups in assisted living or in group education sessions. Thorgersen-Ntoumani et al. (27) hypothesize that

delivering a walking intervention within assisted living through resident ambassadors will increase peer to peer support, resulting in greater motivation among residents which will lead to an increase in walking and reduce sedentary time. Maher et al. (22) used peer support to enhance self-regulation and self-awareness of sitting habits; group activities and discussion were also built into Maher's intervention to build self-efficacy and facilitate goal setting (22). Social support provided by residence staff can also promote activity among residents, which highlights the need to increase organizational buy-in and awareness (28).

Individual behaviour change strategies are sometimes coupled with the social support strategies whereby group-based education is used to disseminate information about the effects of prolonged sedentary time. Goal setting, and feedback from activPALs or other activity tracking devices have been used to reduce both self-reported and device-measured sedentary time with community-dwelling older adults (17, 18, 21, 22). Follow up health coaching calls are a common addition to the education sessions (group-based or individual) to assist with continued goal setting and educational support (20, 29, 30). Workplace research has also included these components as the individual behaviour strategies of the multi-level intervention (25).

Organizational support is commonly achieved in occupational research by appointing an "ambassador" to facilitate changes to movement culture within workplaces (31). Research in nursing homes found that physical function was improved by having staff help older adults increase sit to stand transitions and complete more of their own activities of daily living (12, 23). Thus, engaging staff, particularly the activity coordinators (ACs), was identified to be important within Stand to Strengthen as the ACs

are responsible for planning and delivering on-site activities and arranging transportation for formal off-site activities (i.e. shopping trips or activities with other residences). This was intended to be achieved by educating staff about the health consequences of prolonged sedentary time, and by encouraging them to incorporate standing or moving breaks into all organized activities. This would help to change the residence's culture and not leave it solely up to the individual to regulate their own behaviour.

Stand to Strengthen was developed to be flexible with a wide range of strategies to ensure that it would be applicable across a range of supportive living environments. The success of key intervention components within other demographics, and the success of multi-level interventions within workplace environments, suggests that Stand to Strengthen is a promising way to reduce prolonged sitting within ALRs.

### 4.2 Feasibility Trial of Stand to Strengthen

Stand to Strengthen is the first study to intervene at all four levels of the Social Ecological Model in assisted living residents. Our results indicate that it is possible to reduce prolonged sitting and the reduction in device-measured sitting time was similar to studies with community-dwelling older adults (17, 21). Studies suggest that reductions of 60 minutes per day in total sitting may be clinically relevant and result in improvements in mobility and physical function among older adults (32-34).

Due to the pilot nature of Stand to Strengthen, we decided to examine results by site to determine if the strategies showed promise in either or both residences. These results should be considered with caution considering the small sample size but demonstrate that the individual and social environment strategies can reduce prolonged

sitting. Participants at Site A experienced a 37 minute/day reduction in device-measured sitting time and increased sit to stand transitions by 4% per day. Studies using iso-temporal substitutions have suggested that replacing 10-30 minutes of sedentary time with light or moderate to vigorous physical activity can improve physical function (35). Barone Gibbs et al. (19) reported an improvement in SPPB scores (due to improved chair rise scores) following a 12-week intervention with a goal of reducing sedentary time by 1-hour per day. Total sedentary time did not change so it was hypothesized that participants broke up sedentary time more frequently and these breaks resulted in improved chair rise scores (19). Substituting sedentary time with LPA or MVPA has also been associated with improvements in physical function and self-rated health among older adults (35-37). We found an 800 step per day increase, although this change was not significant, possibly due to the small sample size. Increases of 500 steps per day have been found to improve mobility and physical function among older adults which may have also accounted for the improvements in physical function that were observed among participants at Site A (32). Thus, the trends in these pilot data suggest that over a longer period Stand to Strengthen may well improve function in residents of assisted living.

### 4.3 Strengths

Strengths of this thesis include the participatory manner through which the intervention was developed, as gathering information from stakeholders and the literature ensured fit between the intervention and the targeted residences. Healy et al. (38) recommended collecting both self-reported and device-measured values of sedentary time when conducting free-living studies. The use of activPAL4™ inclinometers allowed for a better understanding of how the intervention altered movement patterns and self-report

data also provided important context into the types of activities residents were engaging in pre- and post- intervention. Piloting Stand to Strengthen at two sites also provided valuable insights into how the program can be implemented in different environments. Trends demonstrating that the program was more effective at one site compared to the other is important feedback that will allow for further refinement of Stand to Strengthen and highlights the importance for future research.

### 4.4 Limitations

Some limitations to this thesis include the small sample size and lack of parity between genders in the sample. Although there are generally more women than men in the older adult demographic, our sample was predominantly female which impacts the generalizability of our findings (39). The small sample size means that statistical power was low and examination of data by site was exploratory; results must be interpreted cautiously. Trends suggest that the intervention was more successful at Site A compared to Site B and a larger sample would allow for more detailed analysis by site.

The intervention was intended to target all four levels of the Social Ecological Model, however, individualized feedback about movement patterns was not available to the participants due to difficulties with the activPAL software at the start of the study. The strategies at the organizational level were not well implemented and the ACs indicated that they did not alter the way in which they organized or ran activities. Spending more time on staff engagement may improve the efficacy of the intervention, particularly at Site B where the participants had a slight increase in sitting time over the 6-week intervention. Workplace research routinely uses key management employees to deliver pre-curated content about sedentary time with various tips and strategies, and

these staff members also engage in individual meetings or consultations with research staff to ensure understanding and buy-in for the program (24, 31). The consultation with staff for Stand to Strengthen indicated a large level of trust between residents and the ACs and that sometimes residents only engaged in activities if the AC was present. This relationship was under-utilized in the present study and increasing the amount of content delivered by the AC or similar staff members is important to consider in future studies.

### 4.5 Future Directions

The use of the activPAL4™ inclinometer was an important component of this study as it allowed for a more accurate measurement of sedentary time. Given the health benefits associated with light physical activity and that the message of "move more" may resonate better with residents and staff, also providing information about the number of light physical activity minutes along with sitting time may help motivate residents to reduce or break up prolonged sitting. As previously mentioned, an increased focus on recruiting staff and management to help alter the sitting culture within ALRs should also occur in future research. Incorporating families and friends external to the residence may also improve intervention success by providing additional motivation to residents.

Larger and longer studies are also required to determine if there can be greater improvements in physical function and quality of life. Larger studies would also allow researchers to discern which strategies are the most effective given a residence's individual traits (socioeconomic status, existing programs, resident function level, level of care provided to residents). Long term follow-up is also required to determine the lasting effects of a multi-level intervention addressing sedentary time to determine if behaviours last and the resulting impact of that on health outcomes.

## 4.6 Conclusion

Stand to Strengthen was a novel intervention designed to reduce prolonged sitting within ALRs. The results of the pilot study demonstrate that a multi-level intervention can be implemented within an assisted living residence with relative ease. Although few statistically significant changes were observed over the 6-week intervention, trends in the data suggest the Stand to Strengthen intervention has promise, particularly for individuals with lower function. Increasing staff support and buy in, along with increasing the duration of the intervention may better demonstrate the efficacy of the intervention across residences. Given the increasing population of older adults worldwide and the resulting need for residential care options, creating programs that can prevent or delay functional decline is important. This study demonstrated the preliminary feasibility and effectiveness of the Stand to Strengthen intervention.

