A COMPARATIVE STUDY ON THE EFFECTS OF TAI CHI AND MATTER OF BALANCE ON MEASURES OF BALANCE AND FALL EFFICACY IN OLDER ADULTS

by

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The purpose of this study was to compare the effectiveness of two intervention strategies, Tai Chi (n = 12) and Matter of Balance (n = 13) on balance and fall efficacy of adults 65 years and older as compared to a control group (n = 12). The study compared changes in balance and fall efficacy of the two strategies in an effort to design a more robust fall reduction program for future application. Participants were assessed via pre-test-post-test eight to ten weeks apart by means of two balance tests: the 8-foot Up and Go (UG) test and the Multi-Directional Reach Test (MDRT); as well as a fall efficacy questionnaire: Activities-specific Balance Confidence (ABC) Scale. Results from this study indicate that TC and MOB were both effective in improving or maintaining balance and fall efficacy as compared to the control group. Results show trends leaning toward TC as having a greater impact on participants' overall balance.

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Introduction

Older adults, those 65 years and older, represent the fastest growing age demographic in the United States with an estimated one in five people being classified as an "older adult" by the year 2030 (Census Bureau, 2005, p. 15). One of the many concerns for the older population is the risk of falls. Among individuals age 65 and older, falls are the leading cause of injury death (CDC, 2010). Furthermore, falls in older adults often lead to immobilization, resulting in serious declines in health status and quality of life. Data shows that one in three people age 65 and older suffer a fall each year, and of this, 20–30% becomes less mobile with an increased risk for immobilization, depression, loss of independence, and recurrent falls (Ge, 2002; Nyman & Yardley, 2009).

Older adults are five times more likely to be hospitalized as a result of falls-related injuries than from injuries from other causes (Alexander, Rivara, & Wolf, 1992). In 2005, the average hospitalization cost for a fall injury was $17,500 which has steadily increased each year (Roudsari, Ebel, Corso, Molinari, & Koepsell, 2005). The Centers for Disease Control and Prevention (CDC) (2011) reported that in the year 2000, falls among older adults cost the U.S. health care system over $19 billion dollars and an estimated $28.2 billion in 2010. "With the population aging, both the number of falls and the costs to treat fall injuries are likely to increase" (CDC, 2011, para. 3).

Fall risks can vary and are related to a host of factors including the most common elements: poor balance, poor fall efficacy, lower extremity muscle weakness, slower reaction time, decrease in lean body mass, syncope (e.g., dizziness), impaired cognition and vision, and environmental factors (e.g., poor lighting, cluttered spaces) (DiBrezzo, Shadden, Raybon, & Powers, 2005). In addition, muscular atrophy, linked to the limited use of muscle movement, has

also been identified as one of the leading fall risk factors affecting older adults. Muscular atrophy can affect muscular strength and power, range of motion, endurance, bone density, balance, and gait, all of which can significantly hinder the ability to perform activities of daily living (ADLs) (Brill, Matthews, Mason, Davis, Mustafa, & Macera, 1998).

Once an individual has a fall, he or she is more prone to subsequent falls (Ge, 2002). As a result of falls, succeeding injury, and/or the fear of falling, functional fitness is highly affected and independence is negatively impacted. With the loss of independence, functional abilities begin to decline causing a compounding effect on mental, physical, emotional, and social well-being. These outcomes often negatively impact an individual's quality of life (QoL) and health quality of life (HQoL) (Helbostad, Sletvold, & Moe-Nilssen, 2004).

Following a fall, older adults are apt to develop a new-found fear of falling. The fear of falling can be just as detrimental as the initial fall itself. Although external factors such as postural sway, poor footwear, environmental factors, and poor balance are commonly examined and addressed; exploring the internal factor of fall efficacy, or "the fear of falling", may be equally warranted. Poor fall efficacy can in fact increase the likelihood of a fall taking place as an individual attempts to prevent a fall from occurring through longer stride lengths, slower speeds, and less effective postural sway. Fear avoidance, fragility, and the probability of recurrent falls often lead to the loss of independence, depression, and one's identity as well as leading to the restriction or modification of daily activities as individuals avoid certain activities that he or she once participated in. As a result, the individual loses the ability to perform activities effectively, leading to diminished motor skills such as balance, strength, and range of motion. The fear of falling can also limit social interactions leading to disengagement in life participation, and thus affecting one's socio-emotional health (Ge, 2002).

The fear of falling, most importantly however, affects one's physical activity level and functional fitness. Limited functional fitness can predispose older adults to increased fall risks, fragility, and possible institutionalization (Lambert, Sterbenz, Womack, Zarrinkhameh, & Newton, 2001).

Data indicate that roughly 30 percent of Americans 65 years and older experience a fall at least once a year, with nearly half of them experiencing multiple falls. Thus, the need exists to help the older adult population maintain their quality of life and functional ability in order to live independently longer (Ge, 202). Therefore, a growing demand for fall prevention research and a proactive approach to improve fall efficacy, balance, and functional fitness in an attempt to reduce and prevent falls in older adults, is needed. Consequently, healthcare research must be responsive to the needs of older adults and the common challenges faced by this population, particularly with regard to balance and fall efficacy.

Simple, low cost intervention strategies should be evaluated and implemented to help maintain and even reverse fall risks in older adults. Programs aimed at increasing strength and balance need to focus on four factors: 1) the promise of improving strength with low risk; 2) the ability to be practical (i.e., inexpensive and easy); 3) the provision of overload and progression; and 4) the ability to offer enjoyment and participant satisfaction (Mobily, Mobily, Lane, & Semerjian, 1998). Understanding fall risks and preventative measures is the basis for developing a falls prevention strategy.

Two evidence-based approaches to address falls reduction and falls prevention are the practices of Tai Chi and Matter of Balance, both of which have been accepted as evidence based approaches by the Centers for Disease Control and Prevention (CDC, 2010; 2011). While other activity approaches exist, these two approaches are currently among the most effective

intervention techniques used to reduce and prevent falls, increase fall efficacy and balance, and help to provide older adults with an overall better quality of life and sustained independence (CDC, 2010).

Numerous studies (Fuzhong et al, 2008; Hakim, Kotroba, Courts, Teel & Leninger, 2003; Tsang & Hui-Chan, 2005; Tsang, Wong, Fu, & Hui-Chan, 2004; Wolf, Barnhart, Kutner, McNeely, Coogler, & Xu, 1996) have been conducted to examine the effects of a Tai Chi intervention program on balance in older adults. The results of each study found that Tai Chi reduced falls by increasing balance and fall efficacy and decreasing reaction times. Therefore, the introduction and implementation of a Tai Chi program with older adults can help prevent falls and thus increase one's independence and overall quality of life.

Fall efficacy with the Matter of Balance program has also been studied by a number of researchers (Healy, Peng, Haynes, McMahon, Botler, & Gross, 2008; Org, Smith, Wade, Mounce, Wilson, & Parrish, 2010; Southard, 2006; Tennstedt, Howland, Lachman, Peterson, Kasten, & Jette, 1998). Overall data from these studies suggest that the Matter of Balance program is an effective strategy to help older adults increase fall efficacy, manage fall risks, and ultimately reduce falls. Like Tai Chi, Matter of Balance is considered an evidence based intervention technique to reduce falls and the fear of falling with older adults (Partnership for Healthy Aging, 2010).

In general, the purpose of this study was to compare the effectiveness of two known intervention strategies, which have not been compared previously, Tai Chi and Matter of Balance, on balance and fall efficacy of adults 65 years and older as compared to a control group.

Study Design and Methods

The design for this study used a quasi-experimental approach by means of a pre-post-test strategy. A non-probability convenience sampling technique was used for recruiting participants in the Tai Chi (TC), Matter of Balance (MOB), and control (C) groups.

The procedures used in this research were approved by the Institutional Review Board (IRB) of East Carolina University in North Carolina. Prior to the study, each participant was asked to: 1) read and sign the IRB approved consent form, 2) complete the demographics questionnaire, 3) participate in the Multi-Directional Reach Test (MDRT) in three directions (i.e., forward reach, right reach, left reach), 4) participate in the Up and Go Test (UG), and 5) complete the Activities-specific Balance Confidence (ABC) Scale questionnaire.

Sample and Participant Selection

Participants for this study were volunteers obtained via a convenience sampling technique of those aged 65 years or older residing in community-based residential facilities for older adults. Individual advertisements were posted at each facility for free balance screenings. Voluntary participation in either the TC or MOB programs were also offered but not a requirement for the balance screening. All participants were capable of making independent decisions regarding participation.

A total of 51 individuals participated in the initial screening; however, only thirty-seven individuals were included in the final analysis (i.e., n = 12 TC, n = 13 MOB, n = 12 C). Reasons for exclusion in the study included: dropouts or poor attendance within intervention groups, or "no show" to the post-program balance screenings.

Before any data collection, all participants received a full explanation of the study (e.g., purpose, risks, expectations) and were asked to sign informed consent agreements. All

participants completed a pre-balance and fall efficacy assessment including the 8-Foot Up and Go, the Multi-Directional Reach Test, the Activities-specific Balance Confidence Scale, and a self-reported demographics questionnaire. Individuals engaged voluntarily in their selected group (TC, MOB, or C group). A post-balance assessment was completed eight to ten weeks following the initial balance and fall efficacy assessment.

The TC intervention was held at two community-based residential facilities for older adults. Participants in the TC intervention programs engaged in an eight and a ten week Tai Chi training at their residential facility (30 minutes to 45 minutes per session, for a total of 16 sessions depending on facility arrangements) followed by a post assessment. Participants in the MOB intervention groups, held at two community-based residential facilities, engaged in an eight week training with one two hour session per week at their residential community. The MOB training was followed by a post assessment of balance and fall efficacy.

The control group did not participate in either of the intervention programs. The control group did, however, complete initial balance screenings and a follow-up screening eight to ten weeks apart. These individuals self-selected into the control group by indicating that they did not desire to be in the MOB or TC intervention group.

Procedures

Participants responded to the advertisements (i.e., flyers and newsletters) in their residential communities offering free balance screening. Upon completing the free balance screening individuals were asked if they would be interested in participating in the study. Participating in the study included individuals registering and engaging in either the TC or MOB intervention programs, depending upon the intervention being offered at his or her residential community, or enrolling in the control group. Those who wished to participate in the study were

asked to complete the IRB approved consent forms and to participate in the pre-intervention balance screening approximately one week prior to the start of the intervention. Participants were requested to participate as a control group member or to actively engage in their selected intervention program for a period of eight to ten weeks. If an individual did not participate in six or more TC sessions or three or more MOB sessions his or her assessments were not included in the study. Participants were also asked to schedule a mutually agreed upon time and date eight to ten weeks later for post data collection. Data collection for this study was fully voluntary and participants could drop out of the study at any time without reason or penalty.

Training Intervention

Participants were enrolled in one of three groups including TC, MOB, or C. The TC group participated in training two days a week for eight to ten weeks depending upon residential community while the MOB group engaged in training once a week for eight weeks; and the control participated in neither intervention.

