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# The Effects of a Tai Chi and Yoga Intervention on Balance and Balance Confidence

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The Effects of a Tai Chi and Yoga Intervention on Balance and Balance Confidence

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*For all searching souls*

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**Abstract**

The purpose of this study was to determine if the combination of yoga, Tai Chi, and mindful meditation increased balance and balance confidence in older female adults. Ten female participants were randomly assigned to one of two groups: Experimental or Control. The Experimental Group received yoga, Tai Chi, and a guided mindful meditation, while the control group received yoga and Tai Chi. Both groups met for 30 minutes per session, twice a week for seven weeks. Balance was assessed with Timed Tandem Walk, Timed Tandem Stand, and Timed Up-and-Go; balance confidence was assessed with the Activities-specific Balance Confidence Scale. All assessments took place at baseline and post-intervention. A 2 X 2 ANOVA with repeated measures was conducted for all variables. Descriptive statistics and effect sizes were calculated. The Timed Tandem Walk Errors group by time interaction was significant with F of 6.639 ($p$ = .037). The control group had a large effect size of -1.79. No significant differences from pre-test to post-test were found in the Timed Tandem Walk, Timed Tandem Stand, Timed Up-and-Go, and the Activities-specific Balance Confidence Scale ($p$ > .05). The control group had an increase in errors during the balance assessment of Timed Tandem Walk while the experimental group decreased in errors. This suggests that concentration, as enhanced by meditation, improved the experimental groups' balance performance. Future research should include a longer intervention of at least 12 weeks in duration and a larger sample size.

# CHAPTER ONE: INTRODUCTION

Falls in older adults can diminish health and increase the risk of mortality (Shumway-Cook, Gruber, Baldwin, & Liao, 1997). Previous research has estimated that in the year 2000, there were over 10,000 fatal falls and 2.6 million non-fatal falls (Stevens, Corso, Finkelstein, & Miller, 2006). Additionally, falls in older adults are costly to individuals, as well as to health care systems. In 2000, non-fatal and fatal falls for adults over 65 years of age incurred $19 million and $200,000, respectively (Stevens et al., 2006). For fatal falls, women accounted for 55% of the costs, and for non-fatal falls, women accounted for 74% of costs (Stevens et al., 2006). As age increases, so do the financial costs of falling. Research suggests that with effective exercise interventions, falls, and therefore costs, can be reduced (Stevens et al., 2006).

Unintended falls can result in a fracture; the risks of fractures are increased with the presence of low bone mass (Hui, Slemenda, & Johnston, 1988). Previous research suggests that in the United States during the year 2005-2006, approximately 8.3 million women have osteopenia and 300,000 have osteoporosis of the total hip. Although this is a decrease in the number of osteoporotic women in the United States compared to previous years, osteoporosis remains prevalent (Looker, Melton, Harris, Borrud, & Shepherd, 2010).

For those who are currently diagnosed with osteoporosis, measures should focus on prevention of falls. Such tactics can include exercise to increase balance and confidence of functionality. Huang, Yang, and Liu (2011) found that addressing the fears of falling with educational tools is beneficial to reducing fear of falling and increasing mobility. An intervention aimed at the improvement of confidence may be just as important as exercise that targets balance (Powell & Myers, 1995).

Research suggests that interventions focusing on osteoporotic participants should include balance and strength exercises (de Kam, Smulders, Weerdesteyn, & Smits-Englesmann, 2009). Strength training exercises should consist of, or at least include, weight-bearing exercises. Balance disorders are a risk for falling; interventions with the purpose of preventing falls should include balance-improving exercises (American Geriatrics Society, 2001). Community-dwelling older adults have high risks of falling and should participate in exercise interventions aimed at increasing balance, as recommended by Sivan, Sawyer, and Brown (2010). For an exercise intervention to be effective, it is recommended to perform these exercises two to three times per week for at least one year. More research is needed to determine the optimal combination of frequency, intensity, and types of exercises (de Kam et al., 2009). Yoga has been shown to be as effective as or more effective than traditional exercise in improvement of health-related components (Ross & Thomas, 2010).

