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Fall Risk Reduction Using Lifestyle-integrated Functional Exercise (LiFE)

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This capstone paper, written under the direction of Dr. Kitsum Li OTD, OTR/L, CSRS and approved by the chair of the occupational therapy program, Dr. Ruth Ramsey Ed.D, OTR/L, has been presented to and accepted by the faculty of the Occupational Therapy Department in partial fulfillment of the requirements for the degree of Master of Science in Occupational Therapy. The content and research methodologies presented in this work represent the work of the candidates alone.

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Abstract

As the population and longevity of older adults' increases, the prevalence of falls is becoming an ever-growing issue. Falls in older adults may lead to sedentary behavior, decreased independence, and lower quality of life. Evidence has shown that traditional exercise programs emphasizing strength and balance can decrease the fall risk in older adults, but may be difficult to sustain over time. Emerging evidence suggests that exercises that are integrated into daily life, as seen in the Lifestyle-integrated Functional Exercise (LiFE) program, may have a more lasting effect in reducing fall risk in older adults. This study explored the effectiveness of a 26-week modified-LiFE program in decreasing fall risk in community-dwelling older adults. Purposive sampling of men and women 65 years and older, with or without a history of falls, living at two retirement communities yielded 16 participants. Participants were assessed three times using a battery of six fall risk assessments. Results demonstrated a significant reduction in fall risk, and increase in strength and balance. Additionally, results showed a trend toward sustainability of exercise. Therefore, integrating exercises into daily life may offer occupational therapists an effective occupation-based intervention that promotes safety, independence, and quality of life for older adults.

Introduction

Advances in healthcare significantly increase the average life expectancy of the Americans (Centers for Disease Control and Prevention [CDC], 2013). However, this increase in life expectancy also introduces a plethora of health conditions, ailments, and age-related concerns (CDC, 2013). Perhaps one of the greatest concerns facing an aging population is that of falls (CDC, 2016). Falls may jeopardize older adults' abilities to "age-in-place", or safely, independently, and comfortably live in their own home and community (CDC, 2013). Occupational therapists play a pivotal role in fall prevention and the promotion of healthy aging as it relates to safety, engagement in occupations, and quality of life for older adults.

Existing evidence supports fall prevention programs with an emphasis on strength and balance exercises to decrease fall risk in older adults (Cho & An, 2014; Roaldsen, Halvarsson, Sahlström, & Ståhle, 2014; Sherrington, Tiedemann, Fairhall, Close, & Lord, 2011). However, poor access to exercise environments, limited time, and decreased funds may make traditional exercise less sustainable. Emerging evidence suggests that integrated exercise programs may be effective in reducing fall risk in older adults (Burton, Lewin, Clemson, & Boldy, 2014; Clemson et al., 2012; Opdenacker, Boen, Coorevits, & Delecluse, 2008). Integrated exercise programs are defined as interventions where endurance, strength, flexibility, and balance exercises are incorporated into everyday activities and routines. Furthermore, integrated exercise programs have been found to improve exercise sustainability (Burton et al., 2014; Clemson et al., 2012; Opdenacker et al., 2008).

Integrated exercise programs have also been found to decrease fall risk in older adults who have previously experienced a fall (Clemson et al., 2012). With that said, there is limited existing evidence that integrated exercise programs decrease fall risk in older adults who have not previously fallen. This study examined a modified version of the Lifestyle-integrated Functional Exercise (LiFE) program, a fall prevention program with a focus on integrating strength and balance exercises into daily activities, as a possible approach to minimize fall risk in both fallers and non-fallers. Results indicated that the modified-LiFE program can decrease fall risk and increase balance and lower extremity strength over the course of the six-month study. Additionally, results showed a trend toward sustainability of integrated exercise. Therefore, the modified-LiFE program may be a valuable intervention for occupational therapists seeking to decrease fall risk and promote sustainable engagement in meaningful occupations among community-dwelling older adults.

Literature Review

As the population of older adults grows, the concern for risk of falling increases accordingly. This literature review will examine the complex relationships between community-dwelling older adults and risk factors for falls. A review of existing fall risk assessments will identify the most appropriate means for measuring fall risk in community-dwelling older adults. Furthermore, the literature review will explore the benefits and limitations of traditional exercises and examine the effectiveness of utilizing integrated exercise approaches for fall prevention.

Aging and Falls

As medicine continues to advance and lifespans increase, the population of older adults grows exponentially. In the next 25 years, the population of older adults aged 65 years or over will double, accounting for roughly 20% of the U.S. population by 2030 (CDC, 2013). According to the CDC (2016), more than one out of four adults aged 65 years or older experience a fall annually. A fall is defined as "an unexpected event in which an individual comes to rest on the ground, floor, or lower level" (Lamb, Jorstad-Stein, Hauer, Becker & Prevention of Falls Network Europe and Outcomes Consensus Group, 2005, p. 1619). Each year, approximately 800,000 people are hospitalized for injuries related to falls, amounting to 31 billion dollars spent in fall treatment (CDC, 2016). Falls can result in serious injury 20% of the time, and are the number one cause of accidental death for older adults (Healthy People 2020, 2015). In 2014, the CDC reported 27,180 fatal and 2,495,397 nonfatal fall injuries in older adults. Within Marin County alone, falls contributed to 3,501 emergency department visits in 2014, and 38 deaths in 2013 (California Department of Public Health, 2016).

Among older adults, nonfatal falls often result in wrist, shoulder, ankle, and hip fractures. Falls are also the most common cause of traumatic brain injuries among older adults (CDC, 2016). Such injuries may limit older adults' ability to live on their own (CDC, 2016). In addition to decreasing independence, fall-related injuries may affect older adults' abilities and participation in meaningful occupations. Meaningful occupations that may be impacted include dressing, cooking, bathing, and leisure activities. Falls may also lead to a fear of falling, sedentary behavior, and lower quality

of life (Healthy People 2020, 2015). Therefore, as the American population ages, prolonging the health, well-being, and independence of older adults through fall prevention should be a primary focus of all healthcare providers, including occupational therapists.

Risk Factors Contributing to Falls

Older adults are more susceptible to experiencing a fall due to a number of risk factors, including but not limited to decreased muscle strength, stiffened joints, reduced balance, hindered vision, fear of falling (FOF), and diminished awareness of the surrounding environment (Rubenstein, 2006). As the number of risk factors increases for older adults, the risk of falling increases dramatically. In 2001, American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel put forth a guideline on fall prevention in older adults. In this guideline, the panel found older adults with zero or one fall risk factor are 27% more likely to fall. In addition, the panel also found that older adults with four or more fall risk factors were 78% more likely to fall (American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention, 2001).

Decreased muscle strength and balance. Decreases in muscle strength and balance have been identified as two important fall risk factors in older adults. A systematic review of 12 retrospective studies from 1986 to 2003 on falls among older adults living in different settings found balance disorders, muscle weakness, and problems with gait as high risk factors for falls (Rubenstein, 2006). As postural control,

muscle strength, muscle tone, and step height during gait decrease with age, such declines often impair older adults' ability to avoid a fall after unexpected slips (Rubenstein, 2006).

A study by the American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention (2001) sought to determine risk factors for falls using odds ratios. An odds ratio represents the odds that an outcome will occur (Portney & Watkins, 2000). Results of the study found that muscle weakness yielded an odds ratio of 4.4 and balance and gait deficits both received odds ratios of 2.9 (American Geriatrics Society et al., 2001). Given this ratio, older adults with muscle weakness are 4.4 times more likely to have a fall compared to those without muscle weakness, while balance and gait deficits increased fall risks in older adults 2.9 times

Delbaere et al. (2010) also looked at fall risk in 500 community-dwelling older adults aged 70 to 90. The study aimed to identify the relationship between different fall risk factors and falls through a prospective cohort study with a 12-month follow-up period. Delbaere et al.'s (2010) findings supported that muscle strength and poor balance were important risk factors for falls. Additionally, Delbaere et al.'s (2010) study found that poor dynamic balance is a critical predictor of falls. Since dynamic balance is a combination of standing balance, core control, and coordination during movement, older adults with poor dynamic balance may have a hard time finding equilibrium while participating in everyday activities such as reaching, turning, and walking (Delbaere et al., 2010). In summary, studies looking at fall risk indicate that decreased strength and/or

impaired balance are significant risk factors for falls, thereby implicating the importance of improving muscle strength and balance when addressing fall risk.

Fear of falling. First identified in 1982, FOF refers to a "low perceived self-efficacy at avoiding falls during essential, nonhazardous activities of daily living" (Tinetti, Richman, & Powell, 1990, p. 239). FOF can lead to an individual avoiding activities that he or she remains capable of performing (Tinetti & Powell, 1993). For example, an older adult with a FOF may intentionally avoid bathing or gardening. Avoiding participation in activities can negatively affect the older adult's quality of life and social participation, decrease strength, range of motion, balance, and overall endurance, all of which may further increase his or her fall risk.

A study by Scheffer, Schuurmans, Van Dijk, Van Der Hofft, and De Rooji (2008) looked at three aspects of FOF through systematically searching and selecting relevant articles from 1990 to December 2006 using Pubmed. The researchers aimed to examine the prevalence of FOF among fallers and non-fallers, identify the factors related to FOF, and investigate the relationship between consequences of FOF among community-dwelling older adults. Community-dwelling older adults were defined as seniors over 65 years of age who lived independently or with home services. Through analysis of the 28 identified studies, the researchers concluded that FOF may be a consequence of a previous fall experience. However, an analysis of the same studies also showed that almost half of the participants who suffer from FOF have never fallen (Scheffer, Schuurmans, Van Dijk, Van Der Hofft, & De Rooji, 2008). This contradicts the idea that

FOF can only happen with older adults who have fallen before, and strengthens the idea that FOF can be considered a risk factor for both fallers and non-fallers.

Scheffer et al. (2008) revealed that having fallen predicts the chance of having a FOF, and that having a FOF in turn, increases the risk of falls in older adults. FOF is often associated with avoidance of physical activity, daily occupations, and social interaction (Scheffer et al., 2008). Fear-related avoidance of activities can lead to a loss of independence, negative psychological effects including depression and decreased self-confidence, and ultimately a decline in physical function (Scheffer et al., 2008; Van Haastregt, Zijlstra, Van Rossum, Van Eijk, & Kempen, 2008). A decline in physical function resulting from FOF can lead to deconditioning of the muscles and abnormal gait and can eventually increase the risk of future falls (Delbaere, Crombez, Vanderstraeten, Willems, & Cambier, 2004; Rubenstein, 2006).

In summary, FOF can be initiated by a previous fall, although that may not always be the case; FOF can develop in older adults who have not previously fallen. Effects of FOF may be detrimental to older adults, and can cause a downward spiral of decreased participation in activities, which in turn can increase negative psychological effects, including depression and decreased self-confidence. These effects may also lead to deterioration of muscle strength and balance, which are strong indicators for increased fall risk, and ultimately increases the risk of injurious falls due to deconditioning.

Additional intrinsic and extrinsic risk factors. Various intrinsic and extrinsic risk factors for falls must also be considered. Intrinsic risk factors are factors that originate within the individual. A few of the intrinsic risk factors include vision,

cognition level, and pain. In 2006, Lord found impaired vision to be a significant risk factor for falls in older adults. Because balance relies on visual input, loss of vision may contribute to poor balance and increased fall risk. Older adults with decreased vision are 2.5 times more likely to experience a fall than older adults without vision impairments (American Geriatrics Society et al., 2001). Another intrinsic risk factor that is a contributor to fall risk is executive functioning, a vital component of cognition. A decline in executive functioning and attention have been shown to have a high correlation to risk of falling in older adults (Mirelman et al., 2012). Older adults with decreased cognition are 1.8 times more likely to fall than older adults without cognitive impairment (American Geriatrics Society et al., 2001). Furthermore, in a systematic review and meta-analysis completed by Stubbs et al. (2014), the researchers found that pain is also an intrinsic risk factor correlated to falls. In the meta-analysis, Stubbs et al. (2014) examined seven studies focusing on community-dwelling older adults. The review found that older adults with pain were 2.05 times more likely to have a recurrent fall. Specifically, pain often affects gait patterns and increases avoidance of activities. The increase in avoidance of activities often result in muscle deconditioning, which is a known risk factor for increased fall risk (Stubbs et al., 2014).

Extrinsic risk factors are factors that originate outside the individual. Some extrinsic risk factors include medication and type of shoe wear. The majority of medications that older adults take have side effects that decrease balance, blur vision, and increase dizziness (Mehta, Chen, Johnson, & Aparasu, 2010). Polypharmacy, the use of four or more medications, is also common in older adults and can increase fall risk due to

the side effects from medication interactions (Ziere et al., 2006). Looking at the relationship between medication intake and fall risk, Ziere et al. (2006) found that the risk of falling increased significantly with the number of medications used per day. Another extrinsic factor that affects fall risk is the type of shoe wear an older adult wears (Menant, Steele, Menz, Munro, & Lord, 2008). According to a study of 29 community-dwelling older adults, the most definitive fall risk in shoe wear was heel height. The study found that an elevation of 4.5 cm significantly increases postural sway and impairs overall balance in older adults (Menant et al., 2008).

Although one risk factor alone may not lead to a fall, research has shown the interaction of intrinsic and extrinsic risk factors can significantly increase fall risk. In a systematic review and meta-analysis done by Deandrea et al. (2010), 74 studies met the inclusion and exclusion criteria and 31 risk factors were identified. Researchers found history of falls, gait problems, use of walking aids, and vertigo had the strongest associations with fall risk. In particular, older adults who had previously fallen were three times more likely to experience another fall, and older adults who used mobility assistive devices were 2.6 times more likely to experience another fall. Given that many factors can increase fall risk, it is important to assess or be aware of additional intrinsic and extrinsic risk factors when aiming to decrease fall risk in older adults.

Fall Risk Assessments

As the consequences of falls continue to plague the aging population, means of assessing fall risk are of paramount importance. Existing fall risk assessments have addressed different aspects of fall risk including muscle strength, balance, and FOF. A

review of these assessments helps to identify the most appropriate fall risk assessments for community-dwelling older adults.

Senior Fitness Test. The Senior Fitness Test was developed in response to a lack of suitable measurement tools to assess the underlying physical factors associated with functional mobility (Rikli & Jones, 1999). The Senior Fitness Test contains a battery of seven performance tests that address strength, endurance, flexibility, balance, and agility in community-dwelling older adults over 60. For community-dwelling older adults over 60, the Senior Fitness Test is user-friendly, enjoyable, and motivating.

Eighty-two community-dwelling older adults participated in establishing the reliability of the Senior Fitness Test (Rikli & Jones, 1999). All seven subtests of the Senior Fitness Test demonstrated good test-retest reliability, with an intra-class correlation coefficient (ICC) of .80-.98, and a majority of values being .90 or above (Rikli & Jones, 1999). Additionally, the Senior Fitness Test has good content, construct, and criterion validity, and is successful in measuring functional mobility without significant floor or ceiling effects (Rikli & Jones, 1999).

The 30-second Chair Stand Test. For older adults, lower body strength has been well established as a major factor in maintaining functional mobility and independence (Rikli & Jones, 1999; Smith et al., 2001). The 30-second Chair Stand Test (30-s CST) is one of the seven subtests within the Senior Fitness Test, and is a modification of the timed-stand test published by Csuka and MCarty in 1985 (Rikli & Jones, 1999). The 30-s CST assesses lower body strength by counting the number of times the participant can rise to a full stand from a seated position, without pushing off the arms of the chair,

within 30 seconds. As a subtest of the Senior Fitness Test, normative data of the 30-s CST were developed by collecting scores from over 7,000 community-dwelling older adults aged 60-90 and above, from 267 sites in 21 states across the nation (Rikli & Jones, 1999). Normative data for 30-s CST is presented through percentile norms. Based on the participant's gender, age, and number of chair stands completed, these percentile norms provide information on how a participant’s test scores rank relative to his or her peers (Rikli & Jones, 1999). Good test-retest reliability (ICC=.84-.92) and good construct and criterion validity of the 30-s CST was found among 76 community-dwelling older adults (Jones, Rikli, & Beam, 1999). Therefore, the 30-s CST can be used as an effective measurement of the lower body strength in community-dwelling older adults.

Balance assessments. Impairment in balance is known to be a major predictor of falls in older adults (Delbaere et al., 2010; Muir, Berg, Chesworth, Klar, & Speechly, 2010). Common balance assessments used to measure fall risk in older adults include the Berg-Balance Scale (BBS), Dynamic Gait Index (DGI), Tinetti Performance Oriented Mobility Assessment (POMA), Functional Reach Test (FRT), Timed Up and Go (TUG), and the One-Leg Stand (OLS). A review of these balance assessments was completed to identify the most appropriate assessment of fall risk in community-dwelling older adults.

Berg-Balance Scale. The BBS is a 14-item assessment that measures balance impairments in older adults. It involves evaluating static and dynamic activities of varying difficulty beginning from sitting, and ending on a single leg stance. In each of the activities on the BBS, older adults’ balance is scored on a 5-point scale, with a score of zero indicating an inability to complete the activity, and a score of four indicating

independence in completing the activity. The maximum score is 56, with a cutoff score of 45 indicating a risk for falling (Berg, Wood-Dauphine, Williams, & Gayton, 1989). The BBS has good inter-rater and intra-rater reliability (ICC=.98-.99), as well as high internal consistency with a Cronbach's alpha of .96 (Berg et al., 1989). In 2011, Neuls et al. conducted a systematic review on the use of the BBS among community-dwelling older adults. The review confirmed the BBS to have good inter-rater reliability (ICC=.88-.98) and intra-rater reliability (ICC=.68-.99), as well as good construct and concurrent validity when used with community-dwelling older adults (Neuls et al., 2011).