Tai Chi: While there are many forms of Tai Chi that emphasize evidence based improvements in balance, coordination, strength, and concentration (Greenspan, Wolf, Kelley, & O'Grady, 2007; Hakim, Kotroba, Cours, Teel, & Leininger, 2010; Hakim, Newton, Segal & DuCette, 2003; Mihay, Boggs, Breck, Dokken, & NaThalang, 2006; Mihay, Iltzsche, Tribby, Rushing, Spears, Wiltfong, & ... Chronister, 2003;Wolf, Barnhart, Ellison, & Coogler, 1997) the Centers for Disease Control and Prevention has adopted the Sun style of Tai Chi (CDC, 2011). Sun style Tai Chi is different from other forms of Tai Chi in that it encourages smaller steps with higher narrower stances to minimize balance problems found in traditional Tai Chi forms. The Sun style Tai Chi is also designed to be modified or adapted for application to a seated position if needed (Lam, Kircher, & Miller, 2010).

The Sun style Tai Chi intervention in this study consisted of an eight or ten-week series of sessions, two times per week for approximately 45 minutes per session. Six basic movements were taught in a step-by-step progressive manner in both directions, followed by six advanced movements that were taught in the same fashion. Due to facility scheduling the protocol for one group was modified to a ten week sequence. Both groups, however, completed sixteen sessions.

The theory used for this intervention technique is the motor learning theory. Motor learning is used to describe the acquisition of new unknown skills as well as relearning and improving past motor skills (Jarvilehto, 2006). Motor learning theory is used for this study's purpose due to the transferability in which motor learning focuses on understanding how individuals acquire and perform motor skills, and serves as the basis for earned practice which produces better long-term retention and enhances motor skill acquisition (Jarvilehto, 2006). The instructional strategy of the Sun Style Tai Chi approach is to teach movements in a progressive manner. Movements are then integrated to include all 12 movements. The acquisition of movements is transferable into improved motor performance and balance across all life activities.

Matter of Balance: Matter of Balance has been tested and shown to be a reliable and valid intervention program to improve fall efficacy and overall balance (Carmona, 2005; Healy et al., 2008; Lambert et al., 2001; Ness, Gurney, & Ice, 2003; Org et al., 2010; Southard, 2006; Tennstedt et al., 2007). A MOB program includes eight two-hour classes that meet weekly or biweekly. Participants "learn to view falls and fear of falling as controllable; to set realistic goals for increasing activity; to change their environment to reduce fall risk factors; and to promote exercise to increase strength and balance" (Matter of Balance, 2011, para. 1).

For the purposes of this study, the designated MOB intervention was employed on a one

day per week schedule of two hours per session for duration of eight weeks. The protocol included practical coping strategies in a group setting with the use of videotapes, lectures, group discussions, role-playing, exercise training, assertiveness training, and home assignments (Fall Intervention, 2010, p. 2). Classes taught participants how to set realistic goals to increase activity and to change and modify personal environments to reduce fall risks and the fear of falling cycle. The Matter of Balance intervention also taught participants how to manage a fall should one occur. Furthermore the program educated participants on the need to exercise and increase activity levels in order to increase balance, flexibility and strength (Partnership for Healthy Aging, 2010, p. 4).

The Matter of Balance intervention program is founded in cognitive behavior theory (CBT) that includes self-instructional techniques to promote simplification of skills learned during program sessions (Peterson, 2002). Cognitive behavior theory is used with clients to correct negative thinking by recognizing how attitudes and beliefs affect behavior. CBT also helps to describe how cognition is a crucial part in a person's behavioral pattern and is highly relevant for programs serving older people.

Study Measurement

Data collection consisted of a basic demographic questionnaire of the participants (i.e., age, gender, ethnicity, exercise habits, and falls concern), two balance tests (i.e., 8-Foot Up and Go and Multi-Directional Reach Test), and a fall efficacy questionnaire (i.e., Activities-specific Balance Confidence Scale). Measures were completed eight to ten weeks apart. Each test has demonstrated to be effective and reliable measurements of balance and fall efficacy for older adults (Newton, 2001; Powell & Myers, 1995; Rose, Jones, & Lucchese, 2002). Total collection time for pre-and-post-data collection lasted for approximately five minutes per participant;

assistance was provided as needed (e.g., reading questions out loud and/or collecting data verbally) for participants that needed aid in reading or writing during the assessment.

Demographics: Demographic data were obtained from a questionnaire on which individuals reported age, gender, race, current exercise habits, and falls concerns. Demographic data were used for descriptive and impact measures for intervention and control groups.

Activities-specific Balance Confidence Scale (ABC Scale): To determine fall efficacy of the participants, the ABC Scale was used. The ABC Scale has been shown to be a valid and reliable measure of fall efficacy (Powell & Myers, 1995). Respondents were asked to rate their balance confidence (fall efficacy), based on a percentage of confidence scale that addresses concerns on when an individual feels he or she will lose their balance or become unsteady in the course of performing daily activities. Scores were evaluated by taking an average of individual's total responses.

***8-Foot Up and Go Test (UG)*:** The UG test is a balance screening that has been used in numerous studies and has been found to be a valid and reliable balance assessment instrument (Jones, Lucchese, & Rose, 2002; Podsiadlo & Richardson, 1991; Rikli & Jones, 1999). Participant balance was assessed at pre-and-post-intervention by using the UG test. The UG test required the researcher to time participants from the moment the observer said "Go" and the participant rose from a seated position, walked eight feet, turned around, returned to their seat, and sat back down. Participants were instructed to walk at a fast, yet safe pace while also allowing participants to use their everyday mobility device if the individual possessed one. Participant scores were determined using the fastest of three timed trials.

Multi-Directional Reach Test (MDRT): The MDRT was also used to assess participant balance. According to Newton (2001), the MDRT is a valid and reliable measure of balance and

stability with an altered center of gravity. During the MDRT, participants were instructed to raise an arm in front of them, parallel to the floor, and parallel to a fixed yardstick against the wall. Participants were instructed to reach as far as they could in three directions (i.e., in front of them, to their left side, and to their right side) while the researcher measured the end of each reach on the yardstick at the index finger location. If the participant touched the wall, relied on an object for balance, or moved either or both feet, no score was given for that trial. Scores were based on an average of three reach lengths in each direction.

Statistical Analysis

The research followed each of the participants over the course of eight to ten weeks while engaged in a TC intervention program, MOB intervention program, or no program (i.e., control group). The outcomes for the groups were then compared to one another to determine the effects of TC, MOB, or no intervention on balance and fall efficacy among the older adult participants.

Descriptive statistics, frequencies, post-hoc tests, and an Analysis of Variance (ANOVA) were used to identify change scores from pre-to-post-fall interventions among individuals and to compare differences in the outcomes between intervention strategies. The Statistical Package for the Social Sciences (SPSS ®) for Windows ® (Version 19) was used to analyze the results.

Results

Demographics: Of the thirty-seven participants in the study (n = 12 TC; n = 13 MOB; n = 12 C) the average age was 80.43 years (TC M = 82.75; MOB M = 75.92; C M = 83.00), with a range from 65 years to 91 years. There were a total of thirty-two females and five males. The self-reported ethnicity of the participants included thirty White/Caucasians, seven Black/African-Americans, and one Asian. There were no evident differences between groups in terms of demographics (See Table 1).

[Insert Table 1]

Activity-specific Balance Confidence Scale (ABC): An Analysis of Variance (ANOVA) was used to compare pre-and-post-change between and among groups. Results of the average ABC change scores (i.e., from pre to post data collection) indicated the largest change among TC participants (M = 1.82) followed by those who participated in MOB (M = 0.24); those in the control group had the lowest average change from pre to post (M = 0.16). While there existed a trend for greater gains by the TC group, the reported change was not significant at the $p < 0.05$ level (See Table 2).

[Insert Table 2]

8-Foot Up and Go (UG): While not statistically significant, the TC group performed better than the other two groups in pre-test – post-test change on the 8-Foot Up and Go Test. Average change scores in the UG test show that those in the TC group reduced their test times by -1.63 seconds. The MOB group reduced their UG times by -.24 seconds while the control participants reduced their time score by -.83 seconds (See Table 3).

[Insert Table 3]

Multi-Directional Reach Test (MDRT): The MDRT was subdivided into three measures (e.g., forward reach, right reach, and left reach), each measure was assessed by recording the average change score from pre-to-post-testing. Those in the TC group had the farthest average reach change from pre to post assessment in the forward direction (M = 2.02), as well as the left direction (M = 2.44), followed by those in the MOB, who had an average forward reach of M = 1.78 and left reach of M = 1.88.

Average change score in right reach indicated that those in the MOB group had a greater improvement in right reach (M = 1.77) than those in the TC group (M = 1.07). The control

group had the least change in right reach, as well as each of the other reach measures.

The ANOVA for each of the measures demonstrated statistically significant differences between measures of forward reach F = 4.486 (p = 0.018) and right reach F = 6.377 (p = 0.004) (See Table 4). In order to determine the source of the difference, a post-hoc (Tukey HSD) test was performed. The results indicated statistical significance (P < 0.05) between both those in the TC group (p = 0.025) and MOB group (p = 0.049) as compared to those in the C group in the forward direction. In the right reach direction, the TC group and the MOB group were statistically different than the C group with a p = 0.029 and p = 0.005 respectively (See Table 5).

[Insert Table 4]

[Insert Table 5]

Discussion

The results demonstrate some level of effectiveness of each intervention as it relates to select measures of balance and fall efficacy. Given the results, balance and fall efficacy improved for subjects in each intervention group (i.e., Tai Chi and Matter of Balance) in all areas assessed (i.e., ABC Scale, UG, and MDRT) compared to the control group. Although there were no significant differences between the two intervention groups, the Tai Chi group appeared to outperform the Matter of Balance group somewhat on all post intervention measures except the right reach direction of the MDRT. There was a significant difference in the forward and right reach directions from pre-to-post-assessment of the TC and the MOB groups as compared to the control group.

The results suggest that participation in either the TC or the MOB intervention improves balance measures as compared to no participation. By participating in Tai Chi or Matter of Balance, older adults can enhance or maintain functional balance. Improved functional balance

has been demonstrated to reduce fall risks and enable individuals to live independently longer and experience an improved quality of life (Greenspan et al., 2007; Mihay et al., 2003; Tsang et al, 2004).

During both intervention practices, instructor observations witnessed an increase in participant mobility, socialization, and endurance levels. Participants were observed entering the initial sessions with mobility devices and by the completion of the programs were relying on no assistive devices. Participants in both interventions were also observed engaging in communication and socialization with one another before and after sessions as the interventions progressed. Those in the Tai Chi group were also observed to have had an increase in endurance level from initial sessions to intervention completion.

These observations were noticed in part by the duration in which participants were able to stand and complete Tai Chi classes from initial session to program completion. Initially some individuals may have participated in a seated position; however, upon program completion all individuals were observed to be participating in a standing position for the duration of the session. In general, results and observations from both intervention groups support practical application as it relates to activities of daily living (ADLs) and overall functional health. Based on these anecdotal observations, further research on muscular strength and endurance as well as the social and emotional benefits of different interventions may prove valuable.

This study adds to the literature as it relates to the benefits of falls intervention strategies for older adults. These results are consistent with the literature and imply that participants who engage in balance and falls prevention activities may be at a lower fall risk in general (Hakim et al., 2010; Hakim et al., 2003; Mihay et al., 2006; Org et al., 2010; Tennstedt et al., 1998; Wolf et al., 1997).

Conclusions drawn from past literature, as well as results from this study, may be useful for creating a new falls prevention program aimed at incorporating both Tai Chi and Matter of Balance into one. Data support both Tai Chi and MOB as effective interventions in the reduction and maintenance of falls in older adults. Further research may include focusing on a new integrative practice of both interventions as a more compelling approach to this substantial concern.