Yoga is an Eastern practice that promotes body awareness, health, and balance in the physical and mental realms (Ross & Thomas, 2010). Many yoga poses incorporate balance and strength. Little research has studied yoga among women with osteoporosis to determine its impact on balance and thus, falls. Yoga has been shown to increase balance and quality of life (Oken et al., 2006) more than when compared to those performing traditional exercises designed for osteoporotic adults (Tuzun, S., Aktas, Akarirmak, Sipahi, & Tuzun, 2010). Yoga is not limited to physical practices, but also includes breathing exercises and meditation. Yogic meditation is recommended for control over the body and mind in achieving a physical task, such as balance (Dhume & Dhume, 1991). Scientific research in meditation and effective techniques is fairly new and has only been more common in the past twenty years (Ospina et al., 2008).

## Purpose

The purpose of this study was to increase balance confidence in older adult female participants with an intervention focusing on yoga, Tai Chi, and meditation. Balance was predicted to improve with an exercise intervention consisting of yoga and Tai Chi. Balance confidence was addressed with guided meditation. Both balance and balance confidence variables were measured before and after the intervention. This study sought to combine modes of exercise that have individually been shown to increase balance (Hart & Tracy, 2008; Huang et al., 2011; Oken et al., 2006; Tuzun et al., 2010). This study was targeted towards older female adults, specifically, but not limited to, those previously diagnosed with osteopenia or osteoporosis.

## Hypothesis

The hypothesis was that with an intervention of balance exercises, including yoga and Tai Chi, balance would increase; it was also hypothesized that with meditation, balance confidence would increase. The dependent variable is balance confidence; the independent variables are the group assignment and time. The passage of time was measured from baseline to post-intervention.

## Limitations and Delimitations

Participants included were older female adults of at least 65 years of age. Exclusion criteria included diagnosis of cardiovascular disease, previous severe falls or fractures, current full-time use of a cane or walker, or refusal to participate. Limitations of this study included a small sample size, maturation of participants, and compliance and attrition rate of participants.

**Definitions**

The definition of a fall can be interpreted differently; falls in this study were defined as "an unexpected event in which the participant come to rest on the ground, floor, or lower level" (Lamb, Jorstad-Stein, Hauer, & Becker, 2005, p. 1619).

Participants involved in this study included older female adults, some of whom have been previously diagnosed with osteoporosis or osteopenia. Osteoporosis is defined as bone mineral density (BMD) that is lower than 2.5 *SD* from the young adult mean level. Osteopenia is 1 to 2.5 *SD* below the recommended level (Kanis, Melton, Christiansen, Johnston, & Khaltaev, 1994). A diagnosis requires a bone scan with dual-energy x-ray absorptiometry (DXA), as recommended by the American College of Sports Medicine (Kaminsky, 2010). Low BMD can increase the risks of breaks, and therefore, the risks of falling (Hui et al., 1988).

The definition of yoga varies greatly, but the form of yoga followed in this study will be that of Ashtanga yoga. The Sanskrit word of yoga is literally translated as 'union', or 'joining' (Lidell, 1983). It is estimated that yoga began in 2500 BC (Lidell, 1983). The poses, or asanas, used in this study included those that focus on static and dynamic balance, including standing and balancing postures.

In the past, meditation has had spiritual connotations, but in more recent years has been utilized in various forms of therapies (Perez-De-Albeniz & Holmes, 2000). For this program, mindful meditations were practiced. Brown and Ryan (2003) suggest "the concept of mindfulness has roots in Buddhist and other contemplative traditions where conscious attention and awareness are actively cultivated. It is most commonly defined as the state of being attentive to and aware of what is taking place in the present." The yoga instructor primarily using guided visualizations led the meditations.

Tai Chi is an Eastern form of the martial art Kung Fu and is believed to have originated in the year 1200. Unlike Kung Fu, Tai Chi is a conciliatory approach with fluid movements. Sattin, Easley, Wolf, Chen, and Kutner (2005) describe Tai Chi as, ”slow, rhythmic movements that emphasize trunk rotation, weight shifting, coordination, and a gradual narrowing of lower extremity stance.” The Tai Chi moves in this study included body awareness, especially in the lower half of the body (Dang, 1994). This intervention emphasized shifting of weight and coordination of movements, as described by Li et al. (2005).