Although the BBS has shown to be a reliable and valid assessment, limitations have been found. Neuls et al. (2011) indicated that the BBS has low sensitivity and low to moderate specificity in community-dwelling older adults. A low sensitivity means that the BBS may not be able to correctly identify fallers in community-dwelling older adults with high fall risk. A low specificity means that the BBS may not be able to correctly identify non-fallers in those with lower fall risk. Ceiling effects have also been observed when the BBS was used with community-dwelling older adults (Neuls et al., 2011; Pardasaney et al., 2012). Additionally, administration of the BBS takes 15-20 minutes to complete, making it one of the longest functional balance tests to administer (Langley & Mackintosh, 2007). Furthermore, the BBS did not have a consistent cutoff score distinguishing participants from having high or low fall risk (Neuls et al., 2011). Therefore, Neuls et al. (2011) determined that using the BBS by itself may not be effective in predicting fall risk in community-dwelling older adults.

Dynamic Gait Index. The DGI is an 8-item assessment of gait and balance during steady state walking that assesses the ability to modify gait in response to changing task demands in older adults. The DGI is scored on a four-point scale, with a score of three indicating normal performance, and a score of zero indicating severe impairment. The maximum score on the DGI is 24, with a cutoff score of 19 indicating impairment in gait and increased risk of falling (Shumway-Cook & Woollacott, 1995; Shumway-Cook, Baldwin, Polissar, & Gruber, 1997). Studies examining the DGI as a tool for assessing community-dwelling older adults have found good inter-rater and test-retest reliability (ICC=.96-.98) (Herman, Inbar-Borovsky, Brozgol, Giladi, & Hausdorff, 2009). Furthermore, the DGI can identify subtle changes in gait performance, and seems to be an appropriate tool in assessing function in older adults (Herman et al., 2009). However, studies examining the effectiveness of the DGI observed a ceiling effect when used with healthy functioning, community-dwelling older adults (Herman, et al., 2009; Pardasaney et al., 2012). Therefore, the ceiling effect may indicate that the DGI is unable to identify fall risk in community-dwelling older adults (Herman et al., 2009).

Tinetti Performance Oriented Mobility Assessment. The POMA is a 16-item assessment that measures gait and balance abilities in older adults. The POMA subtests are divided into seven gait and nine balance items. The POMA is scored on a 3-point scale, with a score of zero indicating impaired function, and a score of two indicating normal function. The maximum score on the POMA is 28, with a cutoff score of 19 indicating a high risk of falling (Tinetti, 1986). A review on the use of the POMA with community-dwelling older adults indicated good test-retest reliability (ICC=.97) (Faber,

Bosscher, & van Wieringen, 2006). Similarly, the POMA balance subtest was found to have good test-retest reliability (ICC=.93), and moderate to good inter-rater reliability (ICC=.76-.90) (Faber et al., 2006). Similarly, the POMA gait subtest also has good inter-rater reliability (ICC=.83) (Faber et al., 2006). However, even though the POMA and its subtests had acceptable concurrent and discriminative validity, they were found to have low predictive validity with regards to falling (Faber et al., 2006). Furthermore, multiple studies showed that the POMA and its subtests produce a ceiling effect when used with community-dwelling older adults (Faber et al., 2006; Pardasaney et al., 2012).

In summary, although the BBS, DGI, and POMA have been widely used to assess fall risk in older adults, ceiling effects have been observed when used to assess specifically community-dwelling older adults (Faber et al., 2006; Herman et al., 2009; Langley & Mackintosh, 2007; Neuls et al., 2011; Pardasaney et al., 2012). This indicates that the BBS, DGI, and POMA may be too easy of an assessment and therefore ineffective in measuring balance in higher functioning community-dwelling older adults. Further review of the literature indicates that the FRT, TUG, and OLS are more appropriate and effective for measuring balance and fall risk in community-dwelling older adults.

Functional Reach Test. Functional reach is the distance between the arm’s length and maximal forward reach over a fixed base of support. Functional reach requires static balance and is a functional skill essential for performing various tasks, like reaching into a cupboard or closet. Duncan, Weiner, Chandler, and Studenski (1990) first established the FRT as a measure of stability and potential indicator of static balance

impairments. Functional reach was tested in 128 participants composed of students, adults, and community-dwelling older adults, using both an electronic measuring force platform and a yardstick method (Duncan Weiner, Chandler, & Studenski, 1990). The electronic functional reach method obtains digital quantification of functional reach through handles mounted on an adjustable height, sliding track linked to a computer. In contrast, the yardstick method involves a yardstick fixed to a wall at acromion height. Participants make a fist and extend as far forward as possible along the yardstick, with the final measurement made at the end of the third metacarpal. Test-retest of the electronic functional reach and yardstick methods indicated that the FRT had high test-retest reliability (ICC =.81) (Duncan et al., 1990).

A follow-up study assessed the predictive validity of the FRT in identifying fall risk in older adults at risk for recurrent falls (Duncan, Studenski, Chandler, & Prescott, 1992). Two hundred and seventeen older adult men ages 70-104 years old participated in a baseline functional reach screening followed by a six-month fall monitoring. Those with two or more falls in this period were considered recurrent fallers. Logistic regression determined that for individuals who were unable to reach, the adjusted odds ratio of having two falls was 8.97 (Duncan et al., 1992). The odds ratio decreased to 4.02 if they could reach zero to six inches, and to 2.0 if their reach was over six inches but less than 10 inches (Duncan et al., 1992). Results also indicated that functional reach and recurrent falls were independent of age, depression, or cognition. Additionally, the data suggest that the FRT is a precise measurement, with a coefficient of variation of 2.5% (Duncan et al., 1992). Thus the FRT is a portable, inexpensive, reliable, and reasonable

clinical method for assessing stability and predicting fall risk among older adult men (Duncan et al., 1992).

The FRT was later included in an unpublished doctoral dissertation by Langley and Mackintosh (2007). This systematic review combed eight databases for studies specifically assessing the inter-rater reliability, intra-rater reliability, or concurrent validity of the identified 17 functional balance assessments. Eligible studies included those with a participant population of English speaking, community-dwelling older adults over 65. Any studies on participants with conditions affecting balance, such as stroke, Multiple Sclerosis, and Parkinson's disease, were excluded. Two independent reviewers used a modified checklist from the Cochrane Working Group for Screening and Diagnostic Tests to analyze the methodological quality of 898 studies. Of the studies analyzed, 21 met inclusion criteria, four of which specifically confirmed the validity and good to excellent reliability (ICC =.75-.99) of the FRT for use as a functional balance assessment in community-dwelling older adults (Langley & Mackintosh, 2007). In summation, the FRT is an ideal functional measure of static balance and fall risk in community-dwelling older adults.

Timed Up and Go. The TUG is a simple and fast assessment of functional mobility, a necessary component of many everyday tasks. A quasi-experimental study on 30 older adults first established the sensitivity and specificity of the TUG in assessing fall risk (Shumway-Cook, Brauer, & Woollacott, 2000). Of the 30 older adults, 15 had no history of falls and 15 had experienced two or more falls in the previous six months. The study looked at the original TUG and two variations of the TUG, the TUG plus a

cognitive challenge (TUG cog) and the TUG plus a manual challenge (TUG manual). The original TUG requires that the older adults stand up from a chair, walk 3 meters at their regular pace to cross a line marked on the floor, turn around to walk back, and sit down on the chair. The TUG cog adds the cognitive challenge of counting backwards by three from a randomly given number between 20 and 100. The TUG manual adds the manual challenge of carrying a full cup of water, which was not required if participants used a walker. Older adults who took 13.5 seconds or longer on the TUG, or 14.5 seconds or longer on the TUG manual were correctly classified as fallers 90% of the time (Shumway-Cook et al., 2000). Older adults who took 15 seconds or longer on the TUG cog were correctly classified as fallers 87% of the time (Shumway-Cook et al., 2000). Discriminant analysis determined that older adults who took over 14 seconds to complete the TUG were at high risk for falls (Shumway-Cook et al., 2000). Analysis of the results indicated that the original TUG, TUG cog, and TUG manual can all correctly predict fall risk (Shumway-Cook et al., 2000). Langley and Mackintosh's (2007) systematic review further confirmed the practicality, reliability, and validity of the TUG in assessing functional balance among community-dwelling older adults. In their review, the TUG was one of two assessments rigorously tested for reliability, and three studies that looked at the TUG demonstrated excellent inter-rater (ICC=.98-99) and intra-rater reliability (ICC=.97-.98) (Langley & Mackintosh, 2007). In summation, the feasibility, reliability, and validity of the TUG make it an ideal functional-based measure of dynamic balance and fall risk in community-dwelling older adults.

One-Legged Stand. Leg weakness has been identified as an important risk factor for falls in older adults (Vellas et al., 1997a). Vellas et al. (1997a) developed the OLS assessment as a simple, accurate, and reproducible means of indicating fall risk in older adults. During the OLS assessment, older adults are asked to choose a leg to stand on, flex the opposite knee allowing the foot to clear the floor, and balance on one leg for as long as they can. A study comparing the psychometric properties of multiple balance assessments in older adults aged 65 and over concluded that the OLS has good discriminant validity, and good inter-rater and intra-rater reliability (ICC= .93-.99) (Lin et al., 2004).

Studies have indicated that the OLS can be an effective predictor of frailty and increased risk of falling in older adults (Hawk, Hyland, Rupert, Colonvega, & Hall, 2006; Michikawa, Nishiwaki, Takebayashi, & Toyama, 2009; Muir et al., 2010; Vellas et al., 1997a). Vellas et al. (1997a) conducted a study with 512 community-dwelling older adults to focus on the correlation between one legged standing balance and functional status. The study found that an OLS time of less than 5 seconds was indicative of increased frailty in older adults (Vellas et al., 1997a). A systematic review conducted by Michikawa et al. (2009) explored the effects of the OLS among 544 community-dwelling older adults, and further confirmed that the OLS can be an effective tool for predicting frailty.

In another study, Vellas et al. (1997b) assessed 316 healthy older adults using the OLS over a 3-year follow-up period and found that older adults who were not able to maintain balance on one leg for at least 5 seconds had an increased risk of experiencing

an injurious fall (Vellas et al., 1997b). In addition, a study analyzing the ability of balance assessments to measure fall risk in community-dwelling older adults aged 65 and over found that the OLS accurately correlated with better balance for participants who regularly performed balance exercises (Hawk et al., 2006). Therefore, these studies concluded that the OLS was an effective screening and assessment tool for identifying risk of falling in community-dwelling older adults (Hawk et al., 2006, Vellas et al., 1997a; Vellas et al., 1997b).

Since the development of the OLS in 1997, many new versions have been created. A few of these new versions renamed the OLS as the one-legged balance, unipedal stance, and single-limb stance assessment (Michikawa et al., 2009). Currently, there is no standardized procedure for administering the OLS (Michikawa et al., 2009). The procedural components, such as whether or not the participant's eyes are open and deciding which leg to stand on, vary depending on the version of the OLS (Michikawa et al., 2009). Differences in maximum time for performing the OLS also vary from 15, 30, 45, or 60 seconds (Michikawa et al., 2009). Bohannon (2006) conducted a meta-analysis to derive normative reference values for OLS standing times from 22 studies and 3,484 older adults aged 60 and over. The meta-analysis focused on three age groups from 60-69, 70-70, and 80-99 years old. The mean OLS times for these groups were 27.0, 17.2, and 8.5 seconds respectively (Bohannon, 2006). Similarly, Springer, Marin, Cyhan, Roberts, and Gill (2007) also conducted a study to derive normative reference values for the OLS in 549 participants. Of the 549 participants, 255 were men and women aged 60-99. In this study, the mean OLS times for eyes open best of three trials for older adults

aged 60-69, 70-79, and 80-99 were reported as 32.1, 21.5, and 9.4 seconds respectively (Springer et al., 2007). Therefore, a standing time of 30 seconds on the OLS is appropriate when assessing older adults ages 60-99 (Springer et al., 2007).

Fear of falling assessments. FOF has been identified as a risk factor for increased risk of falling in older adults (Hadjistavropoulos et al., 2007; Rossat et al., 2010). Over the years, a number of FOF assessments have been created in order to address the impact that FOF has on performance of daily activities, and risk of falling in older adults. Tinetti, Richman, & Powell (1990) developed the Tinetti's Falls Efficacy Scale (FES) to measure FOF based on the operational definition of FOF as low perceived fall-efficacy during 10 nonhazardous activities of daily living in older adults. The aim of the FES was to determine the extent in which FOF can independently affect falls, confidence in mobility, and performance of daily activities in older adults. Out of a maximum score of 100, a score of 80 or less indicates a low fall-efficacy, and therefore an increased FOF and risk of falling (Tinetti, Richman, & Powell, 1990).

FES was one of the first FOF assessments developed, and has been widely used to measure FOF. However, limitations of the FES have been found when used with higher functioning community-dwelling older adults. Edwards & Locket (2008) found that the FES had a ceiling effect for older adults with good ambulation, and therefore is not appropriate for high functioning community-dwelling older adults. Furthermore, Lachman et al. (1998) found that some older adults do not engage in the activities on the FES list, and that the FES did not discriminate well among community-dwelling older adults (Lachman et al., 1998). Since then, three alternative fall risk assessments were

developed to address the limitations of the FES. These assessments included The Falls Efficacy Scale-International (FES-I), Modified Falls Efficacy Scale (MFES), Survey of Activities and Fear of Falling in the Elderly (SAFE).

The FES-I, MFES, and SAFE were developed to maximize the suitability of the FES for use in a wider range of languages, cultural contexts, and environments (Edwards & Locket, 2008; Lachman et al., 1998; Yardley et al., 2005). The FES-I includes cross-culturally relevant items that were added to the original FES such as walking on slippery, uneven, or sloping surfaces, and walking through crowds (Yardley et al., 2005). Yardley et al. (2005) also identified that the items on the FES apply only to frail older adults, and were not applicable to higher functioning older adults. The MFES increased discrimination of the FES by adding references to assistive devices in the environment such as handrails on stairs and grab bars in the bathroom (Edwards & Locket, 2008). Lastly, the SAFE focused on the role of FOF in activity restriction and quality of life by identifying whether activity restriction was tied to reasons other than FOF (Lachman et al., 1998).

Although the FES-I, MFES, and SAFE attempted to make the FES more applicable to a larger range of older adults, additional review of the literature indicates that the Activities-specific Balance Confidence Scale (ABC) is a more appropriate and effective assessment for evaluating fall risk in community-dwelling older adults.

Activities-specific Balance Confidence Scale. The ABC is another self-report fall efficacy assessment that was developed to address the limitations in Tinetti's FES (Powell & Myers, 1995). The ABC consists of 16 items that represent functional tasks,

such as bending over and picking up a slipper from the front of a closet floor, and walking in a crowded mall where people are rapidly passing by. Older adults are asked to rate their confidence level that they will not lose their balance or become unsteady during each task. On a scale of 0% to 100%, a rating of 0% indicates no confidence, and a rating of 100% indicates complete confidence in completing the task without losing their balance (Powell & Myers, 1995). A cutoff score of 67% was identified as a reliable means of predicting future falls in older adults (Lajoie & Gallagher, 2004).

The ABC addresses two concerns of the FES. First, the items on the FES were identified as too general, which could lead to inconsistent interpretation of what the item's task entails. Secondly, the FES demonstrated a ceiling effect when applied to community-dwelling older adults (Powell & Myers, 1995). The ABC has greater reliability than the FES (ICC=.92) and higher internal consistency with a Cronbach's alpha of .96 (Powell & Myers, 1995). Additionally, while the FES has shown to be effective in assessing balance confidence in frail older adults, the ABC is more appropriate for assessing higher functioning older adults (Powell & Myers, 1995).

A study comparing the ABC and the BBS found that the ABC was more effective than the BBS in predicting falls in community-dwelling older adults (Lajoie & Gallagher, 2004). A recent study reviewing the use of the ABC in 44 community-dwelling older adults confirmed the good reliability (ICC=.88) and high internal consistency with a Cronbach's alpha of .97 (Cleary & Skornyakov, 2014). Furthermore, Hadjistavropoulos et al. (2007) conducted a six-month longitudinal study examining the role of FOF, fear of pain, and associated activity avoidance in the anticipation of pain and falls.

Hadjistavropoulos et al. (2007) found that self-efficacy and FOF, as measured by the ABC, were effective predictors of falls in community-dwelling older adults.

Battery of fall risk assessments. Although many assessments have been developed to examine fall risk in older adults, there is not enough evidence to suggest that any one assessment can effectively predict fall risk in older adults alone (Balasubramanian, Boyette, & Wludyka, 2015; Langley & Mackintosh, 2007). In a population of community-dwelling older adults, the creation of a battery of challenging activities from multiple assessments is a more effective means of measuring and predicting risk of falling (Balasubramanian et al., 2015). Muir et al. (2010) proposed the use of self-reports of balance problems, the OLS, and a stability test to predict falls in community-dwelling older adults. Another study proposed the use of postural sway, reaction time, and the ABC as measurement tools in identifying and monitoring older adults at risk of falling (Lajoie & Gallagher, 2004). This review of fall risk assessments focusing on strength, balance, and FOF as risk factors for falling suggests a combination of the 30-s CST, FRT, TUG manual, OLS, and ABC as an effective means of predicting falls in community-dwelling older adults.

Quality of Life

Quality of Life (QOL) is also associated with fall risk (Li, Fisher, Harmer, McAuley, & Wilson, 2003). A cross sectional study of 256 community-dwelling older adults over 70 years old utilized the SAFE measure, a self-report on falls, a functional ability test, and the Short Form Health Survey (SF-12) scale, a QOL test with high internal consistency with a Cronbach’s alpha of .88, to assess for correlations between

FOF and QOL. Based on the responses on the SAFE measure, participants were separated into two groups, those with a high likelihood of having FOF and those with low likelihood (Li et al., 2003). Further analysis of the data found a significant difference (p <.001) between high FOF and low FOF groups on the QOL measure (Li et al., 2003). Older adults in the high FOF group scored significantly lower on QOL (Li et al., 2003). These results demonstrated the negative effect of FOF on QOL, and further contribute to the growing evidence that falls are a serious health and well-being concern for older adults. Thus, successful means of decreasing fall risk and preventing falls in older adults is of paramount importance.