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## APPENDICES

## APPENDIX A: STAFF CONSULTATION INFORMED CONSENT

**Title of Study: Developing persuasive messages to reduce sedentary time for older adults**

**Principal Investigator:** Dr. Jennifer Copeland (403-317-2804)

**Research/Study Coordinator:** Lauren Voss (403-317-5073)

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**Why am I being asked to take part in this research study?**
You are being asked to be in this study because you work at a lodge. You are being invited to participate in a study that will help us understand what strategies are feasible to reduce the amount of time residents spend sitting.

Before you make a decision one of the researchers will go over this form with you. You are encouraged to ask questions if you feel anything needs to be made clearer. You will be given a copy of this form for your records.

**What is the reason for doing the study?**

The goal of the proposed project is to develop and validate persuasive messages about sedentary behavior and healthy ageing and identify feasible strategies for reducing sitting time among residents. This project will be an important step in a larger program of research that aims to determine the effect of reducing sedentary time on the health and quality of life of older adults

**What will I be asked to do in this study?**

- You will be asked to participate in a small group discussion with 4 or 5 of your peers and a facilitator. You will be asked to share your perceptions of sedentary activities that residents engage in, like watching TV and using the computer. The discussion will take 1-1.5 hours

- You will be asked for your opinion on what barriers you see to reducing sitting time throughout the day amongst residents

- You will be asked to consider some possible strategies that could reduce sitting time among residents. We will ask you to tell us what you think about the strategies and if they are feasible and would be helpful, in your opinion.

- The discussion will be audio-recorded and a research assistant will also take notes. There will be no video recording.

**What are the benefits?**
You will not benefit directly from being in this study, however you will be making an important contribution to research that will help us understand the best way to inform people about the effect of different sedentary behaviours on their health.

**What are the risks and discomforts?**
There are no known risks to participating in this study.

**Do I have to take part in the study?**

Being in this study is your choice. If you decide to be in the study, you can change your mind and stop being in the study; your data can be deleted form the study up to 4 weeks after the focus group meeting. If you choose to withdraw it will in no way affect you.

**Will I be paid to be in the research?**

There is no compensation for being in this study. You can have your name entered into a draw for a door prize that has a value of $20. Odds of winning are approximately 1 in 6.

**Will my information be kept private?**

Your full name will not be used in any of the notes or recordings, only initials and basic demographic information will be recorded. Your personal information, including your name, will be kept confidential by the researchers and will not be distributed in any way. Other participants in the group discussion will hear your responses and we cannot guarantee other participants will maintain confidentiality.

Audio files will be deleted after the data are transcribed. All information collected from the group discussion will be kept securely stored on a secure network drive for 7 years. Your full name will not be linked to your answers.

**What if I have questions?**

If you have questions about this research please contact the Principal Investigator:

**Jennifer Copeland at jennifer.copeland@uleth.ca or 403-317-2804** at the University of Lethbridge.

If you have any other questions regarding your rights as a participant in this research, you may also contact the Health Research Ethics Board at the University of Alberta at 780-492-2615. This office is independent of the researchers. Protocol number: 00075411

**CONSENT**

**Title of Study: Developing persuasive messages to reduce sedentary time for older adults**

Principal Investigator(s): Dr. Jennifer Copeland Phone Number(s): 403-317-2804

Study Coordinator: Lauren Voss Phone Number(s): 403-317-5073

| | | |
|---|---|---|
| Do you understand that you have been asked to be in a research study? | □ Yes | □ No |
| Have you read and received a copy of the attached information sheet? | □ Yes | □ No |
| Do you understand the benefits and risks involved in taking part in this research study? | □ Yes | □ No |
| Do you understand that you are free to leave the study without having to give a reason and without affecting your employment? | □ Yes | □ No |
| Do you understand your comments can only be removed up to 4 weeks after the meeting? | □ Yes | □ No |
| Has the issue of confidentiality been explained to you? | □ Yes | □ No |
| Do you understand who will have access to your information? | □ Yes | □ No |

Who explained this study to you? _____

I agree to take part in this study:

Signature of Research Participant: _____

(Printed Name): _____ Date: _____

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate?

Signature of Investigator or Designee _____ Date _____

## APPENDIX B: MESSAGES DEVELOPED FOR RESIDENT FOCUS GROUPS

Message 1: Gain Framed One Page Poster

**Less time spent sitting and more time spent standing and moving will make it easier to do chores and activities you enjoy.**

Try to sit less and move more every day!

**Change Your Chair**

Pick a firm chair that makes it easy to stand up.

**Walk & Talk**

Try walking or standing while socializing or on the phone.

**Moving Breaks**

Stand up and walk around the room or stretch during TV or radio commercial breaks.

**Need or Want?**

Try to decide when you absolutely need to sit down vs when you want to sit down. Are there alternatives for when you want to sit?

Message 2: Loss Framed One Page Poster

## Research has shown that too much sitting is bad for your health, even if you do physical activity!

If you engage in long periods of seated activities, like watching TV, you will have a greater risk of health complications. Try to sit less and move more, whenever possible!

### Move Every Hour

Set a timer to remind you to move. Try to stand up and stretch at least twice an hour.

### Choose to Move

Stand up and walk around the room, up and down the stairs, or stretch during TV or radio commercial breaks.

### Re-Arrange Your Space

Place your garbage can in a space where you have to stand and walk to it. Put your TV remote on the opposite side of the room while watching TV.

Message 3: Gain Framed Infographic

# How Sedentary Are You?

On a typical day, how many hours do you spend in continuous sitting: in meetings, volunteer commitments and commuting?

☐ None ☐ <1 hour ☐ 1 - <2 ☐ 2 - <3 ☐ 4 - <5 ☐ 5 - <6 ☐ >6

On a typical day, how many hours do you watch television, use a computer, read, and spend sitting quietly during your leisure time?

☐ None ☐ <1 hour ☐ 1 - <2 ☐ 2 - <3 ☐ 4 - <5 ☐ 5 - <6 ☐ >6

Total Sedentary Time (add above): _ _ _ _ _ _ _ hours/day

When sitting for a long time (one or more hours), at what interval do you stand and move around for at least two minutes?

☐ <10 min ☐ 10 - <20 min ☐ 20 - <30 min ☐ 30 - <45 min

☐ 45 min - <1 hour ☐ 1 - <1.5 hours ☐ 1.5 - <2 hours ☐ >2 hours

From the Canadian Society for Exercise Physiology

# Tips to Reduce Sedentary Time

## Walk & Talk

Try walking or standing while socializing or on the phone.

## Move Every Hour

Set a timer to remind you to move. Try to stand up and stretch at least twice an hour.

## Change Your Chair

Pick a firm chair that makes it easy to stand up.

## Need or Want?

Try to decide when you absolutely need to sit down vs when you want to sit down. Are there alternatives for when you want to sit?

## Moving Break

Have an moving break during TV or radio commercials breaks. Stand up and walk around the room.

## Choose to Move

Try taking the stairs instead of the elevator. Take the long route when walking to your destination.

## Re-Arrange Your Space

Place your garbage can in a space where you have to stand and walk to it to. Put your TV remote on the opposite side of the room while watching TV.

Message 4: Loss Framed Infographic

# How Sedentary Are You?

On a typical day, how many hours do you spend in continuous sitting: in meetings, volunteer commitments and commuting?

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☐ None ☐ <1 hour ☐ 1 - <2 ☐ 2 - <3 ☐ 4 - <5 ☐ 5 - <6 ☐ >6

Total Sedentary Time (add above): _____hours/day

When sitting for a long time (one or more hours), at what interval do you stand and move around for at least two minutes?