**Significance**

Falls can be fatal or detrimental to health in older adults; therefore, fall prevention methods need to be established (Shumway-Cook et al., 1997). The improvement and maintenance of balance is a method of prevention against unintended falls; balance may increase with certain yoga poses, Tai Chi, and other balance exercises (Li et al., 2005; Oken et al., 2006). Confidence also has a role in prevention of falls and can be addressed with body awareness through meditation. The aim of this study was to investigate if yoga, Tai Chi, and meditation increased balance and balance confidence in older female adults who have osteoporosis. This study can be further developed into a yoga and balance exercise intervention targeted to those who are frail, have a previous history of severe falls, or those who use a walker or cane.

# CHAPTER TWO: LITERATURE REVIEW

Many studies have been conducted to support the significance of the proposed intervention study; however, to the researcher's knowledge, no study has been conducted combining Eastern modes of exercise, such as Tai Chi and yoga, with the purpose to increase balance and balance confidence in older adults. Few studies have determined the efficacy of meditation on balance confidence. Reviews of literature prior to the implementation of a study or intervention are impertinent to support of the importance of the study in discussion.

## Falls

In 2006, Stevens et al. studied the number of falls and the financial costs of falls that occurred in the year 2000. The purpose was to estimate medical costs for fatal and nonfatal falls in older adults of at least 65 years of age. The estimates were determined from several different data sets to represent the costs nationwide. The data sets used to estimate fatal falls included the 2000 National Center for Health Statistics' National Vital Statistics System (NVSS) and the Healthcare Cost and Utilization Project - Nationwide Impatient Sample (HCUP-NIS) for 2000. To estimate non-fatal falls, data sets used were the 1999 Medical Expenditure Panel Survey (MEPS) and the 2001 National Electronic Injury Surveillance System - All Injury Program (NEISS-AIP). Falls that did not cause an injury that needed medical attention were excluded. After running a generalized linear regression model to determine estimates, the number of incidences and their costs were categorized by gender, age, area of injury, and the type of injury. The study shows that in the year 2000, there were approximately 10,300 fatal falls and 2.6 million non-fatal falls. Fatal falls accrued approximately $2 million; non-fatal falls totaled to be $19 million. Women accounted for 74%, or $14 billion, of the costs for non-fatal falls. The authors conclude that interventions need to be established to decrease the number of falls. A

decrease in falls in an aging population will not only facilitate a healthier population, but will also reduce the individual and economic costs of healthcare for an improved quality of life (Stevens et al., 2006). Many components are involved in the cause of a fall, but some demographics may be at a higher risk than others.

The number of falls differs by gender, as determined by Stevens and Sogolow (2005). The purpose of this study was to determine the number of falls by gender and the types of injuries caused by these falls. These numbers were evaluated from the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP), which was taken by emergency departments (ED) across the United States. Only subjects who were 65 years of age or older and had reported an unintended fall were used in the evaluation process. The researchers estimated that 1.64 million older adults were taken to an ED due to unintentional falls. Women account for seventy percent (1.16 million) of these incidents. Over a third of falls in women (37.8%) resulted in a fracture; this injury rate was 2.2 times higher in women than in men. Based off of these results, the researchers conclude that women's injuries due to falls may be more severe. The researchers also noted that the need for interventions is known, but more research is needed to determine the most effective strategies for fall prevention (Stevens & Sogolow, 2005). Falls in older adults can be devastating; many studies have evaluated the aftermath of a fall. Many studies have also evaluated the cause, time, and place of falls and how this affects a loss of balance.

In 2007, Nachreiner, Findorff, Wyman, and McCarthy conducted a study with 263 female participants to adequately describe the circumstances and consequences of unintended falls in older adults. Participants, who were at least 70 years of age, were involved in the Fall Evaluation and Prevention Program (FEPP), which was a 12-week randomized control trial, and were asked

to report each fall for two years after the intervention. At the end of the two-year data collection period, a chi-square test revealed that over half of participants (54%) reported to have fallen at least once. Two-thirds of participants (61%) reported to have fallen indoors. Of the 341 total falls reported, almost one-fourth of falls (23.2%) were due to a loss of balance. The authors conclude that falls due to loss of balance elicits the need for interventions that are designed to address balance and strength (Nachreiner et al., 2007). An unintended fall can be a devastating event to an older adult, which supports the need for promoting awareness, especially amongst community-dwelling adults.