The Patient-Reported Outcomes Measurement Information System. The Patient-Reported Outcomes Measurement Information System (PROMIS®) is an efficient, flexible, and precise survey that uses 11 item banks to measure self-reported physical, mental, and social health (Cella et al., 2010). These item banks were calibrated on a demographically representative sample of 21,133 Americans (Cella et al., 2010). The largest item bank, physical function, includes 124 calibrated items and a 10-item short form. The item bank on physical function is composed of four subtests: mobility, dexterity, axial (neck and back) function, and the ability to carry out activities of daily living and instrumental activities of daily living (National Institute of Health [NIH], 2011). Sample questions of the physical function item bank include: “Are you able to walk a block on flat ground? Are you able to get in and out of bed?” (NIH, 2011). There are five response options to these questions (e.g., 1=Without any difficulty, 2=With a little difficulty, 3=With some difficulty, 4=With much difficulty, 5=Unable to do) (NIH,

2011). The PROMIS® can be used with all people, regardless of age, language, literacy, function, or lifestyle (NIH, 2011). The physical function item bank is especially apt for measuring poor physical function as it has very high reliability (ICC=.96) when the physical function scores are four standard deviations below the mean and one standard deviation above the mean (Cella et al., 2010). The clear association between FOF and QOL supports the use of the PROMIS® to provide an evaluation of community-dwelling older adults' perceived physical, mental, and social health related to fall risk.

In addition to assessing older adults' perceptions of health and well-being, objective, valid, and efficient means of assessing fall risk in older adults is crucial. Existing fall risk assessments address different aspects of fall risk including muscle strength, balance, and FOF. A review of these assessments helped to identify the most appropriate fall risk assessments for community-dwelling older adults. In summary, use of these fall risk assessments can establish a quantifiable level of fall risk and a baseline for comparison post intervention.

Traditional Exercise Programs Addressing Falls

The CDC (2016) and various fall prevention researchers recommend the use of traditional exercises to maintain and improve balance and strength, thereby minimizing fall risk in older adults. Traditional exercise programs, such as weekly exercise classes, have specific structure and scheduling. Traditional exercise programs that have been found to be effective in reducing fall risk include strength and balance exercises, dual task training, and tai chi.

Strength and balance exercises. Reduced lower extremity strength and impaired balance are added risk factors for falls in older adults (Cho & An, 2014; Roaldsen et al., 2014; Sherrington et al., 2011). Exercise training in fall prevention programs can help improve lower extremity strength, balance, and overall function in older adults with a history of falls (Cho & An, 2014; Kuptniratsaikul et al., 2011; Roaldsen et al., 2014; Sherrington et al., 2011). In a follow-up systematic review and meta-analysis, Sherrington, Tiedemann, Fairhall, Close, and Lord (2011) investigated 54 randomized controlled trials from 2008 to 2011 in which the main intervention for falls in older adults were balance and strength exercises. The results of Sherrington et al.'s (2011) follow-up systematic review were formulated into best practice recommendations for practitioners to help guide the use of exercise for fall prevention in older adults.

The first recommendation was that exercise must provide a moderate to high challenge to balance. Sherrington et al. (2011) suggested three ways to challenge balance. The first way was to decrease the base of support by standing heel to toe. The second way was to move the center of gravity, for example by reaching, transferring the body weight from one leg to another, or stepping onto a step. The last way to challenge balance was to reduce the need for upper extremity support with exercises. The second recommendation from Sherrington et al.'s (2011) follow-up systematic review was that exercise must be of high quantity, meaning it must include exercising two hours a week for six months, to improve balance. Thus, Sherrington et al. (2011) suggested that exercise should be carried out for at least one to two hours per week. A final recommendation from this study was the continuation of exercises, as the benefits of

exercise can quickly be lost when exercises are stopped. As a result, ongoing exercise is essential for long-term fall prevention outcomes. In summary, Sherrington et al. (2011) established that fall prevention programs that include higher quantities of balance and strengthening exercises had the greatest effect on reducing falls in older adults.

In 2014, Cho and An found that balance and lower extremity resistance training were effective methods for decreasing fall risk in community-dwelling older adults with a fall history. Cho and An (2014) examined the effects of an eight-week balance and elastic resistance exercise program on muscle strength and balance in a randomized control trial of older adults ages 75 and older. A total of 55 community-dwelling older adults were randomly assigned to either a balance training intervention, elastic resistance exercise intervention, or a control group. The interventions were executed at home three times a week for eight weeks and twice a week at the participants' local senior citizen center (Cho & An, 2014). Balance exercises comprised of side stepping, tandem walking, walking backwards, and one-leg stance. Elastic resistance exercises consisted of using the elastic band during squats, heel raises, hip and knee flexion and extension, and ankle plantar and dorsiflexion (Cho & An, 2014).

Older adults' muscle strength and balance were assessed before and at the end of the study. Strength of the hip flexors, knee extensors, ankle dorsiflexors, and plantarflexors were measured by a dynamometer. Balance was measured by the fall risk index, and the estimated balance range was used to indicate fall risk (Cho & An, 2014). The results showed that older adults who received balance and lower extremity resistance training had a significant increase in muscle strength and decrease in fall risk compared

to the older adults in the control group (Cho & An, 2014). Older adults in the balance only training group improved muscle strength in the hip flexors, knee extensors, and ankle dorsiflexors. Older adults in the elastic only training group improved muscle strength in all muscle groups. In summary, interventions that increase balance and lower extremity strength have been found to be successful in preventing falls and reducing fall risk in older adults.

Dual task balance. An additional method of decreasing fall risk in older adults is dual task training. Dual task is defined as performing multiple tasks simultaneously (Silsupadol et al., 2006). An example of dual task would be walking while simultaneously maintaining a conversation. In 2012, Hiyamizu, Morioka, Shomoto, and Shimada discovered that poor dual task performance is a predictor of falling in older adults. Applying dual task to balance training has been shown to be an effective intervention in decreasing fall risk (Hiyamizu, Morioka, Shomoto, & Shimada, 2012; Silsupadol, Siu, Shumway-Cook, & Woollacott, 2006; Silsupadol et al., 2009).

Hiyamizu et al. (2012) performed a three-month, randomized, two group parallel trial focused on the benefits of dual task balance training on fall risk in community-dwelling adults aged 65 years and older. In this study, researchers placed 21 healthy older adults in an intervention group that consisted of dual task balance training, and 22 older adults in a control group. The dual task balance training focused on walking and balancing while simultaneously performing cognitive tasks. The older adults' abilities were measured by five different assessments. The 30-s CST measured lower extremity strength. The FRT and TUG identified fall risk. The Trail Making Test part A (TMT A)

and B (TMT B) measured cognitive flexibility. The Stroop task measured attention. All assessment scores for the dual task balance training group improved from baseline. However, posttest results for each assessment had no statistical significance due to the small sample size of 21 healthy older adults. The 30-s CST improved by 2.77 seconds (p=.78), the FRT improved by .45 cm (p=.63), and the Stroop task improved at a rate of 6.58% (p=.62). The TUG, TMT A, and TMT B decreased by .15 seconds (p=.86), 2.31 seconds (p=.28), and 20.54 seconds (p=.35) respectively (Hiyamizu et al., 2012). Although the results were not statistically significant, the study did reveal that dual task balance training improved dual task performance, balance, and physical performance, all key components in reducing falls (Hiyamizu et al., 2012).

Similarly, in a randomized control trial of 21 participants over the age of 65 with balance impairments, Silsupadol et al. (2009) compared the effectiveness of dual task and single task balance training approaches under challenging conditions. Single conditions consisted of narrow walking, while challenging conditions consisted of narrow walking while avoiding obstacles and counting backwards by three (Silsupadol et al., 2009). The results revealed both dual task and single task balance training were effective strategies for improving balance under single conditions (Silsupadol et al., 2009). However, dual task balance training had better balance performance under challenging conditions (Silsupadol et al., 2009). In summary, dual task training has the ability to improve dual task performance and balance, which are key components in reducing fall risk in older adults (Hiyamizu et al., 2012; Silsupadol et al., 2009). Therefore, dual task training should be utilized more in fall prevention programs.

Tai chi. Similar to strength and balance programs, tai chi has also been explored as an intervention for reducing fall risk. Tai chi consists of a series of body positions that are performed with fluid transitions. Benefits of tai chi include increased balance, flexibility, stability, and coordination, as well as decreased FOF, all of which are fall risk factors for older adults (Lin, Hwang, Wang, Chang, & Wolf, 2006; Rubenstein, 2006). Li et al. (2005) conducted a randomized control trial looking at the effects of tai chi on reducing the number of falls and fall risk in older adults regardless of fall history. Li et al. (2005) found that interventions using tai chi are effective in decreasing the number of falls in previously physically inactive adults aged 70 and older by improving functional balance, physical performance, and reducing FOF.

Similarly, Voukelatos, Cumming, Lord, and Rissels (2007) found that tai chi increased balance and health in older adults. In addition, the researchers found that reduction in falls resulting from tai chi were maintained for up to eight weeks after the intervention. Voulelatos et al. (2007) hypothesized that the reduction in falls was due to the fact that tai chi moves were easier to incorporate into daily life compared to other forms of exercise, and that the simple principles of tai chi encouraged older adults to continue to practice the tai chi after ceasing to attend formal classes (Voukelatos, Cumming, Lord, & Rissels, 2007). In summary, tai chi and interventions addressing strength, balance, and FOF have been found to be successful in reducing fall risk in older adults. Furthermore, interventions that are more sustainable have shown to have a longer lasting effect in reducing the risk of falls in community-dwelling older adults.

Overall, traditional exercises such as balance and strength exercises, dual task training, and tai chi have been proven to be effective approaches in reducing fall risk. Studies looking at traditional exercises indicate that exercises need to be sustainable in order to continue to have effects on decreasing fall risk. However, research has shown that traditional exercises may not be sustainable approaches among the older adult population.

Factors Limiting Exercise in Older Adults

Physical exercise has undeniable benefits on overall health, cognition, emotion, and well-being (U.S. Department of Health and Human Services, 2008). Despite this knowledge, older adults continue to be the least active group in the United States (Carlson, Fulton, Schoenborn, & Loustalot, 2010). A review of the literature indicated that a lack of information, health status, social influence, and access to safe and stimulating exercise environments are all factors influencing exercise behavior in older adults (Baert, Gorus, Mets, Geerts, & Bautmans, 2011; Buman, Daphna Yasova, & Giacobbi, 2010; Schutzer & Graves, 2004).

Lack of information. Lack of information and poor professional guidance remain common barriers to exercise among older adults. A qualitative study of 52 randomly selected, community-dwelling, Medicare recipients ages 66-78 found that a lack of professional guidance and poor or inadequate distribution of available and appropriate physical exercise options served as barriers to exercise (Bethancourt, Rosenberg, Beatty, & Arterburn, 2014). Older adults reported either disappointment in their physicians' lack of emphasis on exercise or recommendations to exercise with little

direction for how to safely and appropriately do so. Another study on inactive adults found that due to a lack of education or lack of emphasis on exercise during their childhood, some older adults felt exercise was simply not a priority for the average person (Buman et al., 2010). Thus, a lack of knowledge on the relationship between exercise and health may be a contributing barrier to exercise.

Health status. Older adults also reported that poor health and pain both prohibit and promote exercise (Baert et al., 2011; Buman et al., 2010; Schutzer & Graves, 2004). Older adults, in a qualitative study, were motivated to stay active because they knew physical exercise could help them “maintain the strength, energy, and agility to perform daily tasks and other activities they enjoyed” (Bethancourt et al., 2014, p. 13). However, the majority of the research indicated that poor health may actually lessen exercise behavior in older adults. While the 52 older adults in Bethancourt, Rosenberg, Beatty and Arterburn’s (2014) study self-reported good to excellent health, physical limitations including specific ailments, decreased endurance, and generalized aches and pain were commonly reported as barriers to exercise. Similar conclusions were made in a study analyzing the barriers affecting physical exercise among 20,875 Canadians over 60 years old (Smith et al., 2012). Per self-report on a cross sectional survey, all participants had no health limitations or injuries preventing them from participation in exercise (Smith et al., 2012). However, Smith et al. (2012) found that the participants who engaged in less exercise also had unreported chronic conditions. While participants did not report conditions like heart disease, chronic obstructive pulmonary disease, or mobility impairments as health limitations that could prevent exercise, the researchers found

chronic conditions influenced older adults' participation in exercise (Smith et al., 2012). Thus, both studies concluded that there was a disconnection between health perception and actual physical exercise, with chronic conditions and pain being overlooked as health conditions limiting exercise (Bethancourt et al., 2014; Smith et al., 2012).

Social influence. Older adults are less likely to exercise if they lack an exercise companion (Baert et al., 2011). Bethancourt et al.'s (2014) study on community-dwelling Medicare recipients found that older adults, even those with serious health concerns, were more apt to engage in exercise when socially supported. In a systematic review by Baert, Gorus, Mets, Geerts, and Bautmans (2011), 16 of the 44 included articles emphasized social support as a major motivator to exercise. A method of promoting social connectedness and peer support is through group-based exercise classes. According Baert et al. (2011), older adults felt group-based exercise classes fostered feelings of community, encouraged participants to complete the entire session, and were further enhanced by opportunities to interact with peers. An experimental study of 87 healthy, community-dwelling adults over 60 further explored the benefits of exercising with peers (Dorgo, Robinson, & Bader, 2009). Older adults received fitness coaching by either qualified kinesiology students or trained peers. The perceived impact of the program on physical, mental, and social functions was significant for those in the peer mentor group, but insignificant for those trained under the same exact method by kinesiology students. Researchers concluded that exercising with peers may be more motivating and provide greater benefits than exercising with a younger population (Dorgo et al., 2009).

Access to exercise environment. Exercise environment, financial resources, and time must be considered as both facilitators and limiters of physical exercise. Older adults who reported access to affordable, convenient, and stimulating exercise options were more motivated to exercise (Schutzer & Graves, 2004). Common environmental barriers to exercise included poor weather, no safe place to exercise, and limited access to exercise facilities (Baert et al., 2011; Schutzer & Graves, 2004). A qualitative study by Bethancourt et al. (2014) found walking to be the most commonly reported form of exercise among 52 Medicare recipients in Washington aged 66 and older. However, poor weather, unsafe areas, hills, uneven surfaces or stairs can also deter walking (Bethancourt et al., 2014). Expense may also dissuade older adults from exercise. Results found exercise classes that older adults desired were not covered by Medicare, and free classes were either too far away or not appropriate for their fitness level (Bethancourt et al., 2014). As research is finding that older adults' perceptions of the quality of the exercise class is one of the biggest predictors of exercise adherence, more so than an understanding of the health benefits, access to safe, affordable, and beneficial forms of exercise is a considerable factor (Schutzer & Graves, 2004; Stiggelbout, Hopman-Rock, Crone, Lechner, & Van Mechelen, 2006).

Though physical exercise contributes to numerous health benefits, the older adult population is widely sedentary (Carlson et al., 2010). Factors influencing the exercise habits of older adults should be taken into account when formulating effective interventions to change exercise behavior. The importance of knowledge, the influence of physicians and peers, and the value of both designing and advertising an accessible,

appropriate, stimulating exercise program must be considered (Baert et al., 2011; Bethancourt et al., 2014; Stiggelbout et al., 2006). Underlying health concerns, fear, mobility issues, and financial or time constraints may need to be addressed before exercise adherence will improve (Stiggelbout et al., 2006; Umstattd & Hallam, 2007). In addition to addressing these factors, Smith et al. (2012) suggested that incorporating activities of daily living into exercise routines may increase the meaning and motivation for older adults.

Integrated Exercise Approach

While traditional exercise programs are effective for reducing fall risk, research found this method of exercise unsustainable (Burton et al., 2014; Clemson et al., 2012; Fleig et al., 2016; Opdenacker et al., 2008). Therefore, it is crucial to find sustainable means of exercises to prevent falls in community-dwelling older adults. Integrated exercise programs may provide a more sustainable approach than traditional exercise programs by integrating exercises into everyday activities. Integrated exercise programs are defined as interventions where endurance, strength, flexibility, and balance exercises are incorporated into everyday activities and routines (Burton et al., 2014; Clemson et al., 2012; Opdenacker et al., 2008).

Lifestyle-integration approach. In 2008, Opdenacker, Boen, Coorevits, and Delecluse performed a randomized control trial to bridge the gap in the literature on the benefits of lifestyle-integration approaches in older adults. Opdenacker et al.'s (2008) trial compared the effects of a home-based lifestyle intervention to a structured exercise intervention utilizing older adults 60 years and older. The 24-week trial consisted of a

home-based lifestyle group, a structured exercise group, and a control group. Older adults in the home-based lifestyle group were trained to integrate strength and endurance exercises into their daily routines while using a pedometer. In addition, the home-based lifestyle intervention was individualized based on the older adults' interests and abilities. Activities such as walking, jogging, cycling, swimming, and strength training using bodyweight and elastic bands were included in the home-based intervention (Opdenacker et al., 2008).

Older adults in the exercise group received endurance, strength, flexibility, and balance training three times a week during the 24-week trial with an instructor at a fitness center. The control group only participated in the assessment measurements and did not receive any information about their physical activity until the end of the study (Opdenacker et al., 2008). At the 23-month follow-up, the results found both lifestyle and structured exercise interventions were effective in increasing physical activity in older adults (Opdenacker et al., 2008). However, the study discovered that 86% of the older adults in the home-based lifestyle intervention group maintained adherence to the intervention at the end of the study. In addition, the researchers found that the older adults in the home-based lifestyle intervention continued to integrate endurance exercises into their daily routines, such as walking as their way of transportation (Opdenacker et al., 2008). This study emphasizes the success and sustainability of home-based lifestyle interventions in promoting exercise among older adults.

Lifestyle-integrated functional exercise program. Clemson et al.'s (2012) Lifestyle-integrated Functional Exercise (LiFE) program provided a novel approach to

fall prevention. By embedding exercises that improve lower extremity strength and balance into everyday activities and routines, the LiFE program successfully decreased falls and improved function in older adults with a history of falls. In a randomized parallel trial with 317 community-dwelling older adults, 70 years and older, with a history of falls, Clemson et al. (2012) examined the effects of three different exercise programs.