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## Re-Arrange Your Space

Place your garbage can in a space where you have to stand and walk to it to. Put your TV remote on the opposite side of the room while watching TV.

## APPENDIX C: INTERVIEW GUIDE FOR STAFF CONSULTATION

**Introduction:**

*Thank you for coming today and talking to us. Your input is so important for our project and we really appreciate your help! We are doing research on healthy ageing and in particular we are interested in talking about sedentary behavior. Sedentary behaviour refers to any waking activity that is performed while seated or reclining and has a low energy expenditure. So this includes things like watching TV, reading a book, or using a computer. We want to know if you think it is feasible or important to reduce sitting time among the residents you care for. There are no right or wrong answers, but rather your honest opinions are important to us.*

| Question | Purpose of question(s) |
|---|---|
| 1. What does sedentary behavior mean to you?<br>Probe – can you give examples of activities that you would label as sedentary? | To determine the awareness of the health implications of sedentary behaviour. |
| Define sedentary behavior.<br>2. With this definition in mind, what are some examples of sedentary behaviors that residents engage in regularly? | |
| 3. What do you think are the benefits/drawbacks of these activities? | |
| 4. Do you think spending time in these activities is beneficial or harmful for residents? Or neither?<br>Probe – Why do you think these activities are beneficial/harmful/neither?<br>Probe 2 – Can you provide some examples? | |
| 5. Do you think it is important for residents to reduce their sitting time?<br>Probe – If yes, why do you think it is important?<br>Probe 2 – Can you provide some examples? | |
| 6. Do you think residents spend too much time sitting or lying down? Can you provide some examples?<br>Probe – If yes, what do you think would help residents reduce their sitting time?<br>Probe – If no, can you provide some examples why not? | To determine awareness of the pervasiveness sedentary behaviour. |
| 7. What do you think would help residents reduce their sitting time?<br>Is there anything you could do to help reduce sitting time in the lodge? | To gauge motivation/willingness to reducing sitting time, identify potential strategies for reducing sitting time |

| | |
|---|---|
| 8. Do you have any concerns with residents reducing their sitting time?<br>Probe – If yes, what are they?<br>Probe – If no, can you provide some examples of why not? | To identify sources of resistance to reducing sedentary behaviour. |
| 9. What kinds of things might prevent residents from standing up and moving around more frequently?<br>Probe – can you provide some examples? | To identify potential barriers to reducing sitting time. |
| Transition: That ends the questions about your opinions about time spent sitting and lying down. Now I would like to hear your opinion some potential strategies we have thought of that might help residents reduce the time they spend sitting during a day. Then I am hoping you will tell me what you think about those ideas and if you think they are feasible or if they will be effective.<br>(Some sample strategies from attached table will be presented 1 at a time) | |
| 10. Do you think this would be effective in reducing sitting time?<br>11. Do you think this strategy is possible or feasible?<br>12. Do you think this strategy would be difficult to accomplish? | |
| 13. Do you think there is anything missing that is important for us to know? | |

**APPENDIX D: EDUCATIONAL WORKBOOK**

# What is Sedentary Behaviour?

Sedentary behaviour refers to periods of time spent sitting or lying down while awake.

Puzzles, card games, reading, and socializing can help to keep your brain sharp and improve your mental health. But too much time spent sitting can be bad for you. Everything in moderation!

## Benefits of Sitting Less and Moving More

Breaking up time spent sitting with even short bouts of standing and moving around may improve your health. Sitting for even one hour less a day could reduce your risk of chronic disease.

- Improved heart health
- Maintain muscle strength
- Stay mobile
- Improved quality of life
- Maintain your independence

# How Sedentary Are You?

On a typical day, how many hours do you spend in continuous sitting: in meetings, volunteer commitments, and commuting?

☐ None ☐ <1 Hour ☐ 1 - <2 ☐ 2 - <3 ☐ 3 - <4

☐ 4 - <5 ☐ 5 - <6 ☐ >6 Hours

On a typical day, how many hours do you watch television, use a computer, read, and sit quietly during your leisure time?

☐ None ☐ <1 Hour ☐ 1 - <2 ☐ 2 - <3 ☐ 3 - <4

☐ 4 - <5 ☐ 5 - <6 ☐ >6 Hours

**Total Sedentary Time (add above): _____ hours per day**

When sitting for a long time (one or more hours), at what interval do you stand and move around for at least 2 minutes?

☐ <10 min ☐ 10 - <20 min ☐ 20 - <30 min

☐ 30 - <45 min ☐ 45 min - <1 hour ☐ 1 - <1.5 hours

☐ 1.5- <2 hours ☐ >2 hours

# Tips to Reduce Sedentary Time

## Walk & Talk

Try walking or standing while socializing or on the phone.

## Change Your Chair

Pick a firm chair that makes it easy to stand up.

## Moving Break

Have a moving break during TV or radio commercial breaks. Stand up and walk around the room.

## Move Every Hour

Set a timer to remind you to move. Try to stand up and stretch at least twice an hour.

## Need or Want?

Try to decide when you absolutely need to sit down vs when you want to sit down. Are there alternatives for when you want to sit?

## Choose to Move

Try taking the stairs instead of the elevator. Take the long route when walking to your destination.

## Re-Arrange Your Space

Place your garbage can in a space where you have to stand and walk to it. Put your TV remote on the opposite side of the room while watching TV.

WHAT IS SEDENTARY BEHAVIOUR?

# Tips for Goal Setting

Setting goals can help you stay motivated and on track. This worksheet will provide you with more information about how to set realistic goals.

## SMART Goals

| | |
|---|---|
| **S**pecific | Include as much detail as possible. Create a clear picture of what you want to achieve. |
| **M**easurable | If you don't measure it, you can't manage it. How much will you do? |
| **A**ctionable | Focus on things you can control. This will give you a sense of ownership over your goals and make them more achievable! |
| **R**ealistic | Is your goal achievable within your timeline? If not, how can you make it more realistic? |
| **T**ime | Creating a deadline for your goals will help keep you accountable and give you a sense of urgency. |

# Tips & Tricks for Goal Setting

## Tell Friends & Family

This will keep you accountable to your goals and provide extra motivation.

## Revisit Your Goals

Revisit your goals frequently to remind you what they are and provide you motivation.

## Modify Your Goals

Life happens. Instead of abandoning your goals, take stock of the situation and change them to make them SMART again.

## Reward Yourself

Take some time to appreciate the journey and how far you've come. Don't wait until you've reached your end goal to celebrate success.

## Schedule It In

Put reminders in your calendar or on your phone so you don't forget.

**A GOAL IS A DREAM WITH A DEADLINE**

# Goal Setting Worksheet

## Brainstorm

In the space below, list any sitting behaviours or habits that you would like to change. Don't limit yourself!

## Make it SMART

Pick up to 3 things you listed above turn it into a SMART goal.

**Goal 1:**

**Goal 2:**

**Goal 3:**

# Identifying Barriers

## Brainstorm

Barriers are real or perceived obstacles that keep you from achieving your goals. In the space below, brainstorm some things that might prevent you from achieving the goals you set on the last page.

## Make a Plan

Pick the 3 biggest barriers that you listed above and make a plan for how to overcome them.

**Barrier 1:**

**Barrier 2:**

**Barrier 3:**

# Frequently Asked Questions

## What is Sedentary Behaviour?

Sedentary behaviour is time spent seated or lying down with a low energy expenditure. It is different from not being physically active or exercise.

## What types of activities are considered sedentary?

Any activities completed while sitting or lying down are considered sedentary. This includes things like puzzles, cards, reading, socializing, and watching TV. If you are exercising while sitting, like in exercise class or on a bike, then that is not considered sedentary.