Falls may contribute to a decline in functionality in older adults, as determined by Tinetti and Williams (1998). The purpose of this study was to examine the number of falls, the injuries due to the falls, and functionality. The participants of this three-year study consisted of 770 community-dwelling older adults of at least 71 years of age. Functionality was determined by questionnaires and interviews of basic activities of daily living and instrumental activities of daily living. Falls were self-reported by monthly fall calendars. Fall injury information was obtained from ED. Assessments were taken at baseline, one year, and three years. The three-year analysis revealed that 50% of participants had at least one fall; ten percent of total participants had at least one fall resulting in an injury. Women were more likely to be injured due to the fall than men. The authors noted that the weakening of balance and gait and the decrease of confidence result in a decline in functionality. Although this study's purpose did not include finding such a correlation, that authors note that falling also contributes to functional decline. The authors conclude that falling is a preventable health condition, and that prevention tactics should be implemented (Tinetti & Williams, 1998).

A limitation to previous studies was the lack of diversity in demographics. Additionally, all falls were self-reported, allowing for errors in misreporting due to failure of participants to remember.

**Balance**

Multidimensional balance interventions have been shown to increase balance, such as in the study conducted by Shumway-Cook et al., (1997). The purpose of this study was to determine the effectiveness of a balance program on fall risk, balance, and mobility in older adults. Participants ($n$ = 84) were categorized into a fully-adherent exercise group (FAE), a partially-adherent exercise group (PAE), or a control group. Participants were of 65 years of age or older and dwellers of a community. After assessments of balance, mobility, and fall history, participants were given a personalized balance exercise program to last eight to 12 weeks in duration. An ANOVA test revealed that balance, as assessed by the Berg Balance Scale and the Balance Self-Perceptions Test, significantly improved in both FAE and PAE groups when compared with the control group ($p < 0.001$). The FAE group decreased their risk of falling more so than the PAE group. The authors conclude that the adherence to a balance exercise program can reduce the risk of falls; a balance exercise program can also increase balance, mobility, and functionality in older adults (Shumway-Cook et al., 1997). A strength of this study was use of a control group; the authors did not specify if participants were randomly assigned. Participants were not considered to be frail or unhealthy; therefore, this study may not be applicable to frail older adults.

**Yoga and Meditation**

A previous research study (Tuzun et al., 2010) created a yoga intervention to increase balance and quality of life in participants. The purpose of this study was to compare a yoga

exercise group with a classic exercise group on the differing effects on balance. The yoga group practiced hatha yoga, which focused on movement and breath. The exercise group performed traditional exercises, focusing on strengthening and stretching exercises of all major muscle groups. Twenty-six subjects participated in the study. Participants were postmenopausal osteoporotic women, 55 years of age or older. Participants met for one hour per session, meeting twice a week; the intervention was 12 weeks in duration. Pre- and post-assessments included a Quality of Life survey and a neuromuscular test battery. The Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO) includes questions concerning pain, functional activity of daily living, functional activity of households, mobility, social functions, general health perception, and mental health status. The neuromuscular test battery measured balance, using the tests one-legged stance, body sway, and tandem walk. The traditional exercise group significantly improved in only sections of QUALEFFO, specifically the pain and functional activity of daily living sections and the total QUALEFFO score ($p = 0.005$, $p = 0.042$, $p = 0.016$, respectively). All sections of QUALEFFO significantly improved from baseline to post-intervention in the yoga group; this included pain, functional activity of daily living, functional activity of households, mobility, social functions, general health perception, mental health status, and the total score ($p = 0.007$, $p = 0.005$, $p = 0.003$, $p = 0.002$, $p = 0.027$, $p = 0.002$, $p = 0.040$, $p = 0.002$, respectively). The one-leg balance assessment significantly improved in the yoga group for both the right ($p = 0.027$) and left leg ($p = 0.012$), but did not in the exercise group for the right leg ($p = 0.231$) and left leg ($p = 0.173$). The authors conclude yoga training has been shown to be advantageous in balance in osteoporotic women and may be an effective alternative to strength training exercise; however, more research is needed to support this idea

(Tuzun et al., 2010). While this study focused on yoga as a balance intervention, other studies have also incorporated balance confidence components.