The study evaluated the LiFE program, a structured exercise program, and a flexibility program to see if an integrated exercise program is as effective in reducing fall risk in community-dwelling older adults as compared to traditional exercise programs. A total of 107 older adults in the LiFE group learned balance-training exercises comprised of reduced base of support, weight shifting, and stepping over objects. The community-dwelling older adults also learned various lower extremity strengthening exercises that consisted of standing on tiptoes, bending knees, sit-to-stands, walking sideways, and climbing stairs (Clemson et al., 2012). Examples of integrating exercises into everyday activities include standing on one leg while brushing teeth or tandem standing while washing the dishes. A total of 105 community-dwelling older adults in the structured exercise group learned six lower extremity strength exercises and seven balance exercises and performed them three times a week. The control group of 105 community-dwelling older adults engaged in 12 flexibility exercises for the duration of the study (Clemson et al., 2012).

Over a six-month period, community-dwelling older adults in the LiFE group and structured exercise group received specific training taught over five sessions, two booster

sessions, and two follow-up phone calls (Clemson et al., 2012). Results of the 12-month follow-up found that 64% of the LiFE older adults adhered to the lifestyle-integrated program whereas only 53% of the participants adhered to the structured and control programs (Clemson et al., 2012). Falls among the older adults in the LiFE and structured exercise groups decreased at the 12-month follow-up. The community-dwelling older adults involved in the LiFE program experienced 172 falls with a 31% reduction in fall rate, while the older adults involved in the structured exercise group experienced 193 falls with no significant reduction in fall rate (Clemson et al., 2012). The result of Clemson et al.'s (2012) study provides an additional fall prevention option for older adults.

A study conducted by Burton, Lewin, Clemson, and Boldy (2014) provided further evidence that integrated exercise fall prevention programs improve balance, increase strength, and increase exercise adherence in community-dwelling older adults. In a six-month pragmatic randomized controlled trial with 80 community-dwelling older adults, 65 years of age and over, who were referred for a restorative home care service, Burton et al. (2014) examined the long-term effectiveness of the LiFE program compared to a structured exercise program. Eight commonly used outcome measures for falls were used to assess long-term effectiveness of the LiFE and the structured exercise group (Burton et al., 2014). The assessments utilized in the study included the FRT to measure standing balance, the 30-s CST to measure lower extremity strength, the TUG to measure functional mobility, and tandem walking to measure dynamic balance. The FES and ABC scale were used to measure confidence in not falling during daily tasks. The

Vitality Plus Scale was used to measure any effect on physical and cognitive well-being and the Late Life Function and Disability Instrument was used to measure the level of function and disability in everyday tasks (Burton et al., 2014).

At the six-month follow-up, the results indicated no significant difference in exercise adherence between the LiFE and the structured exercise groups. The participants in the LiFE group exercised on average 4.91 times per week while the participants in the structured exercise group exercised on average 4.05 times per week over the six-month period (Burton et al., 2014). However, balance and strength results of the LiFE group significantly improved from pretest to posttest compared to the structured group, especially in tandem walking and lower extremity strength. The results indicated that the LiFE program can improve balance and strength in community-dwelling older adults (Burton et al., 2014). Additionally, the results illustrated that integrated exercise programs, such as LiFE, can slightly improve adherence rate in older adults compared to structured exercise programs. Burton et al.'s (2014) study provides an additional option for older adults who dislike fall prevention programs involving structured exercises.

In 2016, a study conducted by Fleig et al. further supported the effectiveness of the LiFE program on community-dwelling older adults. In a six-month mixed method design study with 13 retired women 65 years and older, Fleig et al. (2016) examined the possibility of the LiFE program to create habit formation and promote behavior change in inactive women. The LiFE intervention comprised of seven two-hour group sessions and two 30-minute follow-up phone calls over a 6-month period (Fleig et al., 2016). A certified exercise physiologist and a personal trainer introduced and trained the 13

women in two of the LiFE balance and strength exercises each week over the six-month period (Fleig et al., 2016). In addition to the balance and strength sessions, the exercise physiologist conducted two follow-up phone calls to provide encouragement, support, and answer questions (Fleig et al., 2016). Both quantitative and qualitative methods were used to collect the women's data. A Short Physical Performance Battery and a self-reported psychosocial measure were utilized for quantitative data, and one semi-structured interview at the final session was conducted for qualitative data.

At the end of the six-month follow-up, a total of 10 women completed the program. Two women withdrew from the study due to health reasons and one due to a family emergency. From the results, Fleig et al. (2016) discovered that the LiFE program could change exercise behavior in older retired women. Specifically, the results illustrated improved satisfaction of the women's experience with balance and strength exercises. The results also revealed that exercises integrated into everyday activities increased automaticity and were successful in sustaining physical activity in older women (Fleig et al., 2016). The study's findings encompass what Clemson et al. (2012) reported about the LiFE program and speaks to its adaptability and effectiveness in the older adult population. Lastly, Clemson et al. (2012), Fleig et al. (2016), and Burton et al.'s (2014) studies provide crucial evidence that simple, low intensity, short-lived activities that can be easily integrated into the lives of older adults are more effective and sustainable than traditional strength and balance exercises in habit formation and fall prevention.

Summary and Conclusion

From the literature review, it is evident that falling is a serious concern for older adults. Increased fear of falling and a lack of strength and balance contribute to fall risk. Addressing fall risk through fall prevention programs is a valuable means of decreasing the occurrence of falls among community-dwelling older adults. Strong evidence shows fall prevention programs with an emphasis on strength and balance exercises decrease fall risk in community-dwelling older adults. However, due to various factors limiting exercise among community-dwelling older adults, these programs for minimizing fall risk are not sustainable. These current limitations may be addressed by a concept known as integrated exercise. Integrated exercise programs help community-dwelling older adults build and maintain strength and balance by educating them on how to incorporate exercises within their everyday routines. While the possibility is promising, few studies have explored the effectiveness of integrated exercise programs as an alternative to traditional methods to decrease fall risk factors. Clemson et al.'s (2012) study provides an effective framework for addressing fall risk using an integrated exercise program for older adults with a history of falls. However, Clemson et al.'s (2012) study did not explore the program's potential ability to prevent falls in community-dwelling older adults without a history of falls.

Statement of Purpose

The paucity of evidence on integrated exercise programs merits further research as it may provide a sustainable solution to fall risk reduction in fallers, fall prevention in non-fallers, and overall exercise compliance among community-dwelling older adults.

The purpose of this study was to explore if alternative exercise methods, such as the modified-LiFE program, decrease fall risk in community-dwelling older adults with and without a history of falls. The null hypothesis states the modified-LiFE program will have no effect on fall risk in older adults, regardless of fall history, who live in an independent living unit in senior residential communities. The alternative hypothesis states the modified-LiFE program will have an effect on fall risk in older adults who live in an independent living unit in senior residential communities. Although not the hypothesis of this study, the student researchers aimed to also explore if exercises integrated into everyday activities can be sustained over time. The independent variable was the fall prevention program. The dependent variables were risk factors for falling including strength, balance, FOF, and QOL as measured by a battery of fall risk assessments during the pretest, posttest, and follow-up assessment.

Theoretical Framework

The Model of Human Occupation (MOHO) is the most widely used model in occupational therapy practice worldwide (Braveman, Fisher, & Suarez-Balcazar, 2010). This evidence-based, client-centered, and occupation-focused model was developed by two occupational therapists, Gary Kielhofner and Janice Burke, to guide the occupational therapy intervention process to focus more on the needs and abilities of the individual rather than his or her impairments (Braveman et al., 2010). The key components of MOHO include examining the person, environment, and occupational performance. The individual components of a person include performance capacity, volition, and

habituation (Kielhofner, 2008). An understanding of the interaction between these components is crucial for providing an individualized and effective intervention.

Performance capacity refers to a person's underlying ability to engage in occupations, and includes cognitive, musculoskeletal, neurological, and physiological abilities (Kielhofner, 2008). A decline in performance capacity can in turn lead to decreased involvement in valued occupations. For example, FOF, decreased vision, and pain all contribute to decreased participation in valued life activities. Consideration of performance capacity, especially physical and cognitive abilities, is critical for providing an effective fall prevention program (Kielhofner, 2008).

Volition refers to what motivates an individual and drives engagement in occupations (Kielhofner, 2008). The model classifies volition into three core personal factors: (a) personal causation, (b) values, and (c) interests. Personal causation is an individual's sense of his or her own capability and effectiveness (Kielhofner, 2008). Values refer to an individual's beliefs about what is good, right, and important. Values also identify what is worth doing, how to perform an occupation, and what goals or ambitions deserve commitment (Kielhofner, 2008). Interests are activities, objects, or topics an individual finds enjoyable or rewarding (Kielhofner, 2008). The three personal factors of volition come together and direct how an individual predicts and translates information from his or her environment (Kielhofner, 2008).

Habituation is a semi-autonomous process where individuals organize their behaviors into patterns and routines (Kielhofner, 2008). Patterns of behaviors are directed by habits and roles, which form how individuals go about their daily lives.

Habits are patterns that happen automatically in the same context after the actions are consistently reiterated (Kielhofner, 2008). A morning routine such as brushing one's teeth is an example of a habit. Roles are a set of internalized behaviors that define an individual (Kielhofner, 2008). Roles are influenced by personal behaviors, participation in society, and occupations. Roles and habits are different for all individuals and shape how they interact with their changing environments (Kielhofner, 2008).

MOHO also considers the influence of the environment, which can be physical, social, economical, cultural, or political. The effect of each environment on the individual varies. Some provide resources and opportunities, while others may be constraining or put demands on the individual (Kielhofner, 2008). Physical environments can decrease fall risk by providing opportunities for safe ambulation and exercise through factors such as the use of grab bars, even surfaces, and proper lighting. However, other physical environments such as the presence of clutter, throw rugs, and pets challenge the strength and stability of older adults (Forsyth & Kielhofner, 2003; Kielhofner, 2008).

MOHO emphasizes the dynamic interplay between the individual and the environment, and the consequent effect on motivation, habituation, and performance capacity. Through interaction with environments, whether physical or contextual, individuals receive feedback on their occupational performance (Kielhofner & Burke, 1980). This feedback allows individuals to modify their behavior and ideally their occupational performance. The LiFE program relies on situational cues to prompt participation in fall prevention exercises. For example, the kitchen sink can serve as a

situational cue prompting engagement in standing balance exercise. Therefore, the household task of washing dishes can provide an opportunity to perform balance exercises using a firm counter surface for support. Furthermore, the program suggests that LiFE participants make modifications to their environment to encourage specific LiFE exercises. For example, placing cups on the top shelf can trigger a tiptoe exercise, while placing the toothpaste in the lowest draw can trigger a knee bending exercise. These opportunities will eventually lead to new habit formation, creating a sustainable method for increasing strength, improving balance, and decreasing fall risk.

Although not stated by Clemson et al. (2012), the development of the LiFE program reflects the application of MOHO because of the importance of the interplay between motivation, habit formation, environment, and performance capacity. MOHO focuses on the individual, just as the LiFE program also recognizes the importance of tailoring the program to fit the specific needs of each older adult. The success of the LiFE program is based upon the therapists' ability to evaluate the performance capacity of the older adults, and the older adults' ability and motivation to independently incorporate individualized exercises into their lives in order to form new habits. Given that motivation, habit formation, environment, and performance capacity are essential components of the LiFE program, MOHO is a fitting frame of reference to guide this study.

Terminology

Definitions

Falls. “An unexpected event in which an individual comes to rest on the ground, floor, or lower level” (Lamb et al., 2005, p.1619).

Fall efficacy. Perceived self-efficacy or confidence in avoiding falls (Tinetti et al., 1990).

Fear of falling. “Low perceived self-efficacy at avoiding falls during essential, nonhazardous activities of daily living” (Tinetti & Powell, 1990, p.239).

Integrated exercises. Intervention where endurance, strength, flexibility, and balance exercises are incorporated into everyday activities and routines (Burton et al., 2014; Clemson et al., 2012; Opdenacker et al., 2008).

Operational Definitions

Faller. An older adult who has experienced a fall within the last six months.

Non-faller. An older adult who has not experienced a fall within the last six months.

Structured exercise program. Exercise that is routinely planned or supervised, and may be conducted in a class, group, or one-on-one setting. Examples of common structured exercise programs and classes are: yoga, tai chi, chair exercise, movement to music, and strengthening exercise classes.

Traditional exercise. Exercise requiring specific structure and scheduling.

Ethical and Legal Considerations

Because participants in this study were older adults, they are considered an at-risk population. Therefore, it is important to ensure that their rights are protected. A full board review and approval from the Dominican University of California Institutional Review Board for Protection of Human Subjects was obtained prior to the recruitment process (IRBPHS file #19398). In addition, the student researchers used the 2015 Occupational Therapy Code of Ethics (American Occupational Therapy Association [AOTA], 2015) to guide professional judgments, decisions, and actions throughout the study. The principles of beneficence, nonmaleficence, autonomy, and veracity were applied for this research study.

Beneficence refers to the concern for the well-being and safety of the participants in this study (AOTA, 2015). Beneficence also includes deliberate actions to benefit all participants involved in the study (AOTA, 2015). Student researchers initially addressed this concern through screening possible participants with the Montreal Cognitive Assessment (MoCA©) version 7.3 in order to ensure that they are cognitively capable of participating in the modified-LiFE program (See Appendix A). Cognitive capacity is important to ensure participants understand and remember how to perform the exercises correctly and safely during the modified-LiFE program. Student researchers also conducted training sessions on how to safely implement the modified-LiFE program. During these training sessions, student researchers asked participants to demonstrate the exercises to ensure accuracy and safety. On weeks 15 and 20, two follow-up phone calls were conducted by the student researchers to address problems that arose. In addition to

the possibility of increasing the participant's balance and strength through the LiFE program, a Fall Prevention Education Handout was given to all participants upon completion or termination of the study (See Appendix B). By providing participants with a Fall Prevention Education Handout, regardless of the results from the study, participants benefited from participation.

Nonmaleficence refers to the obligation to do no harm to the participants in this study (AOTA, 2015). In addition to providing an individualized exercise program for each participant, additional precautions were taken to prevent falls. This included screening for possible hazards before group sessions, education on appropriate footwear, and education on identifying signs and symptoms that are precursors to falls. In order to uphold nonmaleficence, student researchers also exercised professional judgment through regular group meetings with the faculty advisor to raise any concerns and to avoid compromising the rights or well-being of participants. To further reduce harm to the participants, student researchers were cautious in addressing any personal problems and limitations that might have caused harm to the participants.

Autonomy refers to the respect of the participant's self-determination, privacy, confidentiality, and consent (AOTA, 2015). Student researchers demonstrated autonomy by providing participants with a Participant Consent Form (See Appendix C), which fully disclosed the benefits, risks, and potential outcomes of the study. The Participant Consent Form reiterated the participants' right to refuse and withdraw from the study. Participants' confidentiality was maintained through following the Health Insurance Portability and Accountability Act (HIPAA) regulations. Specifically, confidentiality

was maintained by assigning a code number to each participant. The participants' names and corresponding code numbers were kept in a password protected master file, separate from the data collected. In order to maintain the confidentiality of participants' identities, student researchers used only coded numbers on all data forms. Consent and demographic forms with participant names were kept in locked file cabinets in the faculty advisor's locked office at the Dominican University of California. All data and records were destroyed after a period of one year following completion of the research project.

Veracity refers to accurate and objective conveyance of information, which includes ensuring participants understanding of the information (AOTA, 2015). Student researches adhered to veracity through representing their qualifications, education, and experience accurately. Student researchers were also truthful in explaining how much time the study involved. In addition, student researchers cited all work and ideas that were not of their own and obtained approval to use copyrighted material before use (See Appendices D, E, & F). Lastly, to further support the principles of veracity, student researchers recorded and reported all data accurately and within a timely manner.

Methodology

Design

This study used a modified replication of the LiFE program developed by Clemson et al. (2012). The LiFE program was chosen because it has been shown to be effective in reducing falls in older adults with a history of falls. While the original study by Clemson et al. (2012) used a three-arm randomized controlled design, this study utilized a single-group quasi-experimental pretest posttest research design. Though the

original LiFE program utilized two booster sessions at weeks 8 and 12, the administration of the booster session was modified to include a single booster session at week 10. Additionally, the traditional LiFE program included two phone calls to participants at weeks 10 and 20, however the phones calls in the modified-LiFE program were made at weeks 15 and 20. Therefore, this study followed a modified-LiFE program schedule (Table 1). Thus, a modified-LiFE program and a battery of fall risk assessments were utilized to explore the sustainability and effectiveness of the modified-LiFE program in decreasing fall risk in community-dwelling older adults, both fallers and non-fallers aged 65 and over, who reside in independent living units in senior residential communities.

Participants

Participants were recruited through purposive sampling of men and women aged 65 years and older, who lived either at Aldersly or The Redwoods retirement communities in Marin County. There were no gender, racial, or ethnic-based enrollment restrictions. Both fallers and non-fallers were included in the study. To be included in the study, participants had to be fluent in English. Participants also had to be able to ambulate independently, with or without the use of a cane. Any observed significant instability in mobility with or without use of a cane, and per staff report at Aldersly and The Redwoods retirement communities, were taken into consideration for exclusion from the study. The MoCA©, a valid and sensitive screen for mild cognitive impairment available on public domain, was used to screen older adults for participation in this study. A cutoff score of 18 out of 30 on the MoCA© indicates mild cognitive impairment (Nasreddine et al., 2005). Older adults who did not meet the cutoff score of 18 out of 30

on the MoCA© screening were excluded from the study as they may not be able to safely complete the modified-LiFE program without supervision. Lastly, older adults who were participating in other traditional exercises at the start of this study were allowed to continue such programs. However, to ensure validity of the results, participants were excluded from the study if they changed or altered their engagement in their current physical activities. A Physical Activity Form (See Appendix G) was provided at the pretest, posttest, and follow-up assessments in order to monitor other exercises that participants were engaging in.