While efforts were instituted to control limitations in this study, some factors could not be controlled. Due to the nature of research in a natural environment, several limitations were evident. For instance, the study could not control day-to day events (e.g., individual activity levels outside of intervention, individual motivation levels, exercise compliance, medication use, and health status on data collection days) that impact an individual's participation in the selected intervention and, perhaps, outcome measures in balance and fall efficacy. The small sample size can also be identified as a limitation of this study; thereby reducing the power to detect significant changes within and between groups.

Another limitation of the study relates to the use of a convenience sample. Outcomes of the study can only be generalized to the individual participants and may not apply to other populations. Efforts were made, however, to choose similar cohorts of community dwelling older adults in both intervention strategies.

Future research to evaluate the effectiveness of specific falls prevention strategies is warranted. Additional studies comparing the efficacy of various intervention strategies including strength and conditioning to Tai Chi or Matter of Balance will add to the body of knowledge.

Other research may need to focus on balance improvements as it relates to other variables including gender, race, and past physical activity participation. The small sample size in this

study made it difficult to assess differences between male and female performance although previous research indicates that gender is related to fall risks. According to the Centers for Disease Control and Prevention (2010) men are more likely to die from a fall than are women. "The fall death rate in 2007 was 46% higher for men than for women, while women are more likely than men to be injured in a fall. In 2009, women were 58% more likely than men to suffer a nonfatal fall injury" (CDC, 2010, para 2.).

Ethnicity may also impact balance performance and the potential for falls. As stated by the CDC "older Whites are 2.5 times more likely to die from falls as their Black counterparts" (CDC 2010, para. 4). Death rates also differ by ethnicity; non-Hispanics have higher fatal fall rates than do Hispanics (Stevens & Dellinger, 2002).

Past physical participation and weight may be a contributing factor to falls and fall efficacy. Those who are overweight may have a harder time with balance compared to their healthier counterparts. A study by Himes and Reynolds (2012) found that older adults who are obese are anywhere from 12 to 50 percent more likely to suffer a fall than people at a normal weight. Furthermore, individuals with a BMI of 40 or higher had a 50 percent greater likelihood of sustaining a fall with a report of longer-term disabilities after the fall (Himes & Reynolds, 2012). The results of this study may imply the need to integrate nutrition and diet content into falls prevention strategies.

In addition, older adults who had an active lifestyle when younger tend to stay active throughout their adulthood. Physical activity and an active lifestyle can be contributing factors in fall reduction by impacting weight, lower leg strength, and fall efficacy (Kossuth & Bengtson, 1988). An increased effort to include physical activity options for adults and older adults in community recreation centers and senior aging is warranted.

The impacts of enjoyment as an aspect of physical activity programming may also need to be explored. Enjoyment can positively influence activity engagement and continued participation. Longer participation patterns lead to better long term effects. As with many interventions "practice makes perfect" and if the individual enjoys a program he or she is more likely to continue participation (Hampton & Russell, 2005; Wankel, 1993; Young, 2005). For falls prevention programs, the more the individuals immerse themselves in the activity the higher the prospect of lowering functional decline and preventing falls. This premise was supported in a study by Hatch and Lusardi (2010) where exercise participation was assessed. The results indicated that "regular exercisers demonstrated better preservation of functional status and a lower rate of falling than non-regular exercisers" (para. 30).

Both the TC and MOB interventions in this study complied with established protocols. The short duration of each intervention, however, may not offer sufficient time to produce significant and long lasting changes in balance and fall efficacy between the groups. For this study, a continuation of the interventions may have produced additional results allowing for the comparison of the two intervention strategies.

Overall, regardless of the intervention, more proactive and yet inexpensive approaches to falls prevention need to be examined and implemented. A reduction in falls for older adults lowers healthcare costs and allows for a higher quality of life (K. Mobily et al., 1998).

Conclusion

Although the sample size for this study was small, a comparison of the two evidence-based falls interventions demonstrated that there is support that participating in some sort of falls intervention is better than no participation at all. In this study, Tai Chi and Matter of Balance had greater results than no participation.

Results from this study indicate that Tai Chi and Matter of Balance were both effective in improving or maintaining balance and fall efficacy, with a trend in evidence that Tai Chi had a greater impact on participants' overall balance. It is recommended that further research with a larger sample size be done to statistically determine if one fall intervention is in fact better than the other.

In addition, the testing of specific protocols and length of intervention strategies warrant investigation. The results from this study offer an indication of trends toward improvement where balance and fall efficacy may or may not become more pronounced over a longer time frame of participation.

The frequency of participation (e.g., number of bouts per week) may also impact the outcomes of the interventions. The TC group participated in the intervention two times per week whereas the MOB group participated once a week. It is uncertain if the frequency of participation per week has a greater impact on the results of the intervention on falls measures.

Future research should focus on identifying the effects of participant characteristics including, but not limited to, program enjoyment, gender, socioeconomic status, health status, and race/ethnicity, physical history, program adherence, retention, and outcomes. Identifying specific variables that impact outcomes add to the overall body of knowledge and the ability to prescribe tailored strategies for falls prevention.

In summary, additional inexpensive, evidence based interventions to reduce falls among older adults need to be assessed and put into practice. Although tentative, this study demonstrates that Tai Chi and/or Matter of Balance may be potential solutions in the fight to reduce falls among older adults.

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APPENDIX A

Extended Literature Review

To better understand the research and evidence behind the measures and constructs of this study additional literature was examined. This extended review is presented in four sections. The first section addresses the issues surrounding falls and falls prevention for older adults. The second section presents the theoretical constructs for the study. The theoretical constructs section is followed by a review of the intervention strategies used in the study and the research supporting the strategies. Finally, the measures used in the study are discussed. In addition, the expanded data analysis is included.

BACKGROUND

Older adults, those 65 years and older, represent the fastest growing age demographic in the United States with an estimated one in five people being classified as an "older adult" by the year 2030 (Census Bureau, 2005, p. 15). One of the many concerns for the older population is the risk of falls. "Among individuals age 65 and older, falls are the leading cause of injury death" (CDC, 2010, para. 2). Furthermore, falls in older adults often lead to immobilization resulting in serious declines in health status and quality of life. Data show that one in three people age 65 and older suffer a fall each year, and of this, 20–30% become less mobile with an increased risk for immobilization, depression, loss of independence, and recurrent falls (Ge, 2002; Nyman & Yardley, 2009).

Older adults are five times more likely to be hospitalized as a result of falls-related injuries than from injuries from other causes (Alexander et al., 1992). In 2005, the average hospitalization cost for a fall injury was $17,500 which has steadily increased each year

(Roudsari et al., 2005). The Centers for Disease Control and Prevention (2011) reported that in the year 2000, falls among older adults cost the U.S. health care system over $19 billion dollars and an estimated $28.2 billion in 2010. "With the population aging, both the number of falls and the costs to treat fall injuries are likely to increase" (CDC, 2011, para. 3).

Fall risks can vary and are related to a host of factors including the most common elements: poor balance, poor fall efficacy, lower extremity muscle weakness, slower reaction time, decrease in lean body mass, syncope (e.g., dizziness), impaired cognition and vision, and environmental factors (e.g., poor lighting, cluttered spaces) (DiBrezzo et al., 2005). In addition, muscle atrophy has been identified as one of the leading fall risk factors affecting older adults. Muscular atrophy affects muscular strength and power, range of motion, endurance, bone density, balance, and gait, all of which can significantly hinder the ability to perform activities of daily living (ADLs) (Brill et al., 1998).

Once an individual has a fall, he or she is more prone to subsequent falls (Ge, 2002). As a result of falls, subsequent injury, and/or the fear of falling, functional fitness is highly affected and independence is negatively impacted. With the loss of independence, functional abilities begin to decline, causing a compounding effect on mental, physical, emotional, and social well-being. These outcomes often negatively impact an individual's quality of life (QoL) and health quality of life (HQoL) (Helbostad et al., 2004).

Following a fall, older adults are apt to develop a new-found fear of falling. The fear of falling can be just as detrimental as the initial fall itself. Although external factors such as postural sway, poor footwear, environmental factors, and poor balance are commonly examined and addressed; exploring the internal factor of fall efficacy, or "the fear of falling", may be equally warranted. Poor fall efficacy can in fact increase the likelihood of a fall taking place as

an individual attempts to prevent a fall from occurring through longer stride lengths, slower speeds and less effective postural sway. Fear avoidance, due to poor fall efficacy, can also lead to a restriction in everyday activities which pressures individuals to avoid certain behaviors that he or she once enjoyed. Due to this escalating process, the individual loses their ability to perform activities effectively as once before, leading to diminished motor skills (i.e., balance, strength, and range of motion, etc.) disengagement in life participation, and ultimately the loss of independence and poor socio-emotional health (Ge, 2002).

The fear of falling, most importantly however, affects one's physical activity level and functional fitness. Limited functional fitness can predispose older adults to increased fall risks, fragility, and possible institutionalization (Lambert et al.2001).

Data indicate that roughly 30 percent of Americans 65 years and older experience a fall at least once a year, with nearly half of them experiencing multiple falls. Thus, the need exists to help the older adult population maintain their quality of life and functional ability in order to live independently longer (Ge, 2002). Therefore, there is a growing demand for fall prevention research and a proactive approach to improve fall efficacy, balance, and functional fitness in an attempt to reduce and prevent falls in older adults. Consequently, healthcare research must be responsive to the needs of older adults and the common challenges faced by this population, particularly with regard to balance and fall efficacy.

Simple, low cost intervention strategies should be evaluated and implemented to help maintain and even reverse fall risks in older adults. Programs aimed at increasing strength and balance need to focus on four factors: 1) the promise of improving strength with low risk; 2) the ability to be practical (i.e., inexpensive and easy); 3) the provision of overload and progression; and 4) the offer of enjoyment and participant satisfaction (K. Mobily et al., 1998).

Understanding fall risks and preventative measures is the basis for developing and testing a falls prevention strategy.

The strategies for falls prevention, however, must begin with an understanding of the theoretical constructs that support the individual strategies. For this study, two distinct theories were integrated into the research, representing each strategy.

THEORETICAL CONSTRUCTS

This study is grounded in two distinct theoretical constructs. The Tai Chi intervention embraces a Motor Learning theoretical basis while the construct of Cognitive Behavior Theory is embedded in the Matter of Balance intervention. Both theories are supported in the literature for each intervention strategy (Boston & Merrick, 2010; Clemons et al., 2004; Tunney et al., 2006; Voelcker-Rehage, Wiertz, & Willimczik 2003).

Motor Learning Theory

Motor learning is defined as a relatively permanent change, resulting from practice or a novel experience, and the capability for responding (Guthrie, 1952). Motor learning focuses on understanding how individuals acquire and perform motor skills, and serves as the basis for learned practice which produces better long-term retention and enhances motor skill acquisition (Jarvilehto, 2006). Motor learning theory assumes that short-term, or the working memory, is needed for learning new movements and that long term, the save/retrieve portion of the brain, is needed for lasting change. Both are needed for motor learning to occur naturally during task performance (Cole, 2008).

Research in motor skill learning has shown that the structure of practice impacts how well people retain what they learn; therefore, for the purposes of this study, the motor learning theoretical framework will be used to describe how one performs motor tasks when learning and

participating in Tai Chi. Traditional Tai Chi teaches through a blocked practice technique (i.e., a single performance at a time) which has been shown to lead to improvements in current performance. Bjork and Simon (2001) conducted research that shows how enhanced skill retention is learned best through random practice patterns that are entwined with block practice techniques; this is because the complexity of the whole body motor skills must be sufficiently developed and acquired first before motor skills can be retained.