## I get a lot of joy out of socializing with friends or reading. I tend to sit during these activities. Does that mean it's bad for me?

Activities that provide you with social interaction or challenge your brain can provide lots of mental and brain health benefits. Sitting too much can be bad for your health. Try to take a standing or stretching break during these activities.

# Frequently Asked Questions

## I go to exercise class every morning. Isn't that enough?

Research has shown that exercise is great for our health but sitting too much can counteract those health benefits. Even if you exercise, still try to get up and move once an hour!

## I have difficulty walking long distances. What else can I do?

You can still get lots of benefits from just standing up for a few minutes every hour. You don't necessarily need to walk or do exercise during these standing breaks.

**APPENDIX E: INTERVENTION POINT OF DECISION PROMPTS**


STAND
and
CHAT
Reduce your time spent sitting to help maintain your balance

## APPENDIX F: INTERVENTION INFORMED CONSENT

**Title of Study: Stand to Strengthen: An intervention to reduce sedentary time**

**Principal Investigator:** Dr. Jennifer Copeland (403-317-2804)

**Research/Study Coordinator:** Lauren Voss (403-970-6735)

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You are being invited to participate in a study that will help us understand how to motivate people to spend less time sitting. This study is being conducted by Ms. Lauren Voss and Dr. Jennifer Copeland from the Active Healthy Aging Laboratory, in the Department of Kinesiology and Physical Education at the University of Lethbridge.

Research of this type is important because there is growing evidence that the time we all spend in sedentary behaviour has an impact on our health. Most of this research has involved children and adults, very little research has been done with older adults.

**What will I need to do in this study?**

- Before you participate, you will be asked to complete the CSEP Get Active Questionnaire, which will take about 5 minutes. The purpose of this questionnaire is to make sure you can safely participate in the study. Therefore, it is important that you answer honestly.

- The study will involve a total of 4 appointments at your lodge over the course of 8 weeks (approximately 30 – 60 minutes per appointment).

- **Appointment 1:** During the first appointment, you will be asked to complete questionnaires about your sitting behaviours, quality of life, and well-being. At the end of this appointment, we will provide you will a small activity tracking device that will placed on your leg using medical adhesive tape. You will be asked to wear this device 24 hours a day for one week to measure your daily movement.

- **Appointment 2:** The following week, we will collect the activity tracker from you and ask you to complete some physical measurements that are described below:
- We will measure your height and weight, and your resting blood pressure and heart rate.
- Gait Speed: You will be asked to walk at your usual speed for 4 metres
- Leg Strength: You will be asked to stand up from a chair five times in a row
- Balance: You will be asked to hold your balance for up to 10 seconds in three different positions with both feet on the floor. You will be asked to stand with

your feet side by side, with your feet staggered, and with your feet heel-to-toe.

- Grip strength: You will be asked to squeeze a hand grip device as hard as you can.

For all of these tests you will be near a wall for support in case you lose your balance

A few days after this second appointment, you will be asked to attend a presentation at the lodge about the benefits of breaking up long periods of sitting. You may also be invited by your activity coordinator to participate in some different activities over subsequent few weeks but they are all voluntary.

Six weeks later you will repeat the first two appointments.

**What are the benefits of being in this study?**
You may experience some physical benefits from participating in this project, such as getting stronger or improving your balance. You will also be contributing to important research on the health and wellness of older adults who live in lodges.

**What are the risks of being in this study?**
You could experience some mild muscle soreness after completing the physical measurements, although this is unlikely. There could be some mild skin irritation from the medical tape used to secure the motion sensor to your leg.

**Do I have to take part in the study?**
Participation in this study is completely voluntary and you do not have to participate. You may also withdraw from the study at any time without a reason. If you choose to withdraw, you may simply email or call either Lauren Voss or Jennifer Copeland (contact information is at the end of this letter), and all of the information you have shared will be destroyed. Withdrawing from the study will not affect your care or living environment in any way. Will I be paid to be in the research?
There is no payment for participating in this study. At the end of appointment 2 and appointment 4 you will receive a $10 gift card as a token of our appreciation for wearing the motion sensor for the week.

**Will my information be kept private?**
All participants are assigned an ID number to ensure anonymity. Only researchers involved with the study will access identifying information associated with each ID number and all files will be stored in a locked filing cabinet and a secure computer. This will ensure that any information that is obtained in connection with this study that can identify you will remain confidential. All files will be stored for 7 years and then deleted and/or shredded. All data will be combined before results are presented (ie: only group averages). None of your personal data will be released in any form.

Because we will conduct some of the assessments at the lodge, it is possible that some

of the other residents may be aware that you have volunteered for this research.

**Feedback on the results of this study:**
At the completion of the study you will be provided with a brief lay summary of the study findings. This results from this study will be reported in general terms in the form of speech or writing that may be represented in manuscripts submitted for publication in scientific journals, or oral and/or poster presentations at scientific meetings, seminars, and/or conferences. We may publish this study in an academic journal. The information published will not identify you in any way.

**What if I have questions?**
If you have questions about this research please contact the Principal Investigator:
**Jennifer Copeland at jennifer.copeland@uleth.ca or 403-317-2804** at the University of Lethbridge.

If you have any other questions regarding your rights as a participant in this research, you may also contact the Office of Research Ethics at the University of Lethbridge at 403-329-2747 or research.services@uleth.ca. This office is independent of the researchers.

Sincerely,
Dr. Jennifer Copeland, Principal Investigator
Lauren Voss, Co-Investigator

This research has been reviewed and approved by the University of Lethbridge Human Subject Research Committee, protocol # 2019-001

**Title of Study: Stand to Strengthen: An intervention to reduce sedentary time**

INFORMED CONSENT

I agree that:

- The objectives and procedures of this study have been explained to me
- I have had all my questions answered.
- I have answered all questions about my health and physical activity honestly.
- I understand that a copy of the information about this study is mine to keep.
- I voluntarily agree to participate in this study.

**Participant Name: _____ Date: _____**

**Participant Signature: _____ Date: _____**

**Research Assistant: _____ Date: _____**

## APPENDIX G: INTERVENTION QUESTIONNAIRES

Questionnaire 1: EQ-5D

Under each heading, please tick the ONE box that best describes your health TODAY.

**MOBILITY**

I have no problems in walking about ❑
I have slight problems in walking about ❑
I have moderate problems in walking about ❑
I have severe problems in walking about ❑
I am unable to walk about ❑

**SELF-CARE**

I have no problems washing or dressing myself ❑
I have slight problems washing or dressing myself ❑
I have moderate problems washing or dressing myself ❑
I have severe problems washing or dressing myself ❑
I am unable to wash or dress myself ❑

**USUAL ACTIVITIES** *(e.g. work, study, housework, family or leisure activities)*

I have no problems doing my usual activities ❑
I have slight problems doing my usual activities ❑
I have moderate problems doing my usual activities ❑
I have severe problems doing my usual activities ❑
I am unable to do my usual activities ❑

**PAIN / DISCOMFORT**

I have no pain or discomfort ❑
I have slight pain or discomfort ❑
I have moderate pain or discomfort ❑
I have severe pain or discomfort ❑
I have extreme pain or discomfort ❑

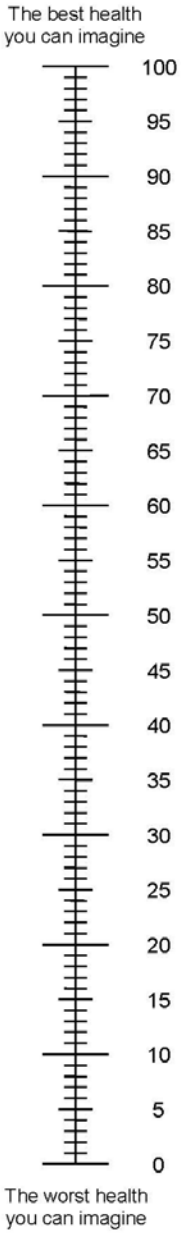
**ANXIETY / DEPRESSION**

I am not anxious or depressed ❑
I am slightly anxious or depressed ❑
I am moderately anxious or depressed ❑
I am severely anxious or depressed ❑
I am extremely anxious or depressed ❑

2

- We would like to know how good or bad your health is TODAY.
- This scale is numbered from 0 to 100.
- 100 means the best health you can imagine.
  0 means the worst health you can imagine.
- Mark an X on the scale to indicate how your health is TODAY.
- Now, please write the number you marked on the scale in the box below.