Recruitment of participants began with letters sent by the student researchers to Aldersly and The Redwoods retirement communities' administration, procuring permission to include their residents in the study (See Appendices H & I). Flyers, a write up in The Redwoods Newsletter (See Appendices J & K), and informational tabling sessions at both facilities were employed to recruit participants. All interested participants from Aldersly and The Redwoods were invited to attend formal screening and assessment sessions. Participant's Bill of Rights (See Appendix L) and signed copies of the participant's informed consent were obtained from all participants prior to the screening process.

Assessments

Formal screening and pretest sessions were held in February 2016 at both Aldersly and The Redwoods retirement communities. Participants' cognitive capacity to participate in the study were screened using the MoCA© version 7.3. A battery of fall risk assessments were administered during the pretest, posttest, and follow-up sessions to

evaluate participants' strength, balance, FOF, and QOL. The assessments used in the study include the 30-s CST, ABC (See Appendix M), FRT, TUG manual, OLS, and the PROMIS® (See Appendix N). The ABC and PROMIS® are available on public domain. All assessment data were recorded on the Assessment Results Form (See Appendix O). Assessments were selected due to their validity. All student researchers were trained to administer the assessment according to the established protocol. To promote reliability from measurement sessions, the materials used for each assessment remained consistent, and each student researcher studied and administered a specific fall risk assessment for all participants during the pretest, posttest, and follow-up.

Intervention

This study implemented a modified version of the LiFE program (Table 1). After completion of the pretest, participants attended five face-to-face sessions with the student researchers where participants were taught the LiFE program exercises. The student researchers utilized a client-centered approach by grading each exercise to match each participants' individual needs and abilities. Participants then used the LiFE Participant's Manual to guide them in performing the modified-LiFE program at home. Each participant was given a Daily Routine Chart (See Appendix P) to help identify ways to integrate the exercises into their everyday activities. Each participant was also given the LiFE Activity Planner and LiFE Activity Counter Forms (See Appendices Q & R) to track their compliance and daily frequency with each of the prescribed exercises. The LiFE Activity Planner and LiFE Activity Counter Forms were collected during each weekly session, the booster session, and the follow-up session.

Participants were re-measured during the posttest at week 7, a week after completing the five face-to-face training sessions. Participants continued to use the LiFE Activity Planner and LiFE Activity Counter Forms to record their exercises on their own for the next three weeks following the posttest. The LiFE Activity Planner and LiFE Activity Counter Forms were collected during the booster session at week 10. Following the booster session, participants were given a binder containing the LiFE Activity Planner and LiFE Activity Counter Forms to continue recording their exercises from weeks 11 to 26. Student researchers conducted two follow-up phone calls using a standardized telephone call script (See Appendix S) at weeks 15 and 20 to provide support and encouragement, and to facilitate problem-solving for integrating exercises into everyday activities. The binders containing the LiFE Activity Counter Forms, completed between week 11 and week 26, were collected during the follow-up session at week 26. Participants were re-measured a final time during the follow-up session at week 26.

Table 1

Overview of the Modified-LiFE program.

Week number	Participant procedures timeline
Week 1	Formal screening session and pretest assessment
Weeks 2	1.5 hour face-to-face session to learn balance and strength exercises
Week 3-6	1 hour sessions to learn balance and strength exercises
Week 7	Posttest assessment conducted
Week 10	1 hour booster session to review balance and strength exercises and prepare for individual participation continuation of LiFE program during week 11 to week 26
Week 15 and Week 20	15 minute follow-up phone calls to check on status and address any questions
Week 26	Follow-up assessment

Note: Adapted from "Lifestyle-integrated Functional Exercise (LiFE) program to prevent falls: trainer's manual," by L. Clemson, J. Munro, and M.F. Singh, 2014, *Lifestyle-integrated Functional Exercise (LiFE) program to prevent falls: trainer's manual,* p. 9. Copyright 2014 by Sydney University Press.

Data Collection Procedures

The student researchers used a battery of fall risk assessments to assess each participant during the pretest, posttest, and follow-up sessions. The MoCA© was used to detect mild cognitive impairment and screen out individuals who did not meet the cognitive capacity required for the study. The 30-s CST was used to assess the participants' lower body strength by counting the number of times a participant can rise to a full stand from a seated position, without pushing from the armrests, within 30 seconds (Rikli & Jones, 1999). The FRT and TUG manual assessment were used to assess static and dynamic balance respectively, both indicators of fall risk (Duncan et al.,

1990; Shumway-Cook et al., 2000). The FRT yardstick method measures the distance between the participants' arms' lengths to their maximal forward reach while using a fixed base of support in which legs were positioned shoulder width apart (Duncan et al., 1990). The TUG manual assessment requires participants to hold a cup of water while getting up from a chair, walking 10 feet at their regular pace safely to a line marked on the floor, crossing it, turning around, walking back, and sitting down on the chair (Shumway-Cook et al., 2000). The OLS assessment was used to assess the participants' balance over a small base of support (Vellas et al., 1997a). The OLS requires participants to choose their most comfortable leg to stand on, flex the opposite knee allowing the foot to clear the floor, and balance on one leg as long as possible for up to 30 seconds maximum (Vellas et al., 1997a). The ABC was used to assess balance confidence during 16 specific daily activities (Powell & Myers, 1995). The Physical Function Short Form 10a Questionnaire of the PROMIS® was used to assess the participants' physical functioning in relation to their quality of life (Cella et al., 2010).

The pretest data were collected before the start of the study at week 1. The posttest data were completed one week after the last weekly face-to-face instruction session at week 7. The follow-up data were collected during the follow-up session at week 26. The pretest data provided baseline information on the participants. The posttest and follow-up data provided information on the changes, as compared to the baseline data, that the modified-LiFE program had on the participants' fall risk since the start of the program. The binders containing the LiFE Activity Counter Forms completed between week 11 and week 26 were also collected during the follow-up session to

provide data on the modified-LiFE program's sustainability. All raw data were written on the assessment sheets locked in the faculty advisor's file cabinet and were transferred onto an Excel document with the participants' code numbers on the student researchers' password-protected computers.

Data Analysis

The purpose of this study was to explore the sustainability and effectiveness of a modified version of the LiFE program in decreasing fall risk in older adults residing in independent living units in senior residential communities aged 65 and over. Descriptive statistics were used to examine the demographics of participants, including age, gender, fallers versus non-fallers, and use of mobility devices. A battery of fall risk assessments were used to compare pretest, posttest, and follow-up scores for each participant. For statistical analysis, the *p* value was set at .05, indicating a 5% chance that results are not due to the modified-LiFE program. Data obtained from the pretest, posttest, and follow-up were transferred from excel to Statistical Package for Social Science® (SPSS®version 22) for statistical analysis. Data were compared at pretest, posttest, and follow-up using a repeated measure analysis of variance (ANOVA) and paired t-tests. A Post Hoc test was used to indicate any significant differences between data. Eta squared was applied on the data obtained from the battery of fall risk assessments in order to identify the effect size of the modified-LiFE program on fall risk, lower body strengths, and balance. Results from the PROMIS® assessment were converted from raw scores to T scores. Attendance and participation were taken into consideration in this study; participants who missed more than two sessions of the study were excluded from the data analysis. Missing data

due to dropout at follow-up were handled by assuming that the modified-LiFE program had no effect and that the participant remained at his or her pretest level. As a result, participants were given a change score of zero.

Results

A total of 19 participants were recruited from the independent living units, including eight participants from The Redwoods and 11 participants from Aldersly retirement communities, in Marin County. Participant demographics are listed below (Table 2). Prior to completion of the study, three participants decided to discontinue the study for personal reasons, resulting in 16 participants completing the five-week face-to-face sessions. Of the 16 participants, 15 reported engagement in traditional exercises prior to the start of the study, such as walking, strength classes, and balance classes. Throughout the study, all 16 of the participants agreed to continue their current traditional exercises, but not to begin any new exercise programs. At weeks 15 and 20, the student researchers conducted two 15-minute follow-up phone calls to check on exercise participation, address any questions that participants might have had, and help participants problem solve to continue with integrating exercises into everyday activities. At weeks 15 and 20, the student researchers were able to successfully connect with 53% and 40% of participants respectively. The remaining participants who the student researchers were not able to connect with during the initial attempt were given a second phone call, but without success. At the end of week 26, follow-up data were collected for 13 of the 16 participants. Three participants, participants D, F, and O, were deemed attritions from the program as one was absent at follow-up, one began physical therapy

two weeks prior to the end of the study, and one elected to discontinue the program for medical reasons. Hence, missing follow-up data from these three participants were assigned their score at pretest (i.e. change score was zero) during data analysis.

A comparison of participants' pretest, posttest, and follow-up individual scores for all assessments were summarized into Tables 3-7. Table 8 illustrates group outcome measure means, standard deviations, and effect sizes. Incidental findings are included in Table 9, Table 10, and Figure 1. For the purpose of this study, participants who had experienced a fall in the six months prior to the start of the study were deemed fallers. Participants were considered non-fallers if they had not experienced a fall in the six months prior to the start of the study. Table 9 compares mean outcome measures of FRT, TUG manual, 30-s CST, and OLS for fallers versus non-fallers. Table 10 compares mean and p-values of falls between fallers and non-fallers. Figure 1 depicts mean number of falls at pretest, posttest, and follow-up between fallers and non-fallers.

The sustainability of the program was measured by collecting the weekly Activity Counter Forms from Weeks 11 to 26, counting exercise participation, and graphing the results to determine trends. Trends were analyzed based on the curve of the graph and were rated 1, 2, 3 or 4 to indicate continued improvement, maintenance, decline, or total cessation of exercises respectively as seen in Table 11. Of the 16 binders handed out, eight were returned, and only six were logged in. Of the six binders logged in, five revealed a trend toward maintenance of the LiFE program exercises and one indicated total cessation.

Table 2

Participants Demographics

Participant	Age	Gender	Assistive Device	Previous falls in last 6 months
A	97	M	No	0
B	91	F	No	0
C	87	F	No	NR
D	93	F	Cane	NR
E	85	F	No	1
F	94	F	Cane	0
G	78	F	No	0
H	85	M	Cane	1
I	94	F	No	0
J	86	F	Cane	2
K	84	F	Cane	3
L	88	F	No	0
M	91	F	Cane	1
N	83	F	No	0
O	87	F	No	0
P	84	F	No	0
Mean (*SD*)	87.94 (4.75)			

Note: NR = Participant left question blank, interpreted as zero falls

Table 3

LE Strength Assessment (30-s CST) Data Including Normative Percentiles

Participants	Pretest		Posttest		Follow-up	
	Raw	Percentile	Raw	Percentile	Raw	Percentile
A	11	65th	13	80th	14	85th
B	0	5th	0	5th	0	5th
C	9	40th	9	40th	9	40th
D	9	60th	8	50th	9	60th
E	13	75th	14	85th	15	90th
F	8	50th	8	50th	8	50th
G	12	50th	13	60th	13	60th
H	0	5th	4	5th	1	5th
I	9	60th	10	65th	13	85th
J	8	30th	12	70th	14	85th
K	0	5th	0	5th	7	15th
L	7	20th	13	75th	14	85th
M	9	60th	12	80th	14	90th
N	11	50th	10	40th	12	60th
O	4	5th	10	50th	4	5th
P	7	15th	12	60th	13	70th
Mean (*SD*)	7.31 (*4.21*)		9.25 (*4.40*)		10 (*4.84*)	

Note: The total number of chair stands the participant was able to complete in 30 seconds compared with aged-matched percentile norms (Rikli & Jones, 2001)

Table 4

Static and Dynamic Fall Risk Assessments (TUG manual and FRT) Data

Participant	TUG Pretest (s)	TUG Posttest (s)	TUG Follow-up (s)	FRT Pretest (in.)	FRT Posttest (in.)	FRT Follow-up (in.)
A	13.59	13.18	11.76	7	9	10
B	19.94	15.28	15.19	7	11	10
C	19.66	16.37	14.32	9	13	11
D	24	24.03	24	7	19	7
E	12.79	9.75	10.34	11	11.5	10
F	23.13	21.15	23.13	7	6	7
G	12.09	13.37	12.37	12	11	12
H	21.44	19.75	15.88	10	12	10
I	21.03	19.18	18.97	9	11	10
J	22.79	16.40	14.86	8	12	9
K	23.78	28.28	17.84	7	9	11
L	15.75	16.85	15.85	8	11	11
M	23.53	18.31	15.31	9	10	10
N	13.53	11.93	11.72	9	11	8
O	18.15	13.75	18.15	9	8	9
P	18.03	16.25	18.03	7	10	8
Mean	18.95	17.11	16.11	8.5	10.34	9.56
(*SD*)	(*4.23*)	(*4.68*)	(*3.86*)	(*1.55*)	(*1.72*)	(*1.46*)

Note: TUG= TUG Manual; Participants unable to complete the TUG manual in less than 14.5 seconds or reach at least 10 inches on the FRT are considered at risk for a fall (Duncan et al., 1992; Shumway-Cook et al., 2000)

Table 5

OLS Assessment Data

Participant	Pretest	Posttest	Follow-up
A	1.31	2.31	3.03
B	2.19	1.85	0
C	16	13.09	7.88
D	0	0	0
E	13.5	9.07	46.03
F	1.68	1.91	1.68
G	3.02	8.78	14.62
H	0	1.75	0
I	1.84	2.47	1.37
J	1.78	0	4.25
K	0.78	0.72	2.25
L	4.78	6.26	2.22
M	2.0	1.16	3.44
N	4.0	4.47	37
O	2.63	0	2.63
P	0	1.63	0
Mean (*SD*)	3.47 (*4.63*)	3.47 (*3.86*)	7.90 (*13.73*)

Note: Participants unable to stand on one leg for at least 5 seconds are at higher risk of an injurious fall (Vellas et al., 1997b)

Table 6

Fall Efficacy Assessment (ABC) Data

Participant	Pretest	Posttest	Follow-up
A	92.25	97.00	92.50
B	73.75	82.50	70.38
C	76.25	79.38	79.75
D	54.38*	25.94*	54.38*
E	98.13	97.50	98.13
F	98.13	55.31*	98.13
G	84.38	92.06	92.56
H	85.00	84.38	52.81*
I	93.13	94.06	91.44
J	95.00	98.13	92.50
K	51.25*	70.00	68.06
L	84.88	84.69	68.75
M	81.44	80.94	95.00
N	86.25	80.00	83.75
O	42.50*	57.19*	68.00*
P	53.13*	73.13	56.25*
Mean (*SD*)	78.12 (*18.11*)	78.26 (*19.09*)	77.31 (*18.46*)

Note: A score of less than 67% on the ABC was identified as a reliable means of predicting future falls in older adults (Lajoie & Gallagher, 2004). Participants were classified as Fallers* based on this cutoff score.

Table 7

PROMIS® Data

Participant	Pretest	Posttest	Follow-up
A	50.8	53	45.4
B	40.2	43.5	43.5
C	40.2	44.4	39.4
D	36.4	32	36.4
E	61.7	49.1	55.3
F	46.4	43.5	46.4
G	53	53	53
H	39.4	38.7	33.5
I	47.7	61.7	49.1
J	44.4	49.1	41
K	37.2	37.9	37.2
L	42.6	46.4	35.7
M	42.6	41	40.2
N	49.1	47.7	49.1
O	42.6	42.6	44.4
P	45.4	45.4	45.4

Note: Participants *PROMIS®* scores were converted from raw scores to T scores, which have a mean of 50 and standard deviation of 10 (*PROMIS® scoring guide*, 2011)

Table 8

Means, Standard Deviations, and Effect Size of Outcome Measures

	Pretest	Posttest	Follow-up	η^2
FRT	8.5 (1.55)	10.34 (1.72)*	9.56 (1.46)$^+$	.404
TUG manual	18.95 (4.23)	17.11 (4.68)*	16.11 (3.86)$^+$	.331
30-s CST	7.31 (4.21)	9.25 (4.40)*	10 (4.84)$^+$	.374
OLS	3.47 (4.63)	3.47 (3.86)	7.90 (13.73)	.126
ABC	78.12 (18.11)	78.26 (19.09)	77.31 (18.46)	.002

Note: *p < .05 Pretest-Posttest; $^+$p<.05 Pretest-Follow-up; FRT mean measured in inches, TUG manual mean measured in seconds; 30-s CST mean measured in number of chair stands; OLS mean measured in seconds; ABC measured in self reported percentages; η^2 = Effect Size

Table 9

Outcome Measures of Fallers and Non-Fallers

	Fallers			Non-Fallers			ANOVA-F	
	Pre	Post	FU	Pre	Post	FU	Within Group	Between Group
	M (*SD*)	M (*SD*)	M (*SD*)	M (*SD*)	M (*SD*)	M (*SD*)		
FRT	9.00 (1.58)	10.90 (1.34)	10.00 (.71)	8.27 (1.56)	10.09 (1.87)	9.36 (1.69)	.018	1.139
TUG manual	20.87 (4.61)	18.50 (6.67)	14.85 (2.76)	18.08 (3.97)	16.49 (3.70)	16.68 (4.25)	6.368*	.208
30-s CST	6 (5.79)	8.40 (6.07)	10.2 (6.06)	7.91 (3.45)	9.64 (3.72)	9.91 (4.52)	1.29	.164
OLS	3.61 (5.59)	2.54 (3.70)	11.19 (19.54)	3.40 (4.43)	3.89 (4.03)	6.40 (11.04)	.707	.113

Note: **p* < .05; M= Mean; *SD*= Standard Deviation; FU= Follow-up; FRT mean measured in inches, TUG manual mean measured in seconds; 30-s CST mean measured in number of chair stands; OLS mean measured in seconds

Table 10

Means of Falls in Fallers versus Non-Fallers

	N	Pretest Means	Follow-up Means	Pretest-Follow-up Paired t-test
Fallers	5	1.60	0.00	4.000*
Non Fallers	11	0.00	0.18	-1.491