Along with random practice learning techniques a second factor, knowledge of results (KR), is identified as an effective learning technique in the motor learning theory. Optimal KR is considered the single most important factor in learning, with the exception of practice itself. Motor learning and retention have been shown to be enhanced as subjects re-enact a given movement pattern on their own (Schmidt, 1982; Schmidt & Wrisberg, 2004). These techniques can easily be seen during a Tai Chi class, specifically during the Sun style of Tai Chi. During Sun style Tai Chi, participants are asked to "watch", "follow", and "show" each movement as it is demonstrated by the instructor. Participants are taught the movements through a blocked practice which is then interwoven with random practice patterns that incorporate the moves already learned. Participants are also asked to show the instructor what they had learned and then the instructor corrects the movement if needed (i.e., knowledge of results).

Consequently, the application of motor learning theory enhances how participants in the Tai Chi intervention program learn, retain, and apply motor skills in the effort to improve balance and fall efficacy, ultimately integrating the motor skills into daily activities.

Motor Learning Theory Research: Although motor skills decline with age, learning capabilities remain intact; therefore, motor learning will be used as the theoretical framework for Tai Chi in this study. Motor learning is used to describe the acquisition of new unknown skills

as well as relearning and improving past motor skills.

Research suggests that regardless of performance decrease, specifically due to age, considerable learning improvements are possible, and recurrent, in older age. For instance, a study by Voelcker-Rehage, Wiertz, and Willimczik (2003) investigated motor learning by examining three groups of older adults (50-59, 60-69, <70) using a juggling activity.

Authors	Voelcker-Rehage, C. C., Wiertz, O. O., & Willimczik, K. K. (2003).
Title	*Motor plasticity in a juggling task in older adults- A developmental study*
Objective	To examine the plasticity of motor performance in old age.
Methods	This study consisted of older adults, children, youths and younger adults, all with no juggling experience (N = 1,206, range 6–89 years). Older adults were instructed and trained in a juggling task while their performances were compared, first, within the group of older adults and, second, with the group of children, youths, and younger adults. Performance was tested before instruction (pre-test 1), after instruction (pre-test 2) and six days after juggling practice (post-test).
Results	Results showed that older adults had clear improvement in juggling performance after instruction and after six days of juggling practice. On average, they [older adults] reached performances comparable with those of children between ages of 10 and 14 years, and with those of younger adults between the ages of 30 and 59 years. Results illustrated that only youths and younger adults between the ages of 15 and 29 years showed significantly higher performances at baseline, after instruction and after practicing. Significant difference between the time of assessment [F (1.83, 343.17) = 1,440.33, $p < 0.01$, $\eta^2 = 0.89$] but no significant effect of age [F (3, 188) = 0.19, $p = 0.91$] and gender [F (1, 188) = 2.50, $p = 0.12$] and no significant time × age interaction [F (5.48, 343.17) = 1.20, $p = 0.31$]. Overall, younger old adults did not perform on a significantly higher level as compared with older old adults.
Conclusion	The authors concluded that older adults exhibit high reserve capacity, that is, a potential for learning new' motor skills.

Tunney et al., (2006) also suggested in their study that for older adults, mental practice facilitates retention of newly learned functional motor tasks.

Authors	Tunney, N., Billings, K., Blakely, B. G., Burch, D., Hill, M., & Jackson, K. (2006).
Title	*Mental practice and motor learning of a functional motor task in older adults: A pilot study*
Objective	To examine the influence of mental practice on retention of a newly learned functional motor task in older adults.
Methods	In this study nineteen non-demented community-dwelling older adults were randomly assigned to an experimental or control group and then each received a

	session of individual instruction in a novel motor task. Participants were scored on their performance of the motor task on the final practice trial of the training session, and again 48-72 hours later. The experimental group mentally rehearsed the procedure four times in the 48 hour interval between training and testing while control subjects did not.
Results	Subjects in the experimental group scored significantly higher on the test day than the control subjects ($p < 1.0$). Difference scores, from training to testing dates, were significantly different between groups ($p) < 0.50$).
Conclusion	Authors suggest that for older adults, mental practice facilitates retention of a newly learned functional motor task.

Mynark (1999) determined from his study that older adults can be re-trained in balance by use of the motor learning theory framework.

Authors	Mynark, R. G. (1999).
Title	*The effects of balance training on the segmental reflex system of elderly subjects*
Objective	To determine the effects of balance training on the segmental reflex system of elderly subjects
Methods	This study consisted of ten young and ten elderly subjects that underwent balance training in an effort to down-train the soleus H-reflex, while five young and five elderly subjects participated as control subjects. During the three day study participants were evaluated on their H-max/M-max ratios, personal conditioning, static balance**,** and recovery from perturbation profiles. Following testing, the experimental subjects underwent two days of balance training to down-train the H-reflex while the control subjects received an equal number of soleus H-reflexes while standing (e.g., only on a firm support surface).
Results	Results from the study demonstrated that healthy elderly subjects were equally capable of down-training the soleus H-reflex in response to a balance paradigm when compared to the young subjects. After the first day of balance training, the elderly subjects achieved nearly the same magnitude of down-training (18.7 percent) as that of the young subjects (20.4 percent). “Additionally, on the second day of training, both groups demonstrated the ability of quickly re-establishing a significant depression of the soleus H-reflex. Also, changes observed in H-reflex amplitude and the down-training of the soleus H-reflex seemed to have a functional impact on the static balance of elderly subjects” (abstract, para 1). Furthermore, elderly subjects in the study demonstrated a significant decrease in the area of static sway from pre-test to post-test (10.1 percent).
Conclusion	Authors report that balance can be re-trained and rehabilitated through the use of motor learning in subjects with decreased reflex function.

Motor learning was also researched by Tunney et al., (2003).

Authors	Tunney, N., Taylor, L. F., Gaddy, M,, Rosenfeld, A., Pearce, N., Tamanini, J., & Treby, A. (2003).
Title	*Aging and motor learning of a functional motor task.*
Objective	To compare the ability of older and younger adults to learn a functional motor task following a single session of directed practice.
Methods	Thirty younger community-dwelling adults (aged 20–35), and thirty older community-dwelling adults (aged 61–93), all with no prior experience using a walker participated in this study. Participants each received instructions for use of a walker for getting into the passenger side of a car. A single practice session lasted upwards of twenty minutes (or five practice trials) and was given to each participant. Performance of the motor task (i.e., using the walker to get into the passenger side of a car) was scored during the final trial of the training session and again 48 hours later.
Results	Younger adults scored significantly higher than the older adults on the final trial of the training session ($p < .001$), and on the test trial (i.e., 48 hours after instruction) ($p < .001$). There was a decline in performance of the motor task over 48 hours for the older adults ($p < .002$).
Conclusion	Authors suggest that older adults do not acquire and maintain functional motor skills as accurately as younger adults; however, motor learning in older adults may be enhanced by extended/additional instruction and through practice.

Cognitive Behavior Theory and Falls Prevention

The cognitive behavior theory (CBT) evolved via the emergence of behavior theory and cognitive theory as a way to explain human behavior. As an approach, the cognitive behavior theory (CBT) aims to focus on how people think, what an individual perceives from vision and hearing, how much he or she retains and remembers, and how he/she reacts to a stimuli (Karthik, 2010).

The Matter of Balance intervention program is founded in cognitive behavior theory. Programs, such as a Matter of Balance, include self-instructional techniques to promote simplification of skills learned during program sessions added with an element of homework, which serves to reinforce what was learned and applied in the intervention program (Peterson, 2002).

Cognitive behavior theory is used with clients to correct habitually negative thinking by recognizing that attitudes and beliefs affect behavior. CBT also helps to describe how cognition is a crucial part in a person's behavioral pattern and has been used in several studies focusing on older adults (e.g., Boston & Merrick, 2010; Orti & Donaghy, 2004; and Young, 1997). As a strategy, CBT is highly relevant for programs serving older people. According to Karthik (2010) and Peterson (2002), CBT is effective for several reasons: (a) CBT focuses on current concerns and skill building rather than personality change; (b) CBT can be used via group settings where older adults can observe peers thus increasing a sense of self-efficacy, belonging, and well-being; (c) CBT facilitates social awareness and interaction, and promotes positive adjustment within one's environment; (d) the use of CBT can provide opportunities for older adults to examine motivational factors linked to activity; and (e) the use of CBT directly tackles myths or misunderstandings about aging that can prevent elders' from engagement in health promoting activities.

One important lesson for older adults to learn in the MOB intervention program is that what was once effortless (e.g., walking up stairs) now may require more effort. Matter of Balance, using CBT, helps to restructure the ideas that older adults do have control and that the investment of effort and practice does promote change (Lachman & Jette, 1997). Also, if control beliefs are enhanced by restructuring, along with educating and teaching new skills, this combination is more likely to increase one's effort and persistence, thereby increasing the effectiveness of skill learning (e.g., increasing one's fall efficacy) (Bandura, 1977).

There are several components to the Matter of Balance intervention program that correlate to CBT including: (a) educating older adults about the nature of the aging process; (b) helping participants identify the negative beliefs and self-defeating attitudes that interfere with

sustained efforts; (c) teaching participants ways to restructure negative perspectives and attitudes; and (d) strategies to promote confidence in one's abilities to promote change (e.g., how to modify one's environment and to inspire the belief that one's efforts will make a difference) (Lachman & Jette, 1997). Overall, cognitive restructuring through the use of cognitive behavior theory can ultimately change negative believes and attitudes into more adaptive perspectives; therefore the Matter of Balance intervention program will use the theoretical framework of cognitive behavior theory as a means to explain change (Lachman & Jette, 1997).

Cognitive behavior theory (CBT) is used as the basis for the Matter of Balance intervention program. This theory suggests that cognition plays an important role in determining the behavioral pattern of a person and focuses on how people think, what an individual perceives from vision and hearing, how much he or she retains and remembers, and how the individual reacts to a stimuli. One of the aspects of this theory also deals with enhancing the crucial ability of one's memory to retain more information (Karthik, 2010).

Cognitive behavior theory has been used in numerous studies including a study by Orti and Donaghy (2004). This study of cognitive-behavior intervention was used to increase adherence of adult women exercisers and aimed to assess the impact of a cognitive-behavioral intervention on the short-term adherence to exercise of previous sedentary women.

Authors	Orti, E., & Donaghy, M. (2004).
Title	*Cognitive-behavioral intervention to increase adherence of adult women exercisers*
Objective	Used to increase adherence of adult women exercisers aimed to assess the impact of a cognitive-behavioral intervention on the short-term adherence to exercise of previous sedentary women.
Methods	The study consisted of 30 sedentary women (aged 49-69 years old) who were assigned to either an experimental group or a control group. The control group participated in four exercises sessions once a week, while the experimental group participated in four exercise sessions once a week with an additional four sessions where strategies to improve exercise adherence were implemented. Both groups were asked to walk at least 30 minutes a day, twice a week. Short-term exercise adherence for each participant was reported at two different periods; the first of

	which included independent walking sessions two times a week for four weeks while the second period consisted of unsupervised group sessions two times a week for five weeks.
Results	Results reported that the short-term adherence for the independent walking session from the experimental group was significantly higher than that of the control group (U = 9.0, *n1* = 13, *n2* = 14, p > 05).
Conclusion	Authors report that cognitive-behavior theory improves exercise adherence during the implementation period of the intervention.