YOUR HEALTH TODAY = ☐



Questionnaire 2: ICECAP-O

**ABOUT YOUR QUALITY OF LIFE**

By placing a tick (✓) in ONE box in EACH group below, please indicate which statement best describes your quality of life at the moment.

| | | |
|---|---|---|
| **1. Love and Friendship** | | |
| I can have all of the love and friendship that I want | ☐ | 4 |
| I can have a lot of the love and friendship that I want | ☐ | 3 |
| I can have a little of the love and friendship that I want | ☐ | 2 |
| I cannot have any of the love and friendship that I want | ☐ | 1 |
| **2. Thinking about the future** | | |
| I can think about the future without any concern | ☐ | 4 |
| I can think about the future with only a little concern | ☐ | 3 |
| I can only think about the future with some concern | ☐ | 2 |
| I can only think about the future with a lot of concern | ☐ | 1 |
| **3. Doing things that make you feel valued** | | |
| I am able to do all of the things that make me feel valued | ☐ | 4 |
| I am able to do many of the things that make me feel valued | ☐ | 3 |
| I am able to do a few of the things that make me feel valued | ☐ | 2 |
| I am unable to do any of the things that make me feel valued | ☐ | 1 |
| **4. Enjoyment and pleasure** | | |
| I can have all of the enjoyment and pleasure that I want | ☐ | 4 |
| I can have a lot of the enjoyment and pleasure that I want | ☐ | 3 |
| I can have a little of the enjoyment and pleasure that I want | ☐ | 2 |
| I cannot have any of the enjoyment and pleasure that I want | ☐ | 1 |
| **5. Independence** | | |
| I am able to be completely independent | ☐ | 4 |
| I am able to be independent in many things | ☐ | 3 |
| I am able to be independent in a few things | ☐ | 2 |
| I am unable to be at all independent | ☐ | 1 |

**Tick one box only in each section**

Questionnaire 3: LASA Sedentary Behaviour Questionnaire

Instruction study participant:

*The next questions refer to the time you spend sitting or lying down during a full day (24 hours). Could you first respond to the questions for an average weekday (Monday-Friday) and then for an average weekend day (Saturday and Sunday)? If you do not perform an activity, please write down '0' (zero).*

*PLEASE NOTE: if you perform two activities at the same time, for example listening to music while knitting, please report only one of the two activities. You can choose yourself for which activity you report this time.*

| **On average, during a weekday (Monday - Friday), how many hours / minutes in a day (24 hours) do you ……** | | | |
|---|---|---|---|
| 1* | take a nap on a chair or couch?..... | ___ h | ____ min |
| 2* | read while being seated or lying down?..... | ___ h | ____ min |
| 3* | listen to music while being seated or lying down? ..... ..... | ___ h | ____ min |
| 4* | watch television, video or DVD? ..... ..... | ___ h | ____ min |
| 5* | perform a hobby while being seated, such as knitting, doing jigsaw puzzles or playing a music instrument? ..... | ___ h | ____ min |
| 6* | talk (in person or on the phone) with friends, family or acquaintances while being seated?..... | ___ h | ____ min |
| 7 | sit at the computer for work or leisure…… | ___ h | ____ min |
| 8 | perform sitting activities such as administrative tasks, writing a letter or having a meeting…… | ___ h | ____ min |
| 9 | sit in car, bus or train…… | ___ h | ____ min |
| 10 | visit church or (movie) theater…… | ___ h | ____ min |

2

| **On average, <u>during the weekend</u> (Saturday and Sunday), how many hours / minutes in a day (24 hours) do you ……** | | | |
|---|---|---|---|
| 1* | take a nap on a chair or couch?..... | ___ h | ____ min |
| 2* | read while being seated or lying down?..... | ___ h | ____ min |
| 3* | listen to music while being seated or lying down? ..... ..... | ___ h | ____ min |
| 4* | watch television, video or DVD? ..... ..... | ___ h | ____ min |
| 5* | perform a hobby while being seated, such as knitting, doing jigsaw puzzles or playing a music instrument? ..... | ___ h | ____ min |
| 6* | talk (in person or on the phone) with friends, family or acquaintances while being seated?..... | ___ h | ____ min |
| 7 | sit at the computer for work or leisure…….. | ___ h | ____ min |
| 8 | perform sitting activities such as administrative tasks, writing a letter or having a meeting…… | ___ h | ____ min |
| 9 | sit in car, bus or train…… | ___ h | ____ min |
| 10 | visit church or (movie) theater…… | ___ h | ____ min |

## APPENDIX H: GET ACTIVE QUESTIONNAIRE

CSEP | SCPE
THE GOLD STANDARD IN EXERCISE SCIENCE AND PERSONAL TRAINING

# 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.

## 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 before you become more physically active. If you are unsure about any question, answer **YES**.

| YES | NO | |
|---|---|---|
| | | **1** Have you experienced **ANY** 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

# Get Active Questionnaire

## 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**

Sign and date the Declaration below

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

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.)

# APPENDIX I: SHORT PERFORMANCE PHYSICAL BATTERY PROTOCOL

Study ID _____ Date _____ Tester Initials _____

## SHORT PHYSICAL PERFORMANCE BATTERY PROTOCOL AND SCORE SHEET

*All of the tests should be performed in the same order as they are presented in this protocol. Instructions to the participants are shown in bold italic and should be given exactly as they are written in this script.*

**1. BALANCE TESTS**

The participant must be able to stand unassisted without the use of a cane or walker. You may help the participant to get up.

***Now let's begin the evaluation. I would now like you to try to move your body in different movements. I will first describe and show each movement to you. Then I'd like you to try to do it. If you cannot do a particular movement, or if you feel it would be unsafe to try to do it, tell me and we'll move on to the next one. Let me emphasize that I do not want you to try to do any exercise that you feel might be unsafe.***

***Do you have any questions before we begin?***

**A. Side-by-Side Stand**

1. ***Now I will show you the first movement.***
2. (Demonstrate) ***I want you to try to stand with your feet together, side-by-side, for about 10 seconds.***
3. ***You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position until I tell you to stop.***
4. Stand next to the participant to help him/her into the side-by-side position.
5. Supply just enough support to the participant's arm to prevent loss of balance.
6. When the participant has his/her feet together, ask ***"Are you ready?"***
7. Then let go and begin timing as you say, ***"Ready, begin."***
8. Stop the stopwatch and say ***"Stop"*** after 10 seconds or when the participant steps out of position or grabs your arm.
9. If participant is unable to hold the position for 10 seconds, record result and go to the gait speed test.