*Note: *p< .05*

Figure 1

Mean Number of Falls in Fallers and Non-Fallers

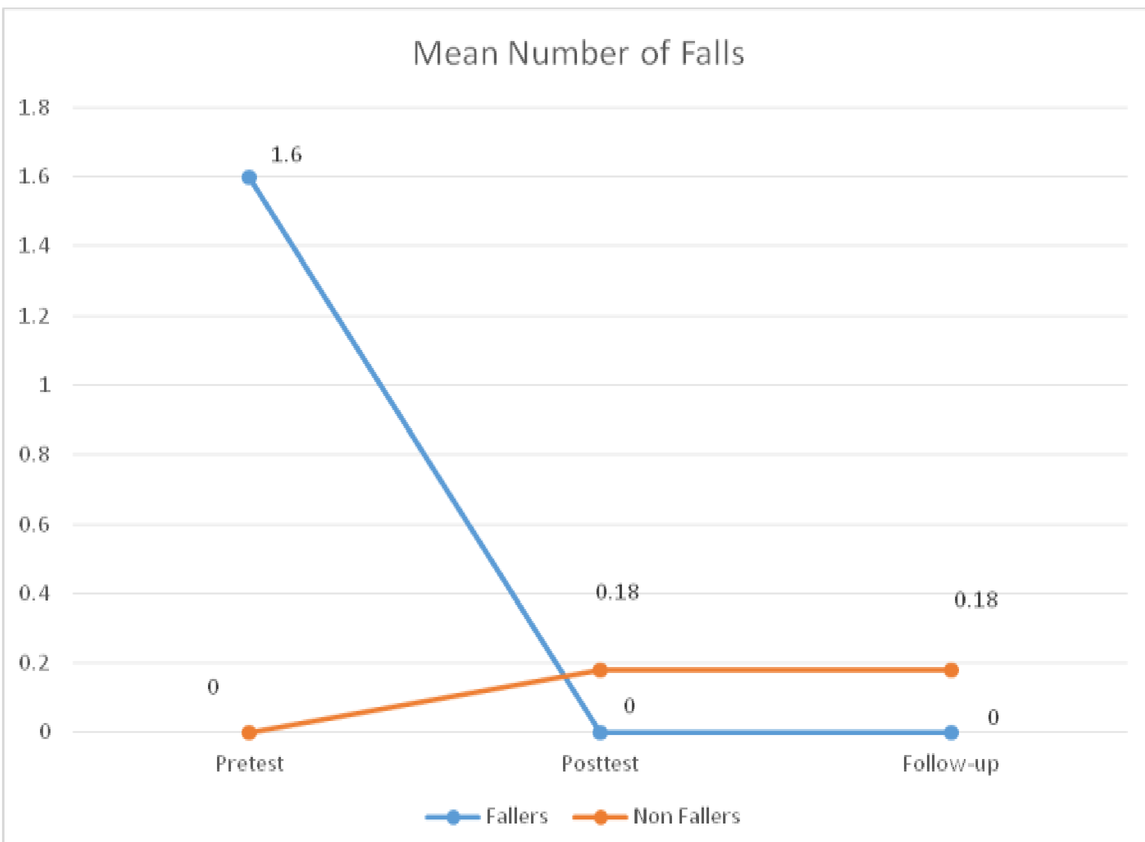

Table 11

Sustainability Based on Trend From Summer Activity Counters

Participants	Sustainability Rating
A	2
C	4
G	2
K	2
N	2
O	2

Note: Data from returned Activity Counter Forms from weeks 11 through 26 were converted into Sustainability Ratings based on the following guidelines:
1= Continued to improve throughout the summer, participant exercise count was trending up
2=Maintenance, participant exercise count plateaued which may have included some minor dips and changes
3= Decline, participant exercise count showed significant decrease and the count was trending down
4= Total cessation of exercises, participant exercise count completely stopped

Discussion

Fall prevention is a primary concern for occupational therapists working with older adults. Research has shown that older adults who have experienced a fall often develop a FOF, which leads to avoidance of valued occupations. Avoidance of valued occupations leads to decreased strength, balance, and endurance, which in turn increases older adults' fear and risk for experiencing another fall.

The purpose of this study was to examine the effectiveness of the modified-LiFE program in decreasing fall risk in community-dwelling older adults who reside in senior residential communities, both fallers and non-fallers. The hypothesis of this study was

that the modified-LiFE program would have an effect on fall risk in older adults, fallers and non-fallers, who live in an independent living unit in senior residential communities. At the beginning of this six-month study, five of the 16 participants who completed the study were identified as fallers, while 11 were identified as non-fallers. A battery of assessments measuring participants' strength, balance, and fall efficacy were used to indicate participants' risk for falling. Through administration of these assessments, it was found that a majority of the participants were at high risk for a fall prior to the start of the study. At the end of the follow-up at week 26, results of this study support the effectiveness of the modified-LiFE program as a means to increase strength and reduce fall risk in community-dwelling older adults.

The 30-s CST assessment was used to measure participants' lower body strength. Literature has shown that the 30-s CST is a reliable and valid assessment for measuring lower body strength in community-dwelling older adults (Jones, Rikli, & Beam, 1999). Lower body strength has been linked to functional independence, and is a good predictor of physical vulnerability, and therefore an indicator for risk of falling in older adults (Smith et al., 2010). Based on the significant increase in the group means for the number of chair stands completed from pretest to posttest, and pretest to follow-up sessions, the results showed that the modified-LiFE program was effective in increasing lower body strength. Additionally, all participants maintained or increased their normative age percentile rankings throughout the study, which further supports the effectiveness of the modified-LiFE program in increasing lower body strength. Furthermore, the results of the 30-s CST (η^2=.374) are of moderate effect size,

and support Clemson et al.'s (2012) original findings that integrated exercise programs are effective for increasing lower body strength in community-dwelling older adults.

The FRT and TUG manual assessments were used to measure participants' static and dynamic balance respectively. According to the literature, the FRT and TUG manual are also reliable and effective means of predicting fall risk in older adults (Duncan et al., 1992; Langley & Mackintosh, 2007; Shumway-Cook et al., 2000). Duncan et al.'s (1992) study indicated that older adults who are not able to reach 10 inches on the FRT were at risk for falling. Results from the FRT showed that 76.9% of participants that completed the program changed their fall risk status from at risk for a fall to not at risk for a fall. In addition, literature has also shown that the TUG manual assessment classified older adults who took 14.5 seconds or longer to complete the assessment to be at risk for a fall (Shumway-Cook et al., 2000). According to the results from the TUG manual, there were a total of 11 fallers at pretest and nine fallers at follow-up. Even though 84% of the participants decreased their times on the TUG manual, only two participants changed from faller to non-faller as identified by the TUG manual. Therefore, results of both the FRT and TUG manual show significant improvement in the group means for distance reached on the FRT and time measured on the TUG manual from pretest to posttest, and pretest to follow-up. The results from both assessments also showed a medium effect size, FRT (η^2=.404) and TUG manual (η^2=.331) respectively, supporting that the modified-LiFE program can increase reach over a fixed base of support, improve walking speed, and therefore may be effective in decreasing fall risk.

The OLS assessment was used to measure participants' balance, over a narrow base of support, which the literature has shown to be an indicator of injurious fall risk (Vellas et al., 1997b). Participants who are not able to stand on one leg for at least 5 seconds are at higher risk of an injurious fall (Vellas et al., 1997b). While group means on the OLS increased from pretest to follow-up, the results were not found to be significantly influenced by the modified-LiFE program. The insignificant results may be due to the low predictive validity or external variables of the OLS (Lin et al., 2004). External variables affecting participants' performance on the OLS may have included fatigue while recovering from an illness, the order in which the OLS was completed with relation to other fall risk assessments, and participants' perceived self-efficacy on the particular day of assessment. For consistency purposes, the highest OLS score between the participant's legs at pretest were used to determine the leg used for analysis in both the posttest and follow-up sessions. However, at the end of the follow-up assessment, three of the 16 participants demonstrated increases in their OLS times when attempting the assessment with the leg opposite to the one that scored the highest during pretest. Although the results of the OLS assessment were not significant, seven of the participants' OLS times increased, five remained the same, and only four decreased, as compared to the baseline.

The ABC and PROMIS® measure participants' FOF and perceived physical function respectively. The results from the ABC and PROMIS® were not found to be significantly changed by the modified-LiFE program. The insignificant results may be due to various factors. Some participants expressed difficulty in understanding the

language and format on the assessments, relating to the questions if the occupations did not pertain to them, and reading the questions due to various visual impairments. The ABC and PROMIS® are subjective measurements. Consequently, the order in which the participants took the assessments in relation to the physical assessments given that day, as well as various occurrences in the participants' personal life may have affected their overall mood and perceived self-efficacy on the day of assessment.

In addition to analyzing the effectiveness of the modified-LiFE program, the student researchers also explored the program's potential sustainability. Attempt to measure sustainability was done through collecting the weekly Activity Counter Forms participants logged from weeks 11 to 26, when the researchers were no longer having face-to-face meeting with the participants. Participants' weekly entries were counted and graphed to determine trends. Trends were analyzed based on the curve of the graph and then assigned four categories, one to four, to indicate continued improvement, maintenance, decline, or total cessation of exercises respectively. Of the 16 binders handed out, eight were returned, and only six were logged in. Of the six binders logged in, one indicated total cessation of the integrated exercise while five revealed a trend toward maintenance. These graphs may suggest that the modified-LiFE program can be sustainable over time. Regarding the 10 participants whose binders were not received, the follow-up data and participants' testimonials collected led the student researchers to believe that the integrated exercises were maintained. Given the overall poor return rate of the binders, the student researchers concluded that binders may not be an appropriate method of monitoring sustainability. Several factors may have contributed to the low

number of binders returned, such as a decrease in motivation in logging in exercises after face-to-face sessions with the student researchers had ended, or the repetitive and time consuming nature of logging in daily exercises, may have deterred participants in continuing with recording onto the Activity Counter Forms religiously. Furthermore, as participants demonstrated an understanding of the exercises but expressed difficulty with keeping up with the logging during the initial group meetings, the student researchers had continually emphasized the importance of doing the integrated exercises over the importance of logging in the binders in their training.

The student researchers felt the two follow-up phone calls at weeks 15 and 20 did not provide any significant information as only eight participants responded at week 15 and only six of the participants responded at week 20. Despite being actively involved during weekly sessions, the participants were difficult to get ahold of and hesitant to engage in conversations over the phone. Scripted conversations that the student researchers had prepared to use with participants did not appear to be an effective method in helping them problem solve or improve their performance with the program. These difficulties could have been due to a number of reasons including the student researchers calling at an inconvenient time, challenges with hearing, or poor comprehension of the purpose of the scripted phone conversation.

Though this study included both fallers and non-fallers, it was not the intention to compare between groups. However, analysis of the data between these two groups yielded incidental results. At baseline, the five fallers averaged 1.60 (*SD*= 0.894) falls compared to the 11 non-fallers who averaged zero falls. However, by the follow-up at

week 26, the fallers averaged zero falls, a significant decrease from pretest (*t(4)=4.00, p=.003)*, can be attributed to the modified-LiFE program. The non-fallers averaged 0.18 (*SD=0.405)* falls at follow-up, however, these results were found to be insignificant (*t*(10)= -1.491, *p=.167)*. Thus, the increase in falls from the non-faller group were concluded to be due to random chance. This further supports Clemson et al.'s study in 2012 that the LiFE program, in its modified format, can be effective in decreasing fall risk among fallers.

A comparison of pretest, posttest, and follow-up data for the FRT, TUG manual, and 30-s CST demonstrated a significant reduction in participants' fall risk, increase in lower extremity strength, as well as static and dynamic balance. This study contributes to the body of evidence supporting the use of integrated exercise programs in everyday activities as a sustainable way to increase lower extremity strength, improve balance, reduce fall risk, and therefore prevent falls in community-dwelling older adults. Furthermore, this study supports the benefits of utilizing a client-centered exercise program, where consideration of the older adults' physical and mental abilities, personal routines, and environments are seen as important factors when developing a successful fall prevention program. Occupational therapists may benefit from the use of integrated exercise programs, such as the modified-LiFE program, as an effecive fall prevention approach to help increase strength, balance, and decrease fall risk in community-dwelling older adults. This study's findings ultimately contribute to promoting participation in meaningful occupations and successful aging in place for community-dwelling older adults.

Testimonials

The student researchers collected informal testimonials in writing at the week 26 follow-up assessment (Table 12). Within these testimonials, participants expressed their enjoyment of the program, the feasibility of participation, and the benefits of integrated exercises in helping them effectively engage in their daily occupations. Additionally, many of the testimonials received expressed the participants' increased confidence in their abilities to perform daily tasks with less fear of falling. The testimonials received may provide support for integrated exercises as a sustainable means of fall prevention. However, participants' enthusiasm for the program may be influenced by their desire to please the student researchers, known as the Hawthorne effect. The Hawthorne effect is described as a phenomenon where participants modify or improve their behavior to fulfill the observer's expectations (Portney & Watkins, 2000). This may explain why outcomes improved from pretest to posttest, when the student researchers were actively meeting with the participants, but improved less over the summer when the participants were continuing the program independently without face-to-face interaction with the student researchers. However, it is also possible that the participants reached a plateau in their exercise performance or failed to challenge themselves appropriately without the guidance from the student researchers. Regardless, the participants' testimonials provided clear support for the effectiveness of the modified-LiFE program as a means of promoting fall prevention and engagement in everyday occupations.

Table 12

Formal Participant Testimonials

Participant Testimonials
"Great program! Thank you! Incorporating the balance exercises into daily movements is the way to go! While traveling I kept up the exercises. I have incorporated other exercises I let lapse" – Participant G
"I found the program useful and encouraging. I now bend knees and almost squat to pick up items off the floor. I am more confident with my balance over all. I welcome stairs (most of the time!). I can stand to pull on slacks, one leg at a time! I have learned not to lean on railings as I walk or go up stairs. I am more aware of using my body consciously" – Participant C
"I could not get out of a regular chair before without a cane or arms, now I can. I think I walk better, with the cane sometimes, even though I have." – Participant K
"From the beginning I realize the importance of strength to do exercises. I've been thinking about exercises whenever I am. This program inspires to do that." – Participant P

Note: Participants provided testimonials in writing at the follow-up assessment.

Limitations

There were a few limitations that may have impacted the results of this study. A limited number of participants meeting the inclusion criteria and attrition of six participants, three at the end of the program and three prior to follow-up data collection, resulted in a small sample size. In addition, convenience sampling of participants only included older adults from two retirement residential communities in Marin County. Having a limited sample size and a narrow demographic limited the possibility of generalizing the results of the study to a larger population, resulting in low external validity. The limited sample size also increased Type II error, resulting in the study

having low power. In an effort to compensate for the low power, the three participants that dropped out prior to the follow-up at week 26 were still included in data analysis with their pretest scores in place of their follow-up scores, indicating no change from their participation in the modified-LiFE program.

Limitations concerning the participants that threatened the internal validity of the study included the Hawthorne effect, self-report bias, and the possibility of competition between participants. By modifying or improving their behavior, participants would no longer represent their natural behaviors and could possibly skew the results. In this study, participants may have demonstrated the Hawthorne effect by exercising more than normal in an attempt to please the student researchers. Based on testimonials, the participants enjoyed the interaction with the student researchers and the opportunity to contribute to the study. This may explain why assessment outcomes demonstrated greater improvement pretest to posttest while the student researchers were conducting weekly face-to-face sessions, but less improvement posttest to follow-up as participants were continuing the program independently. Self-report and recall biases may have been present due to dependency on the participants to log their own exercise frequency, and self-report measures like the ABC and PROMIS®.

Utilizing the Activity Counter Forms may not have been an appropriate method of tracking continuing participation of the integrated exercises. Only six completed binders were returned, yet participants' scores and verbal reports indicated continued exercise participation. This indicates that logging in binders may not be a valid measure of the sustainability of integrated exercises. As instruction was done in a group setting,

competition between participants was also a concern. In order to minimize this limitation, the student researchers individualized the exercises to meet the abilities of each participant, reminded them that the objective was not meant to be competitive, and emphasized that safety was the number one priority.

Further limitations that may have affected the study included those resulting from the student researchers' actions and perceptions during the study. To address the lack of inter-rater reliability in repeated measurements, only one student researcher measured the same assessment for all participants during the pretest, posttest, and follow-up assessments. Throughout the study, student researchers continued to be aware of various potential limitations based on their variable actions, and addressed and troubleshot problems that arose through close contact with their research advisor and weekly meetings in an attempt to provide consistent implementation of the modified-LiFE program.

A possible assessment specific limitation is that of the practice effect. Practice effect is defined as improvements in test performance due to repeated exposure to the test materials (Duff et al., 2007). Since the one-leg stand and sit to stand were also assigned exercises in the modified-LiFE program, there may have been a practice effect associated with the assessment results. Since the OLS assessment and the one-leg stand exercise are identical in nature, and the participants practiced the one-leg stand exercise for 26 weeks, there was likely a practice effect associated with this assessment. However, the overall group means did not demonstrate a significant improvement at follow-up, in spite of consistent practice. The 30s-CST and the sit to stand exercise are also similar. However,

in the 30-s CST, participants completed continuous sit to stand in 30 seconds. Since, the 30-s CST measures not only strength but endurance, unlike the sit to stand exercise, which is a lower body strengthening exercise, the likelihood that there was a practice effect between the 30-s CST assessment and the sit to stand exercise is low.

The field of occupational therapy would benefit from further research on the effectiveness of integrated exercises as a fall prevention program for community-dwelling older adults. Future studies would benefit from having a larger sample size, a more diverse population, and involvement of more community-dwelling older adults to increase generalizability of results. Additionally, future studies would benefit on exploring more valid means of assessing sustainability of integrated exercise programs. Collection of more qualitative data, in addition to quantitative data may provide additional support for integrated exercise programs. It would also be beneficial to have a longitudinal study to look at possible long-term effects of integrated exercises as a fall prevention program beyond six months.