Another yoga intervention focused on balance and addressed fear of falling (Schmid, Van Puymbroeck, & Koceja, 2010). The purpose of this study was to determine if a 12-week hatha yoga intervention improved balance and fear of falling. Fourteen participants from a retirement community joined the study; all were at least 65 years of age and reported a fear of falling. The intervention consisted of 75-minute sessions, meeting twice a week. Assessments of balance, fear of falling, and flexibility were taken at baseline, mid-, and post-intervention. Balance was assessed with the Berg Balance Scale, which utilizes different static and dynamic balance tests to determine overall balance. The Illinois Fear of Falling Measure assessed fear of falling, which is a 16-question survey. Flexibility was assessed with a sit-and-reach test and the back scratch test. Results indicated that static balance significantly increased ($p = 0.045$) but dynamic balance and the total score from the Berg Balance Scale did not significantly increase ($p = 0.732$, $p = 0.280$, respectively). Fear of falling slightly decreased, but was non-significant ($p = 0.137$). Lower body flexibility, as assessed by the sit-and-reach test, increased by 34%, but non-significantly ($p = 0.290$). The authors conclude that this pilot study intervention sets the stage for further research into the field of yoga, balance, and fear of falling. It was noted that yoga is a feasible intervention to address balance and fear of falling, but should be challenging enough to find improvements (Schmid et al., 2010). Although research has supported previous findings of the benefits of yoga, few studies have analyzed the most effective and adherent type of yoga for older adults.

Chen, Tseng, Ting, and Huang (2007) developed a two-phase study to evaluate the most feasible yoga practice. The authors identified that the priority of the study was to create a yoga

program that participants could easily adopt and practice regularly. In Phase One of this study, 10 experts in the fields of yoga, gerontology, education, physical therapy, medicine, and osteopathy were consulted to determine an effective yoga treatment. In Phase Two of the study, practitioners analyzed the yoga class. The program, called the Silver Yoga Program, lasted one month; three 70-minute sessions were offered each week at a retirement community. Fourteen healthy older female adults of 60-86 years of age joined the study. After the completion of the program, participants were verbally interviewed on questions inquiring the level of difficulty, how feasible and acceptable the program was, if the program was helpful, and preferences on frequency, intensity, and time. Questions were ranked on a scale of one to 10, of which, 10 being the best score. Interview data was analyzed with frequencies, central tendencies, and percentages. The result of Phase One was the yoga format as agreed upon by the 10 experts. Analysis of the means from interviews in Phase Two revealed that participants rated acceptability, feasibility, and helpfulness between 8.8 and 9.5 on a scale of one to 10. The mean of difficulty reported was between 0.1 and 2.6 (10 labeled as most difficult) for the different portions of the yoga sessions. The authors conclude that the ratings from participants were consistent and positive. The Silver Yoga Program is suitable for this age group, but further research should be done to support this. Also, research should be conducted to determine appropriate yoga classes for those who are unhealthy or frail (Chen et al., 2007). Other components of yoga have been studied, such as the impact of yoga on quality of life.

Kraemer & Marguez (2009) sought to compare a yoga exercise group with a walking group in older adults. The purpose was to compare mood, anxiety, depression, exercise self-efficacy, and quality of life among participants in the yoga group with those in the walking group. The researchers hypothesized that the yoga group would have further improvements than

the walking group. Fifty-one participants of 50 years of age or older and most of whom were women, participated in the study. Measurements were taken before and after an acute bout of instructed yoga or an acute bout of walking. Questionnaires and surveys included the State-Trait Anxiety Inventory, the Positive and Negative Affect Schedule, Subjective Exercise Experiences Scale, The Godin Leisure-Time Exercise Questionnaire, the Center for Epidemiological Studies of Depression, the Barriers Self-Efficacy Scale, the Satisfaction with Life Scale, and the Exercise Barriers Questionnaire. The Fear of Falling and Physical Importance Profile questionnaires were also included. A one-way ANOVA test revealed that perceived barriers to exercise were significantly greater in the yoga group, but that quality of life was significantly greater in the walking group ($p < 0.01$, $p < 0.05$). Fatigue significantly decreased in only the yoga group after the yoga exercise bout ($p < 0.05$). The researchers conclude that those participating in the yoga bout may have chosen to do yoga because of chronic depression and low level of quality of life. The decrease in fatigue post-yoga session supports previous research of this idea. The authors note that more research is needed, but that this study supports the benefits of yoga as physical activity (Kraemer & Marguez, 2009). For some, yoga can entail more than a physical purpose; the following study sought to determine any impact yoga may have on mental and emotional components.