Study ID _____ Date _____ Tester Initials _____

**B. Semi-Tandem Stand**

1. ***Now I will show you the second movement.***

2. (Demonstrate) ***Now I want you to try to stand with the side of the heel of one foot touching the big toe of the other foot for about 10 seconds. You may put either foot in front, whichever is more comfortable for you.***

3. ***You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position until I tell you to stop.***

4. Stand next to the participant to help him/her into the semi-tandem position

5. Supply just enough support to the participant's arm to prevent loss of balance.

6. When the participant has his/her feet together, ask ***"Are you ready?"***

7. Then let go and begin timing as you say ***"Ready, begin."***

8. Stop the stopwatch and say ***"Stop"*** after 10 seconds or when the participant steps out of position or grabs your arm.

9. If participant is unable to hold the position for 10 seconds, record result and go to the gait speed test.

**C. Tandem Stand**

1. ***Now I will show you the third movement.***

2. (Demonstrate) ***Now I want you to try to stand with the heel of one foot in front of and touching the toes of the other foot for about 10 seconds. You may put either foot in front, whichever is more comfortable for you.***

3. ***You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position until I tell you to stop.***

4. Stand next to the participant to help him/her into the tandem position.

5. Supply just enough support to the participant's arm to prevent loss of balance.

6. When the participant has his/her feet together, ask ***"Are you ready?"***

7. Then let go and begin timing as you say, ***"Ready, begin."***

8. Stop the stopwatch and say ***"Stop"*** after 10 seconds or when the participant steps out of position or grabs your arm.

Study ID _____ Date _____ Tester Initials _____

**SCORING:**

**A. Side-by-side-stand**
Held for 10 sec ❒ 1 point
Not held for 10 sec ❒ 0 points
Not attempted ❒ 0 points
**If 0 points, end Balance Tests**

Number of seconds held if
less than 10 sec: ___._ _sec

*If participant did not attempt test or failed, circle why:*
Tried but unable 1
Participant could not hold position unassisted 2
Not attempted, you felt unsafe 3
Not attempted, participant felt unsafe 4
Participant unable to understand instructions 5
Other (specify) _____ 6
Participant refused 7

**B. Semi-Tandem Stand**
Held for 10 sec ❒ 1 point
Not held for 10 sec ❒ 0 points
Not attempted ❒ 0 points *(circle reason above)*
**If 0 points, end Balance Tests**

Number of seconds held if less than 10 sec: ___._ _sec

**C. Tandem Stand**
Held for 10 sec ❒ 2 points
Held for 3 to 9.99 sec ❒ 1 point
Held for < than 3 sec ❒ 0 points
Not attempted ❒ 0 points (circle reason above)

Number of seconds held if less than 10 sec: ___._ _sec

**D. Total Balance Tests score_____(sum points)**

Comments: _____

Study ID _____ Date _____ Tester Initials _____

**2. GAIT SPEED TEST**

***Now I am going to observe how you normally walk. If you use a cane or other walking aid and you feel you need it to walk a short distance, then you may use it.***

**A. First Gait Speed Test**

1. ***This is our walking course. I want you to walk to the other end of the course at your usual speed, just as if you were walking down the street to go to the store.***

2. Demonstrate the walk for the participant.

3. ***Walk all the way past the other end of the tape before you stop. I will walk with you. Do you feel this would be safe?***

4. Have the participant stand with both feet touching the starting line.

5. ***When I want you to start, I will say: "Ready, begin."*** When the participant acknowledges this instruction say: ***"Ready, begin."***

6. Press the start/stop button to start the stopwatch as the participant begins walking.

7. Walk behind and to the side of the participant.

8. Stop timing when one of the participant's feet is completely across the end line.

**B. Second Gait Speed Test**

1. ***Now I want you to repeat the walk. Remember to walk at your usual pace, and go all the way past the other end of the course.***

2. Have the participant stand with both feet touching the starting line.

3. ***When I want you to start, I will say: "Ready, begin."*** When the participant acknowledges this instruction say: ***"Ready, begin."***

4. Press the start/stop button to start the stopwatch as the participant begins walking.

5. Walk behind and to the side of the participant.

6. Stop timing when one of the participant's feet is completely across the end line.

Study ID _____ Date _____ Tester Initials _____

**GAIT SPEED TEST SCORING:**

Length of walk test course: Four meters ❒ Three meters ❒

**A. Time for First Gait Speed Test (sec)**

1. Time for 3 or 4 meters __ __.__ __sec
2. If participant did not attempt test or failed, circle why:

| | |
|---|---|
| Tried but unable | 1 |
| Participant could not walk unassisted | 2 |
| Not attempted, you felt unsafe | 3 |
| Not attempted, participant felt unsafe | 4 |
| Participant unable to understand instructions | 5 |
| Other (Specify) _____ | 6 |
| Participant refused | 7 |
| Complete score sheet and go to chair stand test | |

3. Aids for first walk.....None ❒ Cane ❒ Other ❒

Comments:_____

_____

_____

**B. Time for Second Gait Speed Test (sec)**

1. Time for 3 or 4 meters __ __.__ __ sec
2. If participant did not attempt test or failed, circle why:

| | |
|---|---|
| Tried but unable | 1 |
| Participant could not walk unassisted | 2 |
| Not attempted, you felt unsafe | 3 |
| Not attempted, participant felt unsafe | 4 |
| Participant unable to understand instructions | 5 |
| Other (Specify) | 6 |
| Participant refused | 7 |

3. Aids for second walk..... None ❒ Cane ❒ Other ❒

What is the time for the faster of the two walks?
Record the shorter of the two times __ __.__ __ sec
[If only 1 walk done, record that time] __ __.__ __ sec

If the participant was unable to do the walk: ❒ **0 points**

| **For 4-Meter Walk:** | | **For 3-Meter Walk:** | |
|---|---|---|---|
| If time is more than 8.70 sec: | ❒ **1 point** | If time is more than 6.52 sec: | ❒ **1 point** |
| If time is 6.21 to 8.70 sec: | ❒ **2 points** | If time is 4.66 to 6.52 sec: | ❒ **2 points** |
| If time is 4.82 to 6.20 sec: | ❒ **3 points** | If time is 3.62 to 4.65 sec: | ❒ **3 points** |
| If time is less than 4.82 sec: | ❒ **4 points** | If time is less than 3.62 sec: | ❒ **4 points** |

Study ID _____ Date _____ Tester Initials _____

**3. CHAIR STAND TEST**

**Single Chair Stand**

1. ***Let's do the last movement test. Do you think it would be safe for you to try to stand up from a chair without using your arms?***

2. ***The next test measures the strength in your legs.***

3. (Demonstrate and explain the procedure.) ***First, fold your arms across your chest and sit so that your feet are on the floor; then stand up keeping your arms folded across your chest.***

4. ***Please stand up keeping your arms folded across your chest.*** (Record result).

5. If participant cannot rise without using arms, say ***"Okay, try to stand up using your arms."*** This is the end of their test. Record result and go to the scoring page.