Cognitive behavior theory has been specifically related to Matter of Balance as described by Peterson (2002); she reflects how techniques used in Matter of Balance intervention programs correlate to cognitive behavior theory. Cognitive behavior theory in MOB uses phenomenology (i.e., participants describe how poor fall efficacy affects their lives); collaboration (i.e., groups are encouraged to share knowledge and empathy); activity (i.e., participants practice practical skills including fall prevention and fall maintenance); empiricism (i.e., evidence-based research is presented); and generalization (i.e., homework is given and participants are encouraged to identify and address fall-related issues) (Peterson, 2002). CBT will be used as the theoretical framework for the MOB intervention program due to components of CBT being directly related to MOB.

In a study conducted by Boston and Merrick (2010) results supported cognitive behavioral theory being implemented into programs to determine health anxiety among older adults.

Authors	Boston, A. F., & Merrick, P. L. (2010).
Title	*Health anxiety among older people: An exploratory study of health anxiety and safety behaviors in a cohort of older adults in New Zealand*
Objective	To examine: (a) whether a cohort of older adults was unduly health anxious, (b) which demographic and health factors predicted health anxiety (HA), and (c) whether an aspect of the cognitive behavioral model of HA was applicable to older adults by investigating the relationship between HA and safety behaviors.
Methods	One hundred forty five adults over the age of 65 years participated in an anonymous self-report questionnaire measuring demographic factors, physical health and function, health anxiety, safety behaviors, and medical utilization.

Results	Results found that those who participated in this study were not "unduly health anxious and occurrence of severe HA was similar to that found in younger populations". Results showed that HA and decreased physical function predicted medical utilization and that a decrease in physical function and lower education predicted scores on the HA measure. Furthermore, consistent with the cognitive behavioral model, HA was a unique significant predictor of safety behaviors.
Conclusion	The authors conclude the applicability of the cognitive behavioral model on HA on older adults.

Clemons et al., (2004) used cognitive behavior as the theoretical framework to determine whether a community based falls prevention program (i.e., Stepping On) would reduce falls in older adults.

Authors	Clemson, L., Cummings, R., Kendig, H., Swann, M., Heard, R., & Taylor, K. (2004).
Title	*The effectiveness of a community-based program for reducing the incidence of falls in the elderly: A randomized trial*
Objective	To test whether Stepping On (a multifaceted community-based program using a small-group learning environment) is effective in reducing falls in at-risk people living at home.
Methods	Three hundred ten community residents aged 70 and older who had previously fallen in the previous year at start of the study, or were concerned about falling participated in the Stepping On program (a two-hour session which was conducted weekly for seven weeks, with a follow-up home visit). The Stepping On program was aimed at improving fall efficacy, encourages behavioral change, and fall reduction. "Key features of the program were to improve lower-limb balance and strength, improve home and community environmental and behavioral safety, encourage regular visual screening, and encourage medication review".
Results	The intervention group experienced a 31 percent reduction in falls (relative risk (RR) = 0.69, 95% confidence interval (CI) = 0.50–0.96; p = .025). A secondary analysis of subgroups showed that it was particularly effective for men (n = 80; RR = 0.32, 95% CI = 0.17–0.59). Results also demonstrated that the Stepping On program was effective for older adults.
Conclusion	Authors conclude that cognitive-behavioral learning in a small-group environment can reduce falls. Furthermore, results indicated that the Stepping On program offered a successful fall-prevention option.

Young (1997) also concluded that cognitive behavioral techniques are used in the older population to reduce disabilities associated within this population.

Authors	Young, Q. (1997).
Title	*Health promotion for older adults: Evaluation of a cognitive-behavioral intervention.*
Objective	To develop and test a group intervention for reducing the possible disability associated with aging.
Methods	Twenty-four subjects participated in a six week, one and one half hour sessions of the Living Well workshop while forty-two participated as control subjects. All subjects were also assessed by means of a questionnaire (pre, post, and follow-up).
Results	Results revealed significant differences between the intervention and control groups on the Center's for Epidemiological Study of Depression Scale ($p < .001$), the Health Promoting Lifestyle ($p = .038$), and the general mental health subscale of the Medical Outcome Study ($p = .003$)
Conclusion	The author concluded that application of similar cognitive-behavioral techniques to the aging population should be implemented into similar programs.

MEASUREMENTS OF BALANCE

To compare the impacts of intervention strategies, three measures of balance were selected. The Activities-specific Balance Confidence Scale (ABC), the 8-Foot Up and Go Test (UG) and the Multi-directional Reach Test (MDRT) were used to test balance and balance efficacy.

Activities-specific Balance Confidence Scale (ABC): The ABC Scale is 16-item questionnaire/survey with each item having a rating from 0% (no confidence) to 100% (complete confidence). Reliability and validity for the ABC Scale were evaluated by Powell and Myers (1995) as a comparison with the Falls-Efficacy Scale (FES) and the physical self-efficacy scale. The ABC Scale was tested on 60 community dwelling seniors. Results found that both the FES and the ABC Scale demonstrated reliability and convergent and criterion validity (r = .84) and that the physical self-efficacy scale scores moderately correlated with the ABC Scale (r = .49). The ABC Scale was a more efficient discriminator of high versus low mobility participants and yielded a wider range of responses, thereby indicating that the ABC Score is better suited in detecting poor fall efficacy in older adults than the FES (Powell &Myers, 1995).

Respondents were asked to rate their balance confidence (fall efficacy), according to the given scale, indicated when they felt they would lose their balance or become unsteady in the course of performing daily activities (Powell & Myers, 1995). Scores were evaluated by taking an average of the individual's total responses.

8-Foot Up and Go (UG): The UG is used to assess mobility and balance in older adults and is a modified version of the Timed Up and Go (TUG). The TUG, adopted from Mathias et al. "Get Up and Go Test," uses the researcher's own observations to assess participants' balance. The TUG, created by Podsiadlo and Richardson (1991), uses time to assess participants' balance and mobility. The UG, similar to the TUG, is used to assess participants' balance and mobility, as well as their agility and speed; in 1999 the distance required to complete the test was modified by Rikli and Jones (1999).

The UG has not only been used with the Senior Fitness Test, but also in numerous studies. For instance, in a study by Jones, Lucchese, and Rose (2002), the researchers evaluated 134 older adult patients using the TUG versus the UG in measuring balance, mobility, and accuracy to complete the tests. The results indicated that scores from these tests show significant similarities between the two groups (i.e., $F = (1,132) = 75.01$, $p < .01$ for the UG and $F = (1,132) = 63.20$, $p > .001$ for the TUG). The results concluded that the UG not only discriminated between those who had multiple falls and those who had not, but was also able to help identify those who were at a higher risk for experiencing a fall. The research concluded that the UG was reliable and valid and could be used as a good indicator of the patient's balance, mobility, and is a "valid and effective method for screening for disability and fall risk in older adults" (Jones, Lucchese, & Rose, 2002).

The UG requires the researcher to time participants from the moment the observer says

"Go" and the participant rises from a seated position, walks eight feet, turns around, returns to their seat, and sits back down. Participants were instructed to walk at a fast, yet safe, pace using their everyday mobility device if the individual possessed one. Participants' scores were assessed by the fastest of three timed trials.

***Multi-Directional Reach Test (MDRT*):** The MDRT was developed to determine the ability for one to keep their balance while reaching in multiple directions (Newton, 2001). The MDRT was evaluated for reliability and validity by Newton (2001) in a study of 254 older adults. Subjects participated in the Borg Balance Scale test (BBS), TUG, and the MDRT. The results indicated that there was significant correlation with scores from the BBS: front reach (FR) ($r = 0.476$), behind reach (BR) ($r = 0.356$), right reach (RR) ($r = 0.389$), and left reach (LR) ($r = 0.390$), and significant inverse relationship with the TUG scores: FR ($r = -0.442$), BR($r = -0.333$), RR ($r = -0.260$), and LR ($r = -0.310$). In conclusion the MRDT can be used as a reliable and valid tool for measuring balance amongst older adults.

During the MDRT, participants were instructed to raise an arm in front of them, parallel to the floor, and parallel to a fixed yardstick against the wall. Participants were instructed to reach as far as they could in three directions (i.e., to the front, right and left) while the researcher measured the end of each reach at the index finger location. If the participant touched the wall or relied on an object for balance or moved either or both feet, that trial was discarded. Scores were based on an average of three reach lengths in each direction.

*See Appendix II for test and procedures.

BALANCE INTERVENTIONS

The balance intervention strategies for this study included two evidence–based approaches endorsed by the Centers for Disease Prevention and Control (CDC). The two strategies were Tai Chi (TC) and Matter of Balance (MOB). Both strategies are well supported in the literature.

Tai Chi

Tai Chi originated from an ancient Chinese martial art and involves flowing movements involving all body joints. Tai Chi is not only used for self-defense, but also for health benefits such as improved balance, cardiorespiratory functions, strength, flexibility, and concentration. As an intervention, Tai Chi is a relatively new therapeutic modality used in western medicine for balance and conditioning which incorporates breathing, concentration, and body flow through the use of different moves performed slowly and rhythmically from side to side emphasizing weight bearing at different points while relaxing muscles that are not being used at that moment (Chan & Bartlett, 2000; Greenspan et al., 2007; Lan, Lai, Wong, & Yu, 1996).

Tai Chi incorporates mind and body and has benefits for both and when practiced correctly and over time. Incorporating deep breathing techniques and mental focus helps to promote coordination, greater flexibility and range of motion, increased muscular strength, proprioception (i.e., body awareness), and muscle control and postural alignment, all of which help to improve balance as well as to enhance the total body and mind (McKenna, 2001; Sarnataro, 2006).

Tai Chi Research: Numerous studies have been conducted to examine the effects of a Tai Chi intervention program on balance in older adults. For example, Hakim, Kotroba, Courts, Teel, and Leninger (2010) examined changes in balance related measures in older adults

participating in Tai Chi, yoga, or no exercise.

Authors	Hakim, R., Kotroba, E., Cours, J., Teel, S., & Leininger, P. (2010).
Title	*A cross-sectional study of balance-related measures with older adults who participated in Tai Chi, Yoga, or no exercise*
Objective	To compare balance-related measures in older adults who perform Tai Chi, yoga, or no exercise.
Methods	A sample of 52 older adults (> 65 years old) was categorized according to current participation in Tai Chi (n = 21), yoga (n = 11), or no exercise (n = 20). Participants had their balance assessed by means of the Single Limb Stance (SLS), the Multidirectional Reach Test (MDRT), the Fullerton Advanced Balance Scale (FAB), the Activities-Specific Balance Confidence Scale (ABC), and the Timed Floor Transfer (TFT).
Results	There were no significant differences between the groups for SLS and ABC scores. Results indicated that the Tai Chi and yoga groups scored significantly higher on the FAB (p = 0.001) than the no-exercise group and the Tai Chi group scored significantly higher than both the yoga and no-exercise groups on all directions of the MDRT (p < 0.01). For the TFT, percentage rates for participants able to complete the task were Tai Chi group = 76.1%, yoga group = 54.5%, and no-exercise group = 30.0%. Overall the Tai Chi and yoga exercise groups demonstrated better balance performance than the no-exercise group.
Conclusion	The authors concluded that both Tai Chi and yoga are economical and effective methods of low impact exercise that can be incorporated into a fall-prevention program for older adults.

In another study by Hakim, Newton, Segal and DuCette (2003), the researchers tested the effectiveness of a Falls Risk Reduction Program in older adults by using a Tai Chi intervention program versus that of watching a falls prevention video.