Conclusion

As the population of older adults grows, the concern for risk of falling increases (CDC, 2013). Older adults who experience a fall often demonstrate a decrease in strength and balance, and an increase in FOF (Scheffer et al., 2008; Van Haastregt et al., 2008). Although previous literature supports the use of strength and balance exercises in fall prevention programs, various factors including a lack of knowledge, health status, social influence, and poor access to safe and stimulating exercise environments limit exercise among older adults. These factors contribute to why many fall prevention

programs may not be sustainable, and therefore ineffective in the long run (Burton et al., 2014; Cho & An, 2014; Clemson et al., 2012; Opdenacker et al., 2008; Roaldsen et al., 2014; Sherrington et al., 2011).

The purpose of this study was to explore whether or not integrated exercise programs, specifically the modified-LiFE program, can decrease fall risk in older adults who have or have not experienced a fall. In this study, a modified version of the LiFE program was implemented to a population of community-dwelling older adults ages 65 and over at The Redwoods and Aldersly retirement communities. Results of this study demonstrated a significant reduction in participants' fall risk and an increase in lower extremity strength, and improvement in static and dynamic balance as measured by the FRT, TUG manual, and 30-s CST. This study contributes to the body of evidence supporting the use of integrated exercise programs in everyday activities as a sustainable way to increase lower extremity strength, improve static and dynamic balance, reduce fall risk, and therefore prevent falls in community-dwelling older adults.

Furthermore, this study provides evidence that a client-centered exercise program, where the older adults' physical and mental abilities, personal routines, and environments are considered, may be a successful approach to fall prevention for older adults. This holistic and individualized approach parallels the approach of occupational therapy. As the profession of occupational therapy places increasing importance on the use of evidence based practice, studies such as this are critical for providing quality interventions. This study's findings contribute to promoting participation in meaningful occupations and successful aging in place for community-dwelling older adults.

Occupational therapists may benefit from the use of integrated exercise programs, such as the modified-LiFE program, as a fall prevention approach to help increase strength, improve balance, and decrease fall risk in community-dwelling older adults.

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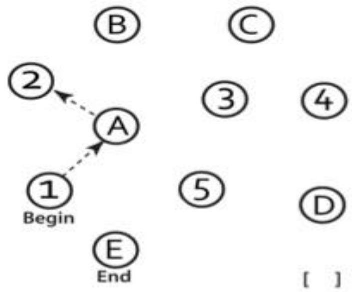
APPENDIX A

MONTREAL COGNITIVE ASSESSMENT 7.3

MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.3 Alternative Version

NAME :
Education :　　　　Date of birth :
Sex :　　　　DATE :

VISUOSPATIAL / EXECUTIVE



[ ]

Copy cylinder

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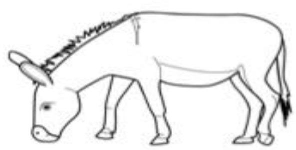
Draw CLOCK (Ten past nine)
(3 points)

[ ] Contour　[ ] Numbers　[ ] Hands

POINTS　__/5

NAMING



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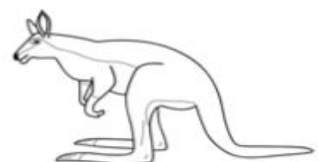


[ ]

__/3

MEMORY		TRAIN	EGG	HAT	CHAIR	BLUE	
Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.	1st trial						No points
	2nd trial						

ATTENTION Read list of digits (1 digit/ sec.).	Subject has to repeat them in the forward order [ ] 5 4 1 8 7 Subject has to repeat them in the backward order [ ] 1 7 4	__/2
Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors	[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B	__/1
Serial 7 subtraction starting at 80	[ ] 73 [ ] 66 [ ] 59 [ ] 52 [ ] 45 4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt**	__/3
LANGUAGE	Repeat : She heard his lawyer was the one to sue after the accident. [ ] The little girls who were given too much candy got stomach aches. [ ]	__/2
	Fluency / Name maximum number of words in one minute that begin with the letter B [ ] ____ (N ≥ 11 words)	__/1
ABSTRACTION	Similarity between e.g. banana - orange = fruit [ ] eye – ear [ ] trumpet – piano	__/2

DELAYED RECALL	Has to recall words WITH NO CUE	TRAIN [ ]	EGG [ ]	HAT [ ]	CHAIR [ ]	BLUE [ ]	Points for UNCUED recall only	__/5
Optional	Category cue							
	Multiple choice cue							

ORIENTATION	[ ] Date	[ ] Month	[ ] Year	[ ] Day	[ ] Place	[ ] City	__/6

Adapted by : Z. Nasreddine MD, N. Phillips PhD, H. Chertkow MD
　www.mocatest.org

Normal ≥26 / 30　TOTAL __/30
Add 1 point if ≤ 12 yr edu

Administered by: ______________________

APPENDIX B

FALL PREVENTION EDUCATION HANDOUT

Fall Prevention Tips

Factor #1: Osteoporosis

- Eat or drink sufficient calcium. Postmenopausal women need 1,500 mg of calcium daily. Calcium-rich foods include milk, yogurt, cheese, fish, and shellfish, selected vegetables such as broccoli, soybeans, collards and turnip greens, tofu and almonds.
- Get sufficient vitamin D in order to enhance the absorption of calcium into the bloodstream. Vitamin D is formed naturally in the body after exposure to sunlight, but some older adults may need a supplement.
- Regularly do weight-bearing exercises.

Factor #2: Lack of Physical Exercise

- Engage regularly (e.g. every other day for about 15 minutes daily) in exercise designed to increase muscle and bone strength, and to improve balance and flexibility. Many people enjoy walking and swimming.
- Wear proper fitting, supportive shoes with low heels or rubber soles.
- Consider joining exercise or Tai Chi class on a regular basis.

Factor #3: Impaired Vision

- Have regular checkups by an ophthalmologist to discern the extent of age-related eye diseases such as cataracts and glaucoma.
- Use color and contrast to define balance-aiding objects in the home (e.g. grab bars and handrails).
- Add contrasting color strips to first and last steps to identify change of level.
- Clean eye glasses daily to improve visibility.
- Consider changing your multifocal lens to separate reading and distance glasses.
- Do not wear reading glasses while walking.

Factor #4: Medications

- Know the common side effects of all medications taken.
- Talk with your physician or pharmacist about ways to reduce your chances of falling by using the lowest effective dosage, regularly assessing the need for continued medication, and the need for walking aids while taking medications that affect balance.
- Have a physician or pharmacist conduct a “brown bag” medicine review of all current medications.
- Limit intake of alcohol as it may interact with medications.
- Carry a list of all your medications (prescribed and over-the-counter) and show it to all your physicians (primary or specialist).
- Fill all your prescriptions at the same Pharmacy.

Factor #5: Postural Hypotension

- Discuss with your physician regarding your symptom if you are experiencing dizziness with change in position.
- Get up slowly after you sit or lie down.
- Stand still for a few seconds before you start walking. Sit down immediately if you feel dizzy.
- Perform ankle pumping in sitting before walking.
- Rest after meals if experiencing post-prandial hypotension.
- Get up slowly after a difficult or prolonged bowel movement. Discuss with your physician if you often feel dizzy after bowel movement.

Factor #6: Environmental Hazards

- Repair cracks and abrupt edges of sidewalks and driveways.
- Install handrails on stairs and steps.
- Remove high doorway thresholds. Trim shrubbery along the pathway to the home.
- Keep walk areas clear of clutter, rocks, and tools.
- Install adequate lighting by doorways and along walkways leading to doors.

All Living Spaces

- Use a change in color to denote changes in surface types or levels.
- Secure rugs with nonskid tape as well as carpet edges.
- Avoid throw rugs.
- Have at least one phone extension or portable phone in each level of the home and post emergency numbers at each phone.
- Reduce clutter
- Check lighting for adequate illumination and glare control.
- Maintain uniform lighting in the room. Turn on lighting 2 hours before dusk to allow for visual adjustment.
- Maintain nightlights or motion-sensitive lighting throughout home.
- Use contrast in paint, furniture, and carpet colors.

Bathrooms

- Install grab bars on walls around the tub and beside the toilet, strong enough to hold your weight.
- Add nonskid mats or adhesive nonskid strips to bathtubs and shower stall.
- Install a portable, hand-held shower hose.
- Add a padded bath or shower seat if needed.
- Install a raised toilet seat if needed.
- Use nonskid mats or carpet on floor surface that may get wet.
- Keep shower curtain inside the tub at all times to reduce the chance of falling over it or the water that drips from them.

Kitchen

- Keep commonly used items within easy reach.
- Never stand on a chair. Ask for help for difficult to reach item.
- Make sure appliance cords are out of the way.
- Avoid using floor polish or wax in order to reduce slick surfaces.
- Do not use difficult to reach shelves.
- Wipe up spills immediately.

Living, Dining, and Family Rooms

- Keep electrical and telephone cords out of the way.
- Arrange furniture so that you can easily move around it (especially low coffee tables).
- Make sure chairs and couches are easy to get in and out of.

Bedroom

- Put in a bedside light with a switch that is easy to turn on and off (or a touch lamp).
- Have a nightlight.
- Use a battery power tap light next to the bed.
- Adjust height of bed to make it easy to get in and out of.
- Have a firm, chair, with arms, to sit and dress.
- Keep commonly used items or clothing within easy reach.

Stairways, Hallways, and Pathways

- Keep free of clutter.
- Make sure carpet is secured and get rid of throw rugs.
- Install tightly fastened handrails running the entire length and along both sides of stairs.
- Apply brightly colored tape to the face of the steps to make them more visible.
- If you have a vision problem apply brightly colored tape to the first and last steps.
- Have adequate lighting in stairways, hallways, and pathways, with light switches placed at each end.

Factor #7: Miscellaneous Personal Factors

- Use a shoulder bag, fanny pack, or backpack to leave hands free.
- Stop at curbs and check their height before stepping up or down.
- Wear supportive, low-heeled shoes at all times, even at home. Avoid walking around in socks, stockings, or backless slippers.
- Do not rush.
- Do not carry heavy loads (e.g. grocery) up the stairs. Consider asking for help or carry smaller loads and making multiple trips.
- Do not carry big box or basket that will obscure your vision to the ground and your feet.
- Eat a balanced diet. Drink plenty of fluids every day. Avoid drinks with caffeine.

APPENDIX C

PARTICIPANT CONSENT FORM

DOMINICAN UNIVERSITY of CALIFORNIA
CONSENT TO BE A RESEARCH SUBJECT

Purpose and Background:
Kayla Comer, Kelly Findlay, Tiffany Huang, and Matthew Tong are conducting a research study on the effectiveness of the modified Lifestyle-integrated Functional Exercise (LiFE) Program in reducing fall risk in older adults. The modified LiFE program integrates physical exercise entailing endurance, strength, flexibility, and balance into everyday activities and routines. Integrated exercise into daily routines has show potential for maintaining long-term exercise participation in older adults. This study will utilize the modified LiFE program and a battery of fall risk assessments to further explore the sustainability and effectiveness of integrated exercise programs in decreasing fall risk in older adults.

I am being asked to participate because I am an able-bodied adult interested in learning how to integrate balance and strengthening exercises into daily routines.

Procedures:
If I agree to be a participant in this study, the following conditions must be met:

1. I shall complete the Montreal Cognitive Assessment to determine if I meet the inclusion criteria for the study.
2. I shall complete the initial demographic questionnaire and participate in the initial assessments, including the 30-Second Chair Stand Test, Activities-specific Balance Confidence Scale, Functional Research Test, Timed Up and Go assessment, One-legged Stand assessment, and the Physical Function Short Form 10a Questionnaire portion of the Patient-Reported Outcomes Measurement Information System. All the initial assessments will be administered by trained student researchers.
3. I shall be given an individualized modified LiFE program and the LiFE participant's manual. The student researchers will provide me with verbal and written instructions of my assigned home program. In addition, the student researchers will demonstrate each exercise during the weekly session to ensure that I understand and can perform them accurately and safely. Weekly sessions will last 1.5 hours for the first session, 1 hour for the next four sessions, and 1 hour for the booster session.
4. The modified LiFE program will be tailored to my specific conditions and needs. I shall not be treated differently based on my physical or cognitive status.
5. I acknowledge that I am expected to comply with the modified LiFE program. I shall perform the modified LiFE program to the best of my ability.
6. I shall log my frequency in performing the LiFE program exercises in the LiFE Activity Planner and LiFE Activity Counter sheets to track my daily progress.
7. If I experience any abnormal discomfort while participating in the modified LiFE program, I understand that I have the right to terminate the program. However, I am encouraged to consult the student researchers in my next appointment before doing so.
8. The student researchers will reassess my progress at week 7 and week 26 from the start of the modified LiFE program. A booster session will be given during week 10. The student researchers will also conduct 2 follow-up phone calls during week 15 and week

20. The re-assessments will include the 30-Second Chair Stand Test, Activities-specific Balance Confidence Scale, Functional Research Test, Timed Up and Go assessment, One-legged Stand assessment, and the Physical Function Short Form 10a Questionnaire portion of the Patient-Reported Outcomes Measurement Information System.

9. I shall return the LiFE Activity Planner and LiFE Activity Counter at the end of each session, after the booster session, and after the follow up session.
10. I understand that all assessment data taken by the student researchers will be documented as part of the study. I also understand these measurements will be shared with the OT student researcher's faculty advisor, Dr. Kitsum Li.
11. I shall be provided with a written summary of the findings and conclusions of this project upon my request. These results will be available by request in December 2016 after the completion of the study.
12. Upon completion of the study, the student researchers will provide me with additional evidence-based Fall Prevention Education. I shall, at any time, have the option to decline the education if I do not see the benefit of the education.

Risks and/or Discomforts:

1. I understand that my participation may involve a risk of a fall and/or injury. To minimize the potential risk of falls, education will be provided by the student researchers to help identify signs and symptoms that are precursors to falls. To ensure my safety, exercise programs given to me will be personalized to reflect my physical capabilities. Before the end of each session, I will also be asked to demonstrate the given balance and strengthening exercises and will be presented with ways to modify the exercises into my daily routine to suit my abilities.
2. I understand that fatigue and soreness are subjective to my condition and me. If I experience discomfort at any point while participating in the modified LiFE program exercises, I shall discontinue the program and consult with the student researchers during my next appointment.
3. I may elect to stop participating in the study at any time. I may refuse to participate before or after the study has started without any adverse effects.

Benefits:

The primary potential benefit in participating in this study is that I may gain increased balance and strength, decreased fall risk, and increased overall functioning with the consistent use of the modified LiFE program. The additional knowledge of evidence-based Fall Prevention education may also contribute to decreasing future fall risk. I shall be given the Fall Prevention Handout and the LiFE participant's manual even if I elect to withdraw early from the study.

Questions:

I have talked to the student researchers about this study and have had all my questions answered. If I have further questions about the study, I may contact the faculty advisor Dr. Kitsum Li, at 415-458-3753.

Consent:

I have been given a copy of this consent form, signed and dated, to keep.

PARTICIPATION IN RESEARCH IS VOLUNTARY. I am free to decline to be in this study or withdraw my participation at any time without fear of adverse consequences.

My signature below indicates that I agree to participate in this study.

PARTICIPANT’S SIGNATURE **DATE**

PARTICIPANT'S NAME (PRINT)

WITNESS SIGNATURE **DATE**

Description of Assessment Tools:

1. The Montreal Cognitive Assessment (MoCA©) will be used to screen cognition.
2. The 30-Second Chair Stand Test (30-s CST) will be used to assess my lower body strength. It involves counting the number of times I can rise to a full stand from a seated position within 30 seconds without pushing off the arm rests.
3. The Activities-specific Balance Confidence Scale (ABC) will be used to assess fear of falling and balance confidence during specific activities of daily living. It involves having me to rate my confidence that I would not lose balance or become unsteady during 16 daily activities.
4. The Functional Reach Test (FR), Timed Up and Go (TUG) manual assessment, and One-Legged Stand (OLS) assessment will be used to assess my functional mobility and balance. The FR involves measuring the difference between the my arm’s length to my maximal forward reach while using a fixed base of support. The TUG manual assessment requires me to stand up from a chair, walk 10 feet at my regular pace safely to a line marked on the floor, cross it, turn around, walk back, and sit back down on the chair while carrying a cup of water. The OLS requires me to choose my most comfortable leg to stand on, flex the opposite knee allowing the foot to clear the floor, and balance on one leg as long as possible for up to a maximum of 30 seconds.
5. The Physical Function Short Form 10a Questionnaire portion of the Patient-Reported Outcomes Measurement Information System (PROMIS®) will be used to assess my physical functioning in relation to my quality of life.

APPENDIX D

LIFE PROGRAM AGREEMENT

DOMINICAN UNIVERSITY of CALIFORNIA

Li, Kitsum <kitsum.li@dominican.edu>

Study?

Lindy Clemson <lindy.clemson@sydney.edu.au> Wed, Oct 21, 2015 at 4:29 PM
To: "Li, Kitsum" <kitsum.li@dominican.edu>

Kitsum
That is fine. I know how hard it is sometimes to recruit.
We have now published both our trainers and participant manuals and you can purchase these in the US from Amazon.com. But for the purposes of your study only you can use the drafts you have. But just for the study. You may wish to purchase a copy of each for yourself to see how we changed them. Not sure which draft manual you have. Also you can download for free our planning and assessment documents from Sydney University Press . If you go on their website browse under my name in authors and you will find them under the Life manuals.
All the best
Lindy

Sent from my iPad

On 21 Oct 2015, at 9:07 PM, Li, Kitsum <kitsum.li@dominican.edu> wrote:

> Dr. Clemson,
> Greeting.
> I am wondering if you have any question regarding my update on the very small scale study completed this year using your LiFE program. Will you allow us making copy of your booklet to repeat the study as a student capstone project for one more time next year?
> Thank you very much for support.
>
> Kitsum Li, OTD, OTR/L, CSRS
> Assistant Professor
>
> On Sep 6, 2015 8:26 PM, "Li, Kitsum" <kitsum.li@dominican.edu> wrote:
>
> Dr. Clemson,
> Greeting.
> Once again, thank you for your generosity allowing my students to photocopy the booklet for their study. I would like to update you regarding my students' study using your LiFE program. We recruited from assisted living facility in the area and we included fallers and non-fallers. Unfortunately, even though we were able to assess and recruit 12 participants initially, the dropout rate was more than 50% and we ended up with only 5 participants completed the program. We have decided to try it running the program one more time since two other assisted living facilities have expressed interest in participating. We will be completing the program by Spring 2016.
> Will you allow us to make photocopy of the LiFE program and continue the study for one more semester (in Feb-May 2016)?
> Thank you again for your attention to this matter.