**Repeated Chair Stands**

1. ***Do you think it would be safe for you to try to stand up from a chair five times without using your arms?***

2. (Demonstrate and explain the procedure): ***Please stand up straight as QUICKLY as you can five times, without stopping in between. After standing up each time, sit down and then stand up again. Keep your arms folded across your chest. I'll be timing you with a stopwatch.***

3. When the participant is properly seated, say: ***"Ready? Stand"*** and begin timing.

4. Count out loud as the participant arises each time, up to five times.

5. Stop if participant becomes tired or short of breath during repeated chair stands.

6. Stop the stopwatch when he/she has straightened up completely for the fifth time.

7. Also stop:
   - If participant uses his/her arms
   - After 1 minute, if participant has not completed rises
   - At your discretion, if concerned for participant's safety

8. If the participant stops and appears to be fatigued before completing the five stands, confirm this by asking ***"Can you continue?"***

9. If participant says "Yes," continue timing. If participant says "No," stop and reset the stopwatch.

Study ID _____ Date _____ Tester Initials _____

**SCORING**

**Single Chair Stand Test**

| | | YES | NO | |
|---|---|---|---|---|
| A. | Safe to stand without help | ❒ | ❒ | |
| B. | Results: | | | |
| | Participant stood without using arms | ❒ | | → Go to Repeated Chair Stand Test |
| | Participant used arms to stand | ❒ | | → End test; score as 0 points |
| | Test not completed | ❒ | | → End test; score as 0 points |

C. If participant did not attempt test or failed, circle why:

| | |
|---|---|
| Tried but unable | 1 |
| Participant could not stand unassisted | 2 |
| Not attempted, you felt unsafe | 3 |
| Not attempted, participant felt unsafe | 4 |
| Participant unable to understand instructions | 5 |
| Other (Specify) _____ | 6 |
| Participant refused | 7 |

**Repeated Chair Stand Test**

| | | YES | NO |
|---|---|---|---|
| A. | Safe to stand five times | ❒ | ❒ |

B. If five stands done successfully, record time in seconds.

Time to complete five stands __ __.__ __ sec

C. If participant did not attempt test or failed, circle why:

| | |
|---|---|
| Tried but unable | 1 |
| Participant could not stand unassisted | 2 |
| Not attempted, you felt unsafe | 3 |
| Not attempted, participant felt unsafe | 4 |
| Participant unable to understand instructions | 5 |
| Other (Specify) | 6 |
| Participant refused | 7 |

**Scoring the Repeated Chair Test**

| | |
|---|---|
| Participant unable to complete 5 chair stands or completes stands in >60 sec: | ❒ 0 points |
| If chair stand time is 16.70 sec or more: | ❒ 1 points |
| If chair stand time is 13.70 to 16.69 sec: | ❒ 2 points |
| If chair stand time is 11.20 to 13.69 sec: | ❒ 3 points |
| If chair stand time is 11.19 sec or less: | ❒ 4 points |

Study ID _____ Date _____ Tester Initials _____

**Scoring for Complete Short Physical Performance Battery**

| **Test Scores** | | |
|---|---|---|
| **Total Balance Test score** | _____ | **points** |
| **Gait Speed Test score** | _____ | **points** |
| **Chair Stand Test score** | _____ | **points** |
| **Total Score** | _____ | **points (sum of points above)** |

**APPENDIX J: SCAVENGER HUNT INSTRUCTIONS**

# SCAVENGER HUNT

**Search for 5 playing cards for the winning cribbage hand around Black Rock Terrace.**

Tell Sharla what the 5 cards are on Monday.

**Win a prize!**

## APPENDIX K: COMPARISON OF RESULTS WITH AND WITHOUT PARTICIPANT 1 AT SITE A

Table M.1 Comparison of Quality of Life Data With and Without Participant 1

| Scale | Site A (n=5) | | Site A (n=4) | | Overall (n=9) | | |
|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | t (p) |
| ICECAP-O | 0.74 ± 0.10 | 0.72 ± 0.17 | 0.76 ± 0.10 | 0.78 ± 0.09 | 0.85 ± 0.11 | 0.84 ± 0.10 | 0.342 (0.746) |
| EQ-5D Health Index | 0.64 ± 0.21 | 0.65 ± 0.14 | 0.71 ± 0.17 | 0.68 ± 0.14 | 0.78 ± 0.14 | 0.75 ± 0.12 | 1.187 (0.269) |
| EQ-5D – Health Today | 70.0 ± 12.7 | 77.0 ± 19.2 | 70.0 ± 14.7 | 78.8 ± 21.7 | 78.3 ± 14.4 | 79.4 ± 15.9 | -0.158 (0.878) |

Table M.2 Comparison of Device-Measured Movement Patterns With and Without Participant 1

| Variable | Site A (n=5) | | Site A (n=4) | | Overall (n=9) | | |
|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | t (p) |
| Sitting time (min/day) | 614.6 ± 132.3 | 577.5 ± 157.9 | 631.1 ± 146.7 | 599.9 ± 173.0 | 596.5 ± 182.4 | 589.9 ± 188.0 | 0.310 (0.746) |
| Stepping time (min/day) | 70.5 ± 54.1 | 93.1 ± 84.8 | 48.4 ± 25.44 | 56.4 ± 25.6 | 67.1 ± 38.4 | 75.2 ± 60.3 | -0.914 (0.385) |
| Standing time (min/day) | 186.5 ± 81.8 | 197.9 ± 67.5 | 166.34 ± 78.8 | 180.3 ± 63.3 | 214 .5 ± 125.4 | 202.6 ± 85.6 | 0.541 (0.601) |
| Upright time (min/day) | 256.9 ± 127.3 | 290.9 ± 142.1 | 214.7 ± 98.4 | 236.7 ± 85.5 | 281.6 ± 140.1 | 277.7 ± 120.8 | 0.150 (0.884) |
| Sitting time in bouts >30min (min/day) | 363.9 ± 144.1 | 320.4 ± 193.1 | 380.9 ± 160.5 | 333.6 ± 220.4 | 376.1 ± 167.0 | 367.2 ± 185.4 | 0.291 (0.776) |
| Steps per Day | 5761 ± 5788 | 7840 ± 9032 | 3284 ± 1936 | 3882 ± 2091 | 5173 ± 3999 | 5962 ± 6358 | -0.935 (0.374) |
| Sit to Stand Transitions per Day | 49.2 ± 10.4 | 54.6 ± 7.1 | 47.8 ± 11.4 | 53.3 ± 7.4 | 45.1 ± 9.0 | 47.0 ± 10.1 | -0.720 (0.490) |