Authors	Hakim, R., Newton, R., Segal, J., & DuCette, J. (2003).
Title	*A group intervention to reduce fall risk factors in community-dwelling older adults*
Objective	To determine the effectiveness of a Fall Risk Reduction Program for community-dwelling older adults
Methods	An intervention group (n = 49) and a comparison group (n = 31) were used for this study. The intervention group received three monthly educational sessions with a Tai Chi home exercise component while the comparison group viewed a video on fear of falling. Selected cognitive (Fall Facts Check-Off), affective (Activities-specific Balance Confidence Scale), and behavioral variables (Multidirectional Reach Test, Timed-Up-and-Go, 30 Second Chair Stand Test, and number of changes to reduce risks) were assessed for each participant.
Results	The intervention group demonstrated a significant increase in knowledge ($F(1,44) = 5.81$; $p < .05$), and averaged 5.4 changes per person in reducing fall risks. The comparison group showed no reports of initiating exercise or reducing fall risk factors.

Conclusion	The authors concluded that the Fall Risk Reduction Program, which utilized Tai Chi, was effective in increasing fall-related knowledge and reducing fall risk factors in community-dwelling older adults.

Mihay et al, (2003), examined the impact of Tai Chi by examining changes in overall balance and confidence while performing ADLs.

Authors	Mihay, L., Iltzsche, E., Tribby, A., Rushing, K., Spears, J., Spears J., Wiltfong, H., Schaub, D., Chronister, A. (2003)
Title	*Balance and perceived confidence with performance of instrumental activities of daily living: A pilot study of Tai Chi inspired exercise with elderly retirement-community dwellers*
Objective	To determine if Tai Chi Inspired Exercise (TCIE) positively impacts balance and confidence level during performance of activities of daily living (ADL) for well elderly.
Methods	The study consisted of thirty-five elderly volunteers. The experimental group (*n* =18) participated in a minimum of ten TCIE sessions over a six-week period. Pre- and post-testing occurred for both the experimental and control groups (*n =17)*. The Activities-specific Balance Confidence (ABC) Scale, Berg Balance Scale (BBS) and Limits of Stability Assessment (LOS) were used to establish baseline scores. These assessments measured changes in the relationship between balance and confidence upon completion of the TCIE sessions.
Results	Participants of the TCIE group scored significantly higher in the post scores of the ABC ($F(1, 31) = 12.07$, $p = .001$), BBS ($F(1, 32) = 13.692$ $p = .001$), and the LOS measures of Maximal Endpoint Excursion (MXE) and Forward. ($F(1, 32) = 4.228$, $p = .048$); ($F(1, 32) = 7.63$, $p = .009$)) respectively.
Conclusion	The authors concluded that Tai Chi Inspired Exercise positively impacts balance and confidence levels during ADL performance for the elderly.

A study conducted by Wolf, Barnhart, Ellison, and Coogler (1997) examined the effects of Tai Chi versus computerized balance training on fall occurrences and functional mobility as well as the psychosocial aspect of frailty.

Authors	Wolf, S. L., Barnhart, H. X., Ellison, G. L., & Coogler, C. E. (1997).
Title	*The effect of Tai Chi Quan and computerized balance training on postural stability in older subjects*
Objective	To determine whether two exercise programs would affect the ability to minimize postural sway relatively inactive older subjects.
Methods	This study included seventy-two older adults who participated in the Atlanta FICSIT trial (Frailty and Injuries: Cooperative Studies of Intervention Techniques). Subjects were randomly assigned and asked to participate for fifteen weeks in one

	of three interventions: (1) a computerized balance training group (*n = 24)*, (2) a Tai Chi group (*n = 24)*, or (3) an educational group (serving as a control for exercise) (*n = 24)*. All subjects were evaluated under four postural conditions before, immediately after, and four months following their individual intervention placement.
Results	Results indicated that when platform balance measures were evaluated, outcomes revealed greater stability after training among subjects in the computer balance training group with little change in stability among subjects in the Tai Chi and educational groups. However, results did indicate that subjects in the Tai Chi group were less afraid of falling after training compared with subjects in the other groups.
Conclusion	The authors of this study concluded that, "Tai Chi may gain its success, in part, from promoting fall efficacy…" Although, Tai Chi may have delayed onset of first or multiple falls in older adults, this effect does not appear to be associated with measures of enhanced postural stability.

Wolf, Barnhart, Ellison, and Coogle (1997) furthermore studied the effects of Tai Chi versus computerized balance training.

Authors	Wolf, S. L., Barnhart, H. X., Kutner, N. G., McNeely, E., Coogler, C., & Xu, T. (1996).
Title	*Reducing frailty and falls in older persons: An investigation of Tai Chi and computerized balance training. Atlanta FICSIT Group. Frailty and injuries: Cooperative studies of intervention techniques.*
Objective	To evaluate the effects of two exercise approaches, Tai Chi (TC) and computerized balance training (BT), on specified primary outcomes (biomedical, functional, and psychosocial indicators of frailty) and secondary outcomes (occurrence of falls).
Methods	This study conducted by Wolf et al. consisted of two hundred participants, aged seventy and older living in the community, who participated in the Atlanta FICSIT (Frailty and Injuries: Cooperative Studies of Intervention Techniques), an intervention group consisting of one of three groups (TC, BT, and education (ED)) who were evaluated over the course of 15 weeks. Outcomes were assessed pre and post intervention and at a four-month follow-up. Falls were monitored continuously throughout the study. Biomedical (strength, flexibility, cardiovascular endurance, body composition), functional (IADL), and psychosocial well-being (CES-D scale, fear of falling questionnaire, self-perception of present and future health, mastery index, perceived quality of sleep, and intrusiveness) were also assessed.
Results	Results showed grip strength declined in all groups, and lower extremity range of motion showed limited but statistically significant changes. Lowered blood pressure before and after a 12-minute walk was seen following TC participation. Fear of falling responses and intrusiveness responses were also reduced after the TC intervention compared with the ED group (P = .046 and P = .058, respectively). Overall, after adjusting for fall risk factors, TC was found to reduce the risk of multiple falls by 47.5%.

Conclusion	The authors determined that a moderate TC intervention can impact favorably on defined biomedical and psychosocial indices of frailty. Tai Chi can also have favorable effects upon the occurrence of falls.

Wolf also collaborated with Greenspan, Kelly and O'Grady (2007) to study the effects of whether Tai Chi could improve health status in older adults better than a Wellness Education.

Authors	Greenspan, A., Wolf, S., Kelley, M., & O'Grady, M. (2007).
Title	*Tai Chi and perceived health status in older adults who are transitionally frail: A randomized controlled trial*
Objective	To determine whether intense Tai Chi (TC) exercise could improve perceived health status and self-rated health (SRH) more than Wellness Education (WE) for older adults who are transitionally frail.
Methods	Two hundred sixty nine women who were 70 years of age and older were recruited from 20 congregate independent senior living facilities for this study. This study consisted of randomly assigning participants in a 48-week intervention program of either TC or WE. Participants were interviewed before intervention participation and at one year in regards to their perceived health status through use of the Sickness Impact Profile (SIP) and self-rated health (SRH) assessment.
Results	Results for thus study demonstrated that when compared with WE participants, participants in the TC group reported significantly lower SIP scores in the physical dimension (f = .0l6) and ambulation category (f = .013). Borderline significant improvements were also seen in the body care and movement category of the SIP (p = .051). Between-group differences in the physical dimension revealed better physical functioning among the TC participants than that of the WE participants (p = .005), however, self-rated health did not change for either group.
Conclusion	Authors suggest that older women who are transitionally frail and who participate in intensive TC exercise demonstrate perceived health status benefits, most notably in ambulation.

Mihay, Boggs, Breck, Dokken, and NaThalng (2006) also examined the effects of Tai Chi versus that of strength training on fall-efficiency and dynamic and static standing balance in older adults.

Authors	Mihay, L., Boggs, K., Breck, A., Dokken, E., & NaThalang, G. (2006).
Title	*The effect of Tai Chi inspired exercise compared to strength training: A pilot study of elderly retired community dwellers*
Objective	To examine the effects of Tai Chi Inspired Exercise (TCIE) as compared to strength training on dynamic standing balance, static standing balance, and fall efficacy in a well elderly population.
Methods	Methods for this study included having two pre-existing groups of elderly

	community dwellers (mean age = 79.2 years) with one group of ten subjects participating in strength training, and the other group of 12 subjects participating in TCIE. Measurements for this study included the Limits of Stability (LOS), the Berg Balance Scale (BBS), Single Leg Stance (SLS), and the Survey of Activities and Fear of Falling in the Elderly (SAFFE). These assessments quantified differences between the two groups based on static and dynamic standing balance, movement characteristics, fear of falling, and activity restriction
Results	Results indicated that the TCIE group scored 0.57 on the SAFFE Fear of Falling compared to the Strength Training group who scored 0.49, indicating that the strength training group had less fear of falling. Also, despite a greater fear of falling, the TCIE group had less activity restriction as seen by a score of 2.92 on the SAFFE Activity Restriction compared to the strength training group who scored 3.20. Furthermore, the TCIE group had a greater activity level at a score of 8.50 as compared to the strength training group with a score of 8.10. The TCIE group also demonstrated better balance according to the BBS with a mean score of 52.25 as compared to the strength training group who had a mean score of 50.20. Moreover, the mean scores of the SLS test with Eyes Open and Closed revealed that the TCIE group stood almost twice as long as the strength training group with a significant result of .017.
Conclusion	Authors identified that both strength training and TCIE positively impact balance. Additionally, the strength training group demonstrated greater balance during repetitive movements in one direction while the TCIE group demonstrated greater balance during functional tasks, showing generalization of fall prevention strategies in ADLs.

To determine the neuromuscular response in older adults Gatts and Woollacott (2006) studied the effects of Tai Chi on balance and the neural mechanisms underlying balance.

Authors	Gatts, S. K., & Woollacott, M. (2007).
Title	*Neural mechanisms underlying balance improvement with short term Tai Chi training. How Tai Chi improves balance: Biomechanics of recovery to a walking slip in impaired seniors*
Objective	Examine neuromuscular response of dynamic balance in balance-impaired older adults.
Methods	The study examined neuromuscular response of dynamic balance in balance-impaired older adults by use of a Tai Chi balance exercise training model (i.e., random practice patterns and KR) compared to a similar control exercise.
Results	Results seen in this study revealed that those in the Tai Chi group significantly reduced TA response time from 148.98+/- 45.11 ms to 98.67+/- 17.22 ms ($p < 0.004$). The Tai Chi group had significant improvements on four clinical functional balance measures (i.e., TUG, Functional Reach, SLS, and Tandem Stance); however, the control group only improved on the functional reach test. Results also showed that only those in the Tai Chi group significantly reduced tripping ($p < 0.005$) and medical cross-step distance ($p < 0.038$), as well as

	increased the use of swing leg heel strike ($p < 0.001$). Data were also reported on center of gravity (COG); which indicated that COG in the anterior-posterior path significantly increased after Tai Chi ($p < 0.017$), but not after the control exercise group.
Conclusion	Completion of this study led authors to identify that Tai Chi participants, overall, had significantly faster and better coordinated neuromuscular gait than other balance-impaired older adults in the control group. Results also concluded that Tai Chi participants took longer steps and increased mechanical loading at the hip when stepping onto unstable surfaces; this indicted better balance and could therefore indicate greater confidence and fall efficacy.