Kitsum Li, OTD, OTR/L, CSRS
Assistant Professor
Department of Occupational Therapy
Dominican University of California
*Kitsum.li@dominican.edu*mailto:Kitsum.li@dominican.edumailto:Kitsum.li@dominican.edu
415-458-3753

On Sat, Jul 5, 2014 at 1:37 PM, Li, Kitsum <kitsum.li@dominican.edu> wrote:

Dr. Clemson,
Yes, I will limit the copy ONLY for our study here using the LIFE program.
Thank you for your generosity.

Kitsum Li, OTD, OTR/L
Assistant Professor
Department of Occupational Therapy
Dominican University of California
*Kitsum.li@dominican.edu*mailto:Kitsum.li@dominican.edumailto:Kitsum.li@dominican.edu
415-458-3753

On Sat, Jul 5, 2014 at 1:35 PM, Lindy Clemson <lindy.clemson@sydney.edu.au> wrote:

For research yes

Lindy
Sent from my iPhone

On 6 Jul 2014, at 6:29 am, "Li, Kitsum" <kitsum.li@dominican.edu> wrote:

Dr. Clemson,

I just received the LIFE manual and participant's manual.
Thank you.

I have a question regarding the participant's manual, I know it is copyrighted to the authors including yourself. Will you grant us permission to make photocopy of the manual to the participants? The cost to purchase each individual manual with over US$20 per booklet is cost prohibited for our students to carry out the study.

I hope that there is other solution for us to run the program cost-effectively.

Thank you for your kind consideration.

Kitsum Li, OTD, OTR/L

Assistant Professor
Department of Occupational Therapy
Dominican University of California
*Kitsum.li@dominican.edu*mailto:Kitsum.li@dominican.edumailto:Kitsum.li@dominican.edu
415-458-3753

APPENDIX E

MONTREAL COGNITIVE ASSESSMENT 7.3 APPROVAL LETTER

MoCa <info@mocatest.org> Oct 22 (4 days ago)
to Ziad, me

Hello Kelly,

There does indeed seem to have been an issue with you permission form, it did not get through. I apologize for this inconvenient.

Thank you for your interest in the MoCA©.

You are welcome to use the MoCA© Test as you described below with no further permission requirements.

No changes or adaptations to the MoCA© Test and instructions are permitted.

All the best,

MoCA
INSTITUT & CLINIQUE

Kathleen Gallant, MSOT
Occupational Therapist/ Psychometrician
On behalf of Dr Ziad Nasreddine, Neurologist, MoCA© Copyright Owner
MoCA Clinic & Institute
4896 Taschereau Blvd, suite 230
Greenfield Park, Quebec, Canada, J4V 2J2
Tel : (450) 672-7766 #222 Fax : (450) 672-3899
kathleen.gallant@mocaclinic.ca
www.mocatest.org / www.alzheimer.TV

Permission to use the MOCA for graduate research

Kelly Findlay <kelly.findlay@students.dominican.edu> Oct 22 (4 days ago)
to INFO

Dr. Ziad Nasreddine,
I am writing to seek permission to use the Montreal Cognitive Assessment in my graduate research study at Dominican University. I have attempted to submit the form online, but seem unable to get any confirmation that the information is going through. I wanted to follow up with an email. I have included the requested information below.

Thank you for your consideration,
Kelly Findlay

Title: A quasi-experimental study examining the effects of the Lifestyle-integrated Functional Exercise (LiFE) program on fall risk in older adults.

Study Objectives: This study will examine the effects of the LiFE program on fall risk in older adults living in retirement communities. The LiFE program is a fall prevention program that incorporates strength and balance exercises into daily tasks. We are asking permission to use the MOCA as a screening tool to screen out cognitive impairment in our potential participants.

Funding: N/A

Principal Investigator: Kelly Findlay

Institution: Dominican University of California

Country: United States of America

Email: kelly.findlay@students.dominican.edu

APPENDIX F

FALL PREVENTION EDUCATION INFORMATION APPROVAL LETTER

Li, Kitsum Nov 5 (1 day ago)

to me

Kelly,

Yes, you may use the Fall Prevention Handout, with the modification you made as outlined, for education purpose in your research study.

Thank you.

Kitsum Li, OTD, OTR/L, CSRS

Li, Kitsum

lik2@sutterhealth.org

Show details

From: Kelly Findlay [mailto:kelly.findlay@students.dominican.edu]

Sent: Wednesday, November 04, 2015 4:19 PM

To: Li, Kitsum

Subject: Fall Prevention Handout Permission

Dr. Kitsum Li,

We are seeking permission to adapt and use your Mills Peninsula Fall Prevention handout as educational material for participants in our graduate level research study. Specific adaptations include the removal of the Mills Peninsula image and the replacement of the word "activity" with the word "exercise". All other content and formatting will remain the same. We have attached the handout with adaptations for your approval.

Thank you for your consideration,

Kelly Findlay

APPENDIX G

PHYSICAL ACTIVITY FORM

Code: ______________________

Physical Activity Form

What forms of exercise or physical activity do you currently participate in? Please include exercise classes, tai chi, yoga, dance, physical therapy, gym memberships, etc.

1.	5.
2.	6.
3.	7.
4.	8.

APPENDIX H

ALDERSLY AGREEMENT LETTER

Aldersly Garden Retirement Community
326 Mission Avenue
San Rafael, CA 94901
Telephone: (415) 453-3281

November 6, 2015

Dear ,

This letter confirms that you have been provided with a brief description of our capstone research study, which concerns implementing the Lifestyle-integrated Functional Exercise (LiFE) Program, and that you give your consent for us to visit your facility to recruit, screen, and provide intervention to qualifying residents. This study is an important part of our graduate education requirements in the Occupational Therapy masters program, and is being supervised by Dr. Kitsum Li, Assistant Professor of Occupational Therapy at Dominican University of California.

As discussed, our group will make every effort to ensure that the data collection does not interfere with everyday life at Aldersly Garden Retirement Community, and that participants will be treated with utmost discretion and sensitivity. If you have questions about the research you may contact Kelly Findlay at the phone number or email address below. If you have further concerns you may contact our research supervisor, Dr. Kitsum Li, at kitsum.li@dominican.edu or the Institutional Review Board for the Protection of Human Participants at Dominican University of California by calling (415)-482-3547.

After our research study has been completed in May 2017, we will be glad to send you a summary of our research results.

If our request to visit your establishment, to recruit, screen, and provide the LiFE program intervention to your residents meets your approval, please sign and date this letter below. Please feel free to contact us if you have any further questions regarding this study.

Thank you very much for your time and cooperation.

Sincerely,

Kayla Comer, Kelly Findlay, Tiffany Huang, Matthew Tong
50 Acacia Ave, San Rafael, CA 94901
kelly.findlay@students.domican.edumailto:kelly.findlay@students.domican.edu
(916) 293-2357

I agree with the above request

Signature ________________________________
Date______________________________

APPENDIX I

THE REDWOODS AGREEMENT LETTER

Director of Programs and Volunteers
The Redwoods
40 Camino Alto
Mill Valley, CA 94941
Telephone: (415) 383-2741

Dear ,

This letter confirms that you have been provided with a brief description of our capstone research study, which concerns implementing the Lifestyle-integrated Functional Exercise (LiFE) Program, and that you give your consent for us to visit your facility to recruit, screen, and provide intervention to qualifying residents. This study is an important part of our graduate education requirements in the Occupational Therapy masters program, and is being supervised by Dr. Kitsum Li, Assistant Professor of Occupational Therapy at Dominican University of California.

As discussed, our group will make every effort to ensure that the data collection does not interfere with everyday life at The Redwoods, and that participants will be treated with utmost discretion and sensitivity. If you have questions about the research you may contact Kelly Findlay at the phone number or email address below. If you have further concerns you may contact our research supervisor, Dr. Kitsum Li, at kitsum.li@dominican.edu or the Institutional Review Board for the Protection of Human Participants at Dominican University of California by calling (415)-482-3547.

After our research study has been completed in May 2017, we will be glad to send you a summary of our research results.

If our request to visit your establishment, to recruit, screen, and provide the LiFE program intervention to your residents meets your approval, please sign and date this letter below. Please feel free to contact us if you have any further questions regarding this study.

Thank you very much for your time and cooperation.

Sincerely,

Kayla Comer, Kelly Findlay, Tiffany Huang, Matthew Tong
50 Acacia Ave, San Rafael, CA 94901
kelly.findlay@students.domican.edumailto:kelly.findlay@students.domican.edu
(916) 293-2357

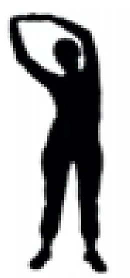
I agree with the above request

Signature ________________________________
Date_____________________________

APPENDIX J

LIFE FLYER

Afraid of falling?...
Want to improve balance and strength?...
Don't have time to exercise?...



Participate in LiFE!

- LiFE is a program to help you **PREVENT FALLS** in a unique way!
- LiFE teaches the core principles of **BALANCE** and **STRENGTH**!
- LiFE can be done during normal daily activities!
- LiFE is **FAST**!
- LiFE is **EASY**!
- Let LiFE help you enjoy **LIFE**!

Join the Lifestyle-integrated Functional Exercise (LiFE) program, brought to you by Dominican University occupational therapy graduate students. Participants must be able to walk independently with or without use of a cane. To learn more about the LiFE program, please contact Dr. Kitsum Li at (415) 458-3753.

APPENDIX K

REDWOOD'S NEWSLETTER

Dominican University occupational therapy graduate students invite you to participate in the modified Lifestyle-integrated Functional Exercise (LiFE) fall prevention program, coming January 2016 to The Redwoods. The modified LiFE program incorporates fall prevention exercises into your daily routine. The modified LiFE program will be customized to meet your individual needs and daily activity. You will receive training on balance and strengthening exercises, an exercise manual, and activity logs to monitor daily participation. You are most suitable for the modified LiFE program if you are walking independently with or without use of a cane. To learn more about the modified LiFE program, please contact Dr. Kitsum Li at (415) 458-3753. We look forward to hearing from you!

APPENDIX L

PARTICIPANTS BILL OF RIGHTS

DOMINICAN UNIVERSITY of CALIFORNIA
RESEARCH PARTICIPANT'S BILL OF RIGHTS

Every person who is asked to be in a research study has the following rights:

1. To be told what the study is trying to find out;

2. To be told what will happen in the study and whether any of the procedures, drugs, or devices are different from what would be used in standard practice;

3. To be told about the important risks, side effects, or discomforts of the things that will happen to her/him;

4. To be told if s/he can expect any benefit from participating and, if so, what the benefits might be;

5. To be told what other choices s/he has and how they may be better or worse than being in the study;

6. To be allowed to ask any questions concerning the study both before agreeing to be involved and during the course of the study;

7. To be told what sort of medical treatment is available if any complications arise;

8. To refuse to participate at all before or after the study is stated without any adverse effects. If such a decision is made, it will not affect his/her rights to receive the care or privileges expected if s/he was not in the study.

9. To receive a copy of the signed and dated consent from;

10. To be free of pressure when considering whether s/he wishes to agree to participate in the study.

11. To receive the same individualized, quality care regardless of her/his status and group assignment

If you have other questions regarding the research study, you can contact the faculty advisor Dr. Kitsum Li, at 415-458-3753. You may also contact the Institutional Review Board for the Protection of Human Subjects (IRBPHS). The Dominican University of California IRBPHS can be reached by telephoning the Office of Academic Affairs at (415) 257-0168 or by writing to the Associate Vice President for Academic Affairs, Dominican University of California, 50 Acacia Avenue, San Rafael, CA. 94901.

APPENDIX M

ACTIVITIES-SPECIFIC BALANCE CONFIDENCE SCALE ASSESSMENT

Patient Name: ____ Date: ____________________

The Activities-specific Balance Confidence (ABC) Scale*

Instructions to Participants: For each of the following activities, please indicate your level of confidence in doing the activity without losing your balance or becoming unsteady from choosing one of the percentage points on the scale from 0% to 100% If you do not currently do the activity in question, try and imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as if you were using these supports.

0% 10 20 30 40 50 60 70 80 90 100%
No Confidence Completely Confident

How confident are you that you will not lose your balance or become unsteady when you…

1. …walk around the house? _____%
2. …walk up or down stairs? _____%
3. …bend over and pick up a slipper from the front of a closet floor? _____%
4. …reach for a small can off a shelf at eye level? _____%
5. …stand on your tip toes and reach for something above your head? _____%
6. …stand on a chair and reach for something? _____%
7. …sweep the floor? _____%
8. …walk outside the house to a car parked in the driveway? _____%
9. …get into or out of a car? _____%
10. …walk across a parking lot to the mall? _____%
11. …walk up or down a ramp? _____%
12. …walk in a crowded mall where people rapidly walk past you? _____%
13. …are bumped into by people as you walk through the mall? _____%
14. …step onto or off of an escalator while you are holding onto a railing? _____%
15. …step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing? _____%
16. …walk outside on icy sidewalks? _____%

*Powell LE & Myers AM. The Activities-specific Balance Confidence (ABC) Scale. Journal of Gerontology Med Sci 1995; 50(1):M28-34.

Total ABC Score: __________

Scoring: ____________ **/ 16 =** __________% of self confidence
Total ABC Score

MEDICARE PATIENTS ONLY
100% - _____% Function = _____% Impairment

Patient Signature: ____ Date: ____________________

Therapist Signature: ____ Date: ____________________

APPENDIX N

PROMIS ASSESSMENT FORM

Physical Function – Short Form 10a

Please respond to each item by marking one box per row.

		Not at all	Very little	Somewhat	Quite a lot	Cannot do
PFA01	Does your health now limit you in doing vigorous activities, such as running, lifting heavy objects, participating in strenuous sports?........................	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFC36	Does your health now limit you in walking more than a mile?..	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFC37	Does your health now limit you in climbing one flight of stairs?..	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFA05	Does your health now limit you in lifting or carrying groceries?...	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFA03	Does your health now limit you in bending, kneeling, or stooping?..	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

		Without any difficulty	With a little difficulty	With some difficulty	With much difficulty	Unable to do
PFA11	Are you able to do chores such as vacuuming or yard work?..	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFA16	Are you able to dress yourself, including tying shoelaces and doing buttons?................................	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFB26	Are you able to shampoo your hair?......................	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFA55	Are you able to wash and dry your body?.............	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
PFC45	Are you able to get on and off the toilet?..............	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

APPENDIX O

ASSESSMENT RESULTS FORM

Assessment Results Form

Code Number: ___________________________________ Date: ___________

Assessment	Pretest Date: _____	Initial	Posttest Date: _____	Initial	Followup Date: _____	Initial
Montreal Cognitive Assessment (MoCA©)						
30-Second Chair Stand Test (30-s CST)						
Activities-specific Balance Confidence Scale (ABC)						
Functional Reach Assessment (FR)						
Timed Up and Go (TUG)						
One-Leg Stand (OLS)						
PROMIS®						

	Pretest	S1	S2	S3	S4	S5	Posttest	Booster	P1	P2	Follow-up
Assistive device											
# Falls											

Assistive device Cane: C None: N

APPENDIX P

DAILY ROUTINE CHART FORM

Code Number:

LiFE Daily Routine Chart

List the activities that you do regularly on a daily and weekly basis

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	Get up	Get up	Get up	Get up	Get up	Get up	Get up
Morning							
	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch
Afternoon							
	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner
Evening							
	Go to bed	Go to bed	Go to bed	Go to bed	Go to bed	Go to bed	Go to bed

APPENDIX Q

LIFE ACTIVITY PLANNER FORM

Life Activity Planner Week Starting / / Check if Done

Balance activity	Example of daily tasks (How, when where?)	M	T	W	Th	F	S	Su
Tandem walk Pg. 26								
Leaning forwards and backwards (Pg. 32)								
Tandem stand Pg. 24								
Leaning side to side Pg. 30								
One legged stance Pg. 28								
Stepping over objects side-to-side (Pg. 36)								
Stepping over forwards & backwards (Pg. 34)								

Strength Activity	Example of daily tasks. (How, when,where?)	M	T	W	Th	F	S	Su
Stand on toes Pg. 66								
Stand on heels Pg. 70								
Move ankles Pg. 78								
Bend/ straighten knees Pg. 80								
Walk on toes Pg. 68								
Walk on heels Pg. 72								
Tighten muscles Pg. 81								
Sit to stand Pg. 62								
Bending knees (Pg. 60)								
Sit to stand low chair (Pg. 64)								
Up the stairs (Pg. 74)								

APPENDIX R

LIFE ACTIVITY COUNTER FORM

Code Number:
LiFE Activity Counter. Week starting: / /

Activity	Day	Count

Have you had any problems while doing any of the activities in this program? Yes/No If yes, please give details.

APPENDIX S

STANDARDIZED TELEPHONE SCRIPT

Participant Code Number: ____________________Call: 1 2
Date:__________

1. **We understand that changing habits and routines can be difficult. What changes have you made to your normal days in order to incorporate the balance and strengthening exercises? What can I do to help you perform the LiFE program consistently?**

2. **Have you had any difficulties with the modified LiFE program? If so, how have you tried to address these problems? What can I do to help you with performing the LiFE program to the best of your ability?**

3. **Your safety is our number one concern. Have you fallen or come close to falling since the booster session? What can I do to help you prevent falls?**

4. **Have you felt the need to make any changes in the assistive devices you use? How did you come to that decision?**

5. **Have you felt the need to upgrade any of the exercises to continue challenging yourself? If so, what did you do? If not, what ways could you upgrade the exercises when you feel ready?**

6. **Do you have any questions for me?**

Remember, the goals of the modified LiFE program are to improve strength and balance through consistent integration of exercises into daily activities. Thank you for taking the time to complete this phone survey, and for your continued participation in the modified LiFE program!