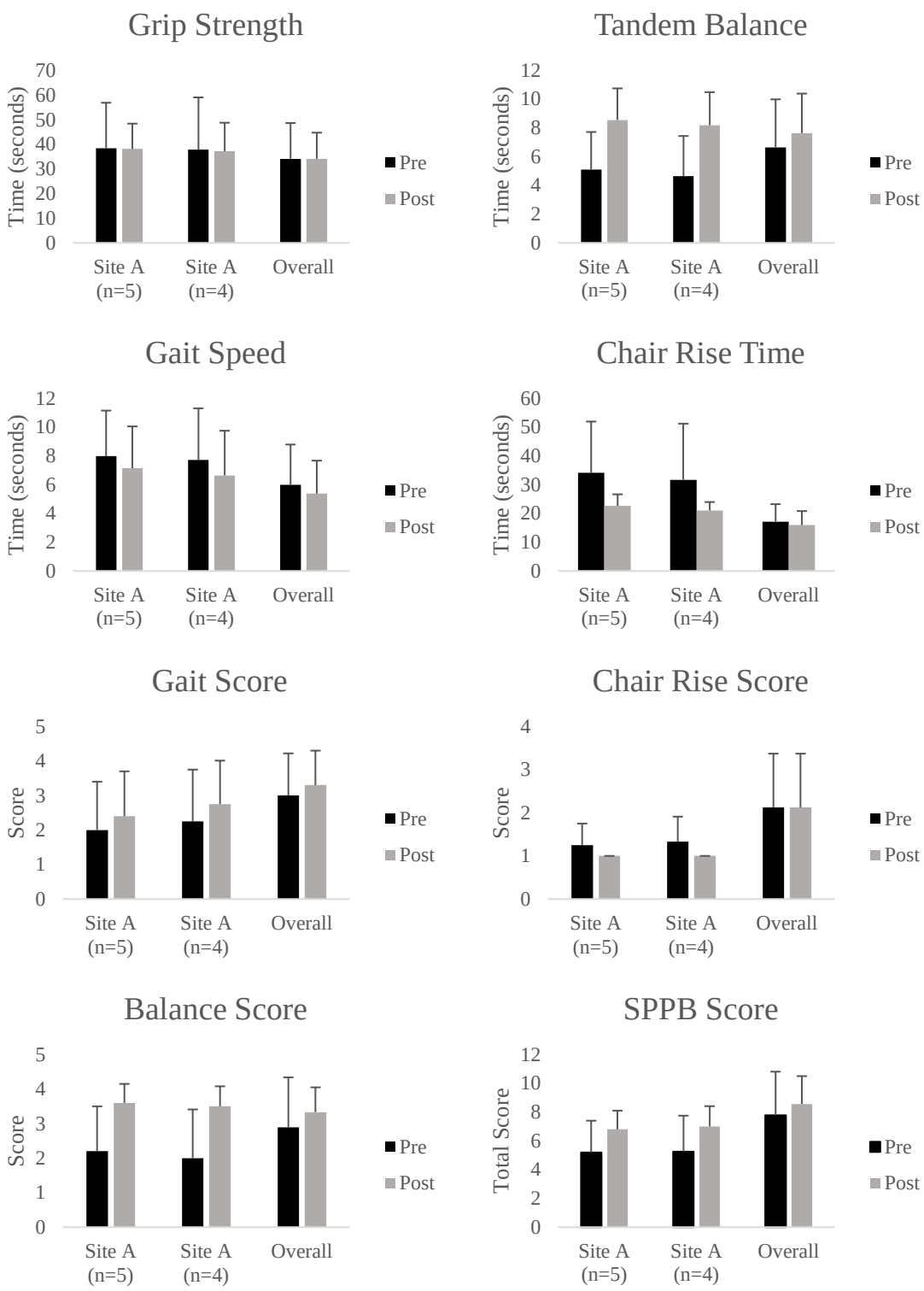



Figure M.1 Comparison of physical measures with and without Participant X at Site A

## APPENDIX L: PARTICIPANT INTERVENTION FEEDBACK FORM

### Resident Feedback

We value your feedback about the Stand to Strengthen program so we can improve the program. All feedback will be anonymous.

Please indicate below which strategies from the Tips and Tricks handout you used through the 6-week program.

| Strategy | How often did you use each tip? | | | |
|---|---|---|---|---|
| | **Daily** | **A few times a week** | **Once or twice over 6 weeks** | **I didn't use it** |
| **Walk and Talk**: try walking or standing while socializing or on the phone. | | | | |
| **Change your chair**: pick a firm chair that makes it easy to stand up. | | | | |
| **Moving break**: Have a moving break during TV or radio commercial breaks. Stand up and walk around the room. | | | | |
| **Move every hour**: set a timer to remind you to move. Try to stand up and stretch at least twice an hour. | | | | |
| **Need or want**: try to decide when you absolutely need to sit down vs when you want to sit down. Are there alternatives for when you want to sit? | | | | |
| **Choose to move**: try taking the stairs instead of the elevator. Take the long route when walking to your destination. | | | | |
| **Re-arrange your space**: place your garbage can in a space where you have to stand and walk to it. Put your TV remote on the opposite side of the room while watching TV. | | | | |

Please indicate how much you liked or disliked each strategy in the table below.

| Strategy | I liked it a lot | I liked it a little | Neutral | I disliked it a little | I strongly disliked it |
|---|---|---|---|---|---|
| Group education session about what sedentary behaviour is | | | | | |
| Goal setting to reduce sitting time | | | | | |
| Tips and Tricks handout in the educational booklet | | | | | |
| Signage (“stand and chat”, sign by TV in lounge) | | | | | |
| Standing table in lounge | | | | | |
| Scavenger Hunt | | | | | |

What can we do to improve the Stand to Strengthen program? Can any strategies or program components be altered to be more effective?

What did you enjoy about the Stand to Strengthen program? Is there anything you learned that you would like to share with program staff?

## APPENDIX M: ACTIVITY COORDINATOR INTERVIEW INFORMED CONSENT

**Title of Study: Stand to Strengthen: An intervention to reduce sedentary time**

**Principal Investigator:** Dr. Jennifer Copeland (403-317-2804)

**Research/Study Coordinator:** Lauren Voss (403-970-6735)

---

You are being invited to participate in a study that will help us understand what strategies are feasible to reduce the amount of time Lodge residents spend sitting.

**What will I need to do in this study?**

- You will be asked to participate in a short discussion (approximately 10 minutes) with the researchers to provide your feedback on the Stand to Strengthen program
- You will be asked for your opinion on what strategies were easy to implement and how residents responded to the strategies
- You will be asked to consider how the strategies could be altered to be more effective at reducing sitting time among residents. We will ask you to tell us what you think about the strategies and if they are feasible and would be helpful.
- A research assistant will take notes about your answers and all of your responses will remain anonymous.

**What are the benefits?**

You will not benefit directly from being in this study, however you will be making an important contribution to research that will help us understand the best way to inform people about the effect of different sedentary behaviours on their health.

**What are the risks?**

There are no known risks to participating in this study.

**Do I have to take part in the study?**

Participation in this study is completely voluntary and you do not have to participate. You may also withdraw from the study at any time without a reason. If you choose to withdraw, all of the information you have shared will be destroyed.

**Will I be paid to be in the research?**

You will be provided with a $10 gift card for your time.

**Will my information be kept private?**

All information you provide is confidential. Your full name will not be used in any of the notes, only initials will be recorded. Your personal information, including your name, will be kept confidential and will not be distributed in any way.

**What if I have questions?**

If you have questions about this research please contact the Principal Investigator:

**Jennifer Copeland at jennifer.copeland@uleth.ca or 403-317-2804** at the University of Lethbridge.

If you have any other questions regarding your rights as a participant in this research, you may also contact the Office of Research Ethics at the University of Lethbridge at 403-329-2747 or research.services@uleth.ca. This office is independent of the researchers.

I have read the above information regarding this research study on and I consent to participate in this study.

_____ Printed Name of Participant

_____ Signature of Participant

_____ Signature of Research Assistant

_____ Date

## APPENDIX N: ACTIVITY COORDINATOR FEEDBACK QUESTION GUIDE

1. As an activity coordinator, how did you feel about the Stand to Strengthen program?
   1a. Were the strategies easy for you to implement?
   1b. do you think the strategies were beneficial?
   1c. any specific strategies that you thought were good? Or not good?
   Include list: Standing table, signage, scavenger hunt, education session (tips & tricks, goal setting, barrier identification)

2. Did you make any changes to the way you organized resident activities over the 6 weeks of the intervention? If so, what changes did you make?

3. What initiatives did residents seem to like the most? For example, the scavenger hunt, standing table, education session, etc.
4. Did you notice any changes in resident behaviour through the 6 weeks? If so, what changes did you see?
5. Do you have any suggestions of how we could improve the Stand to Strengthen program?
6. Do you have any suggestions of how we might recruit more participants for future studies of Stand to Strengthen at other residences?