The effects of Tai Chi on older adults' knee strength, body swap, and balance was studied by Tsang and Hui-Chan (2005).

Authors	Tsang, W. N., & Hui-chan, C. Y. (2005).
Title	*Comparison of muscle torque, balance, and confidence in older Tai Chi and healthy adults*
Objective	To examine whether older Tai Chi practitioners had better knee muscle strength, less body sway in perturbed single-leg stance, and greater balance confidence than healthy older adults.
Methods	This study comprised of older adults in a Tai Chi ($n = 24$) group and control group ($n = 24$) (matched with respect to age, gender, height, weight, and physical activity level) who were assessed based on concentric and eccentric isokinetic measures. Assessments of the subjects' dominant knee extensors and flexors were conducted at an angular velocity of 30 degrees and control of body sway was assessed in static double-leg stance and in single-leg stance perturbed by forward or backward platform perturbations. The Activities-specific Balance Confidence (ABC) scale was used to investigate subject balance confidence in daily activities.
Results	Results showed that Tai Chi participants had higher peak torque-to-body weight ratios in concentric and eccentric isokinetic contractions of their knee extensors and flexors ($p = 0.044$). Tai Chi participants manifested less anterior-posterior body sway angles in perturbed single-leg but not static double-leg stance than did control subjects ($p < 0.001$). Tai Chi participants also reported significantly higher fall efficacy scores ($p = 0.001$). Results also revealed that older adults' knee muscle strengths had negative correlations with body sway angles in perturbed single-leg stance and positive correlations with ABC score ratios. Furthermore, body sway angles in perturbed single-leg stance were negatively correlated with ABC score ratios ($p < 0.05$).
Conclusion	These authors revealed that long-term Tai Chi participants have better knee muscle strength, less body sway in perturbed single-leg stance, and greater balance confidence than those in the control group.

Tsang, Wong, Fu, and Hui (2003) also studied the functional fitness in older adults who participated in Tai Chi, as did Takeshima et al., (2007).

Authors	Tsang, W. W., Wong, V. S., Fu, S. N., & Hui-Chan, C. W. (2004).
Title	*Functional fitness gain varies in older adults depending on exercise mode*
Objective	To investigate the effects of long-term Tai Chi practice on balance control when healthy elderly Tai Chi practitioners stood under reduced or conflicting somatosensory, visual, and vestibular conditions, as compared with healthy elderly non-Tai Chi practitioners and young subjects.
Methods	This study examined twenty elderly Tai Chi practitioners were compared with twenty elderly non-Tai Chi practitioners and twenty young, healthy university students.
Results	Results found in this study indicated that the non-Tai Chi practitioners scored a statistically significantly lower visual ratio than the young subjects and the Tai Chi practitioners. However, no statistically significant difference was found between the young subjects and the Tai Chi practitioners (p = .361). Results found that the non-Tai Chi practitioners scored a statistically significantly lower vestibular ratio (mean ratio, .58 ± .17) than the young subjects (mean ratio, .67 ± .15; p = .033) and the Tai Chi practitioners (mean ratio, .67 ± .09; p = .033). However, no statistically significant difference was found between the young subjects and the Tai Chi practitioners (p = .996). Furthermore results from this study revealed that the elderly Tai Chi practitioners attained the same level of balance control performance as did young, healthy subjects when standing under reduced or conflicting somatosensory, visual, and vestibular conditions.
Conclusion	Authors from this study showed that long-term Tai Chi practice improves balance control in the elderly population when there is an increased reliance on the visual and vestibular systems during stance.

Authors	Takeshima, N., Rogers, N. L., Rogers, M. E., Islam, M. M., Koizumi, S., & Lee, S. (2007).
Title	*Functional fitness gain varies in older adults depending on exercise mode*
Objective	To compare the effects of aerobic, resistance, flexibility**,** balance**,** and Tai Chi programs on functional fitness in Japanese older adults**.**
Methods	Methods for this study included functional fitness (FF) evaluated using a chair stand, arm curl, up and go, sit and reach, back scratch, functional reach, and 12-min walk. One hundred thirteen older adults volunteered for one of five exercise groups: aerobic (AER), resistance (RES**),** balance (BAL), flexibility (FLEX), and Tai Chi (T-CHI), or were assigned to the wait-list control group (CON).
Results	Results indicated that improvements were in cardiorespiratory fitness was limited to AER (16 %). Improvements in upper- and lower-body strength and balance/agility were outcomes of RES, BAL, and T-CHI**.** RES induced the greatest upper-body strength improvement (31 %), whereas BAL produced the greatest improvement in lower-body strength (40 %). Improvements in balance/agility were similar across RES (10 %), BAL (10 %), and T-CHI (10 %) while functional reach

	improved similarly in AER (13 %), BAL (16 %), and RES (15 %).
Conclusion	A single mode with crossover effects could address multiple components of fitness. Furthermore, a well-rounded exercise program may only need to consist of two types of exercise to improve overall functional fitness (i.e., one type should be aerobic exercise, and the second type could be chosen from resistance, balance, and/or Tai Chi).

Tai Chi research has been proven to reduce falls by increasing balance, fall efficacy, and decreasing reaction times than any other modality. Implementing a Tai Chi program into the lives of older adults could help prevent falls and increase one's independence and overall quality of life.

Matter of Balance

A Matter of Balance (MOB) program is specifically designed to improve balance, increase fall efficacy, and improve activity levels among older adults. It is based on research conducted at Boston University by the Roybal Center for Enhancement of Late-Life Function (Matter of Balance, 2008). The program has been successful in increasing fall efficacy and reducing fall risk, as well as increasing participants' exercise levels and social activity levels (Healy et al., 2008; Healy, McMahon & Hayes, 2006).

Those who have participated in MOB found significant improvements in managing and controlling falls, level of exercise, and increasing social activity (Partnership for Healthy Aging, 2010). The Partnership for Healthy Aging reflected that after completing a Matter of Balance program, 97% of participants were more comfortable talking about the fear of falling and felt more comfortable with increasing activity, 99% of participants planned to continue exercising, and, 98% of participants would recommend MOB to others. Matter of Balance has been adopted by the CDC as a falls prevention model and is, therefore, used as a comparison program to the Tai Chi intervention program (CDC, 2010).

Matter of Balance Research: In a study performed by Org et al., (2010), data were collected from September 2007 through September 2009 focusing on fall efficacy and fall management through a MOB program.

Authors	Org, M.,Smith, M., Wade, A., Mounce, C., Wilson, A., & Parrish, R. (2010).
Title	*Implementing and disseminating an evidence-based program to prevent falls in older adults*
Objective	To describe the training and delivery processes though which a Matter of Balance/Volunteer Lay Leader (MOB/VLL) is implemented and disseminated throughout the Texas Association of Area Agencies on Aging. The secondary objective was to examine selected key outcome measures to validate positive findings reported in previous studies.
Methods	The study analyzed two secondary databases: 1) a centralized administrative data set to document implementation processes and structures for delivering the program, and 2) a common set of outcome measures for assessing the effect of the program on older Texans.
Results	Results came from 2007 through 2009 consisting of 3,092 senior residents. The program's capacity was established by certifying 98 master trainers (i.e., instructor trainers) and 402 lay leaders (i.e., instructors) and by delivering the program in 227 classes through the Area Agency on Aging network. The immediate outcome results were positive and indicated a pathway to promote more successful aging in the way of: 1) increasing fall efficacy, 2) improving overall physical activity levels, and 3) reducing interference with everyday routines.
Conclusion	The authors concluded "that a program to prevent falls can promote active aging among people who would otherwise be at risk for a downward cycle of health and functionality. Furthermore, creating partnerships among different delivery sectors is needed for building community infrastructure to enhance the health of older adults (abstract, para 1)".

An experiment conducted in 1997 by Tennstedt et al., tested the reduction in fear of falling and associated activity restrictions in older adults by means of a community-based intervention (i.e., Matter of Balance).

Authors	Tennstedt, S., Howland, J.; Lachman, M.; Peterson, E., Kasten, L., & Jette, A. (1998).
Title	*A randomized, controlled trial of a group intervention to reduce fear of falling and associated activity restriction in older adults*
Objective	To test the efficacy of a community-based group intervention to reduce fear of

	falling and associated restrictions in activity levels among older adults
Methods	Four hundred thirty four people age 60 years and older were recruited for this study. Each participant reported having a fear of falling which was associated with activity restriction. Participants were assessed pre and post a community-based intervention program and then compared to a control group at week six, six months, and twelve months.
Results	Results showed that subjects within the intervention program reported increased levels of intended activity ($p < .05$) and greater mobility control ($p < .05$) immediately after the intervention. Effects at 12 months included improved social function ($p < .05$) and mobility range ($p < .05$).
Conclusion	A community-based intervention can have positive effects on older adult participants in increased fall efficacy, mobility control, and social functioning.

Healy et al., (2008) performed a study to determine whether a Matter of Balance intervention program could be implemented into a community-based volunteer lay leader model and achieve comparable outcomes such as those found in the randomized control trial (RCT).

Authors	Healy, T.C., Peng, C., Haynes, P., McMahon, E., Botler, J., & Gross, L. (2008).
Title	*The feasibility and effectiveness of translating a Matter of Balance into a volunteer lay leader model*
Objective	To determine whether a Matter of Balance intervention program could be implemented into a community-based volunteer lay leader model and achieve comparable outcomes such as those found in the randomized control trial (RCT)
Methods	Using a highly structured Matter of Balance (MOB) curriculum was presented two hours a week for four weeks in groups of 8-12 older adults. Those who participated in the study (*n = 335)* received follow-up questionnaires in the mail at six weeks *(n = 298 responded),* six months *(n = 213 responded),* and 12 months *(n = 120 responded)*
Results	Results from the study indicated that participants in the MOB program had increased fall efficacy at six weeks, six months, and 12 months ($p = 0.0001$, $p = 0.0005$, $p = 0.0013$) respectively when being compared to the RCT representing community-dwelling older adults. In addition falls control and falls management were also significantly increased in MOB participants at six weeks, six months and 12 months, ($p = 0.0060$, $p = 0.0366$, $p = 0.0218$; $p < 0.0001$, $p < 0.0001$, $p < 0.0001$) respectively when compared to baseline data. It was also assessed that those who participated in the MOB program had more social activity ($p = .0516$) than those in the RTC.
Conclusion	Authors suggest that a Matter of Balance program should be available to older adults to help increase fall efficacy, falls management, and falls control.

Lambert, Sterbenz, Womack, Zarrinkhameh, and Newton (2001) researched adherence to

a falls prevention program.

Authors	Lambert, C. C., Sterbenz, K. A., Womack, D. E., Zarrinkhameh, L. T., & Newton, R. A. (2001).
Title	*Adherence to a fall prevention program among community dwelling older adults*
Objective	To determine if older adults participating in a fall prevention program make recommended environmental and personal changes to reduce falls, and to identify factors affecting adherence to the program.
Methods	This study consisted of having 84 healthy community dwelling adults aged 65 to 97 years participate in three sessions: 1) session one (administration of the Health Habits Survey (HHS) and a fall-risk talk) 2) session two (administration of fall risk, balance screening, and a talk on personal and home safety), 3) session three (Health Habit Survey).
Results	Results indicated that a falls prevention program should include both an exercise component and an educational component to move participants along the continuum using the transtheoretical model.
Conclusion	The authors recommend the following elements for a community-based fall prevention program: 1) six weeks in length, occurring on the same day of the week; 2) compatible scheduling with the center's activities; 3) group discussions to facilitate adherence.

Southard (2006) assessed fall efficacy in a balance exercise group and an educational efficacy training group.

Authors	Southard, V. (2006).
Title	*A randomized control trial of the application of efficacy training to balance assessment*
Objective	To assess fall efficacy improvements in balance confidence and performance when compared with controls.
Methods	Thirty-five older adults residing in an assisted-living facility were randomly assigned to either an exercise-only or exercises and efficacy-training group. Both groups met two days a week for four weeks.
Results	The Activities of Balance Confidence Scale (ABC) indicated no significant differences ($F = 0.005$, $p = 0.944$) in balance confidence between groups. However, balance performance, as measured by the Berg Balance Scale, showed significant improvements ($F = 33.453$, $p = 0.0001$). Overall, the intervention produced significant changes in balance performance, but no significant changes in confidence measurement.
Conclusion	The author indicates that there is a direct relationship between balance performance and that of first or multiple falls.

Fall education was also studied by Ness, Gurney, and Ice (2003) when they assessed changes made by older adults after attending a health fair.

Authors	Ness, K. K., Gurney, J. G., & Ice, G. H. (2003).
Title	*Screening, education, and associated behavioral responses to reduce risk for falls among people over age 65 years attending a community health fair*
Objective	To determine whether health fair screening and educational intervention would result in behaviors that could reduce the risk of falls and to determine whether adoption of risk-reduction behaviors differed between people over age 65 years screened as being at high risk for falls and those screened as being at lower risk for falls..
Methods	This study used the Berg Balance Test to classify fall risk in 68 individuals aged 57 to 89 years. All subjects were obtained when attending a community health fair. Participants were interviewed by telephone 30 days after the screening to assess implementation of the recommendations provided at the fair (i.e., subjects were provided recommendations intended to reduce fall risk).
Results	Results indicated that seventy-two percent of the participants in the study had self-reported implementing at least one risk-reduction behavior. The high-risk group (i.e., those who had a score of 45 or more on the Borg Balance Test) was more likely to implement risk reduction behaviors than that of the low-risk group
Conclusion	Screening and education in a health fair setting appear to promote behaviors that could reduce fall risks among older adults.

Carmona (2005) performed research that supported an alternative exercise program.

Authors	Carmona, J. (2005).
Title	*Effects of a functional-based training program on the performance of instrumental activities of daily living among older adults residing in retirement communities*
Objective	To determine the effect a novel functional based training program would have on older adults' ability to perform Instrumental Activities of Daily Living.
Methods	This study consisted of 14 individuals participate in a 10 week control period phase followed by a 10 week functional based training program (i.e., Living Independently through Functional Exercise (LIFE)). The LIFE training program consisted of a "multi-station circuit with nine different activity stations mimicking functional tasks. The stations included, sit-to-stand, stair climbing, laundry, grocery shopping, vacuuming, sweeping, putting on and removing a jacket, pulling a suitcase, and getting down and up from the floor (abstract, para 1)". Participants were tested pre and post control period and again after the training program. The tests included the Physical Performance Test and the Physical Functional Performance-10 to measure the ability to perform Instrumental Activities of Daily Living (IADL) and the Senior Fitness Test to evaluate the physical domains of strength, flexibility, endurance and dynamic balance.
Results	There were no significant differences on any test scores during the control period except for lower extremity flexibility as seen by the Senior Fitness Test, and after the training period, improvements ranging from 10-40% ($p < 0.05$) were seen on all tests of the Physical Performance Test, the Physical Functional Performance-10, as well as on the chair stands, endurance walk, and arm curl of the Senior Fitness Test. Analysis of the data also revealed that the Physical Performance Test (0.58) and the Physical Functional Perfomance-10 (0.69) was significantly greater ($p <$

	0.05) than the magnitude of change in the Senior Fitness Test (0.10). Analysis also revealed a positive relationship between improvements in the Physical Functional Performance-10 and the Senior Fitness Test scores following the training program ($p = 0.002$, $R2 = 0.605$). Furthermore, for every unit of change in the Physical Functional Performance-10 standard score, as seen by analysis, there was only half as much of an increase in the Senior Fitness Test standard score.
Conclusion	Authors report that a novel functional-based training program may be able to facilitate improvements in a broad spectrum of functional measures among older adults. Additionally, this program offers an alternative to traditional exercise programs for this population.

Overall data from these studies suggest that a Matter of Balance program can be used to help older adults increase their fall efficacy, manage fall risk, and ultimately reduce falls therefore.

Summary

As the research indicates, older adults who participate in physical activities have overall better health than those who do not engage in physical activity. Engagement in physical activity on a regular basis can help to improve or maintain functional ability and independence in older adults. Participation in designed falls prevention programs can increase the overall quality of life of older adults and ultimately reduce health care cost due to falls.

Two great examples of improving balance and fall efficacy in older adults is through the use of a Tai Chi and/or Matter of Balance intervention program. Recognizing the need for more research, the purpose of this comparative study between Tai Chi and Matter of Balance was to determine if these approaches differ with respect to balance and fall efficacy in older adults. The results from this study demonstrated the impact of both falls prevention programs in improving balance and fall efficacy.

The outcomes demonstrated that inexpensive, functional based, yet enjoyable intervention strategies to reduce falls among older adults need to be further assessed and put into

practice to alleviate the prevalence of falls. The use of a Tai Chi intervention program and/or Matter of Balance intervention program are potential solutions to the concern of falls in older adults.

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APPENDIX B

Test 1: Activities-specific Balance Confidence (ABC) Scale

Instructions to Participants:
For each of the following, 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 to 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 it you were using these supports.
If you have any questions about answering any of these items, please ask the administrator.

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:

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 tiptoes 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 an escalator while you are holding onto a railing?____%
15. … step onto or off an escalator while holding onto packages such that you cannot hold onto the railing? ____%
16. …walk outside on icy sidewalks? ____%

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Test 2: 8-Foot Up and Go (UG)

1. Equipment: chair, tape measure, tape, stop watch.

2. Begin the test with the subject sitting correctly in a chair with arms, the subject's back should resting on the back of the chair. The chair should be stable and positioned such that it will not move when the subject moves from sitting to standing.

3. Place a piece of tape or other marker on the floor 8 feet away from the chair so that it is easily seen by the subject.

4. Instructions: "On the word *GO* you will stand up, walk to the line on the floor, turn around and walk back to the chair and sit down. Walk at your regular pace.

5. Start timing on the word "*GO*" and stop timing when the subject is seated again correctly in the chair with their back resting on the back of the chair.

6. The subject wears their regular footwear, may use any gait aid that he or she normally uses during ambulation, but may not be assisted by another person. There is no time limit. The subject may stop and rest (but not sit down) if needed.

7. Normal healthy elderly usually complete the task in ten seconds or less. Very frail or weak elderly with poor mobility may take 2 minutes or more.

8. The subject should be given a practice trial that is not timed before testing.

9. Results correlate with gait speed, balance, functional level, the ability to go out, and can follow change over time.

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Test 3: Multi-Directional Reach Test (MDRT)

1) Place a fixed yardstick on the wall at the participant's acromion process and horizontal to the floor.
2) Participants can use whatever arm he or she chooses but need to stay consistent throughout the test.
3) Participant is instructed to lift arm to shoulder height for initial reading.
4) The participant is then instructed to reach as far forward, left, and right as possible for thee trials in each direction, along the yardstick without making contact with the wall or relying on an object for balance as well as keeping both feet flat on the floor without moving either or both feet
5) If the participant touches the wall or relies on an object for balance, or moves either or both feet, the trial is discarded.
6) Start and stop of index finger is recorded and difference is the total reach for that direction.
7) An average of three reaches in each direction is used as the final score.

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Demographics

Today's Date: _____/_____/_____
The Following questions will provide us with background information.

1. What is your date of birth? _____/_____/_____

2. Today, how many people live in your household (including yourself)? _____

3. Are you:
   _____ Female _____ Male

4. Are you of Hispanic, Latin, or Spanish origin?
   _____Yes _____ No _____Unknown

5. What is your race? (Make all that apply):
   _____ American Indian or Alaska Native
   _____ Asian or Asian-American
   _____ Black or African-American
   _____ Hawaiian Native or Pacific Islander
   _____ White or Caucasian
   _____ Other

6. During the last 4 weeks, to what extent has your concern about falling interfered with your normal social activities with family, friends, neighbors or groups?
   _____ Extremely _____ Quite a bit _____ Moderately
   _____ Slightly _____ Not at all

7. Mark ONLY ONE to tell us how much you are walking or exercising now.
   _____ I do not exercise or walk regularly now and I do not intend to start.
   _____ I do not exercise or walk regularly, but I have been thinking of starting.
   _____ I am trying to start to exercise or walk.
   _____ I have exercised or walked infrequently for over a month.
   _____ I am doing moderate exercise less than 3 times per week.
   _____ I have been doing moderate exercise 3 or more times per week.

Matter of Balance. (2008). *A Matter of Balance: Managing concerns about falls.* Retrieved from http://www.maine.gov/dhhs/oes/healthychoices/balance.shtml.

Table 1.
Descriptive Statistics of Participants

Characteristics	Sample Mean (± SD)
Age	
TC	82.75 (± 6.43)
MOB	75.92 (± 5.72)
C	83.00 (± 4.69)
Total	80.43 (± 6.45)
Gender*	
TC	10F; 2M
MOB	11F; 2M
C	11F; 1M
Total	32F; 5M
Ethnicity**	
TC	12W
MOB	8W; 5B
C	9W; 2B; 1A
Total	29W; 7B; 1A

*F=Female, M =Male; W=White, B=Black, A=Asian; TC= Tai Chi, MOB= Matter of Balance, C= Control

Table 2.
Activities-specific Confidence Scale Means (ANOVA)

Outcome Measures		Mean
ABC Change	TC	1.82
	MOB	0.24
	C	0.16

Outcome Measures		df	F	Sig.
ABC Change	Between Groups	2	0.014	0.987
	Within Groups	35		
	Total	37		

TC= Tai Chi, MOB= Matter of Balance, C= Control

Table 3.
Mean Change Score from Pre to Post Assessment of the 8-foot Up and Go Test by Intervention Group (ANOVA)

Outcome Measures	Groups	N	Mean (± SD)
Up and Go Change	TC	13	-1.63 (± 2.28)
	MOB	13	-0.24 (± 1.37)
	C	12	-0.83 (± 3.62)
	Total	38	-0.90 (± 2.55)

TC= Tai Chi, MOB= Matter of Balance, C= Control

Table 4.
Comparing Tai Chi, Matter of Balance and Control Groups on the Multi-directional Reach Test (ANOVA)

Outcome Measures		df	F	Sig.
Forward Reach Change	Between Groups	2	4.486	0.018
	With Groups	35		
	Total	37		
Right Reach Change	Between Groups	2	6.377	0.004
	Within Groups	35		
	Total	37		

* The mean difference is significant at the 0.05 level.
TC= Tai Chi, MOB= Matter of Balance, C= Control

Table 5.
Multi-directional Reach Test Comparing Tai Chi and Matter of Balance to the Control Group (ANOVA)

	(I) Groups	(J) Groups	Mean Difference (I-J)	Sig.
Forward Reach	C	TC	-2.339*	0.025
		MOB	-2.097*	0.049
Right Reach	C	TC	-2.602*	0.029
		MOB	-3.299*	0.005

* The mean difference is significant at the 0.05 level.
TC= Tai Chi, MOB= Matter of Balance, C= Control