Oken et al. (2006) conducted a study to determine any changes in cognitive function, fatigue, mood, and quality of life in older adults after a yoga intervention. A total of 135 older adults, who were 65-85 years of age, were randomly assigned to a yoga group, an exercise group, or a wait-list control group. The intervention was 6 months in duration, meeting once weekly for 90 minutes. Assessments, which were taken at baseline and after the intervention, consisted of numerous questionnaires and tests of quality of life, alertness, mood, anxiety, fatigue, as well as

physical components. Balance was assessed with a one-legged stand timed test for as long as possible. An ANCOVA test was conducted to determine differences. In addition to significant improvement in quality of life ($p = 0.006$) the yoga group also significantly improved in the one-legged balance timed test ($p < 0.05$). However, the yoga group did not differ in cognitive function ($p > 0.05$). The authors conclude that while a yoga intervention may increase balance and physical components, it may not improve cognitive function in older adults (Oken et al., 2006). Yoga and its impact on balance have been tested in many different demographics, including healthy young adults.

Yoga in young adults has been shown to increase steadiness and balance (Hart & Tracy, 2008). The purpose of this study was to determine if the style of Bikram yoga would improve strength and steadiness in participants 21-39 years of age. Participants ($n = 11$) were healthy and reported to being physically activity prior to the study. Two groups existed: a yoga group, and a control group. The yoga group received a Bikram yoga intervention; the control group received nothing, but was encouraged to continue in regular physical activity. Isometric strength, acceleration fluctuations, and balance were assessed before and after the intervention. Balance was assessed with a one-legged timed balance test for up to 30-seconds. The Bikram intervention was eight weeks in duration, with three 90-minute sessions per week. An ANOVA with repeated measures test was conducted; balance significantly improved in the yoga group ($p < 0.05$) but not in the control group ($p > 0.05$). Ninety percent of participants in the yoga group had improvements in balance time. The authors noted that because the form of yoga has been shown to increase balance in older adults, the results of this study indicate that balance should expect to improve in older adults who participate in yoga (Hart & Tracy, 2008).

Dhume & Dhume (1991) conducted a study to compare the usage of dextroamphetamines with the engagement of meditation on balance using a balance board. Dextroamphetamines are drugs used to stimulate the central nervous system and increase concentration. Participants were tested each day for 10 days. Participants ($n$ = 18) were of 17 to 21 years of age and were placed into one of three groups: a placebo (control) group, a yogic meditation group, or a dextroamphetamine group. The placebo and dextroamphetamine groups blindly received a sugar capsule or a dextroamphetamine capsule with the knowledge that they were receiving either a placebo or a dextroamphetamine capsule. The both groups received the capsule one hour prior to testing. The yogic meditation group had been practicing yogic meditation for at least one year prior to the study. Testing of balance and control was performed in a seated position on a balance board. Balance was determined by time spent balanced on the board without error (one side touching the floor). Results indicated that the learning curve ceased after day five of testing. The dextroamphetamine group had a reduction in balance control as shown by a decrease in average time by 40.6%. When compared to the control group, the yogic meditation group improved in balance time by 27.8%. The authors conclude that the dextroamphetamine drug may not enhance performance in balance or control on a balance board. The authors also conclude that meditation is recommended for concentration and control of one's body (Dhume & Dhume, 1991).

Some of the previous studies were weakened by lack of control group (Tuzun et al., 2010) and random sampling (Dhume & Dhume, 1991; Hart & Tracy, 2008). This can be expected in the area of yoga research. Although yoga is an ancient practice, yoga in scientific research is relatively new. All the previously mentioned studies included participants who were healthy. One study included young adults; the other studies focused on older adults, but no studies focused on frail or highly inactive individuals. This weakens the generalizability.

**Tai Chi**

Mendes de Leon, Seeman, Baker, Richardson, and Tinetti (1996) conducted a study to determine the role of self-efficacy in daily living activities amongst the older adult population. This study analyzed data from Project Safety, which was a study of community-dwelling older adults of the age of 72 or older. Participants, $n = 846$, were interviewed at baseline and at 18 months as well as administered questionnaires and physical fitness assessments. Self-efficacy of activities of daily living was assessed by the Falls Efficacy Scale (FES); basic activities of daily living were assessed with the Katz scale. Toe taps test, chair stands test, completing a full circle test, and a walk test were administered to assess gait and balance. An ANOVA and chi square tests were conducted. Those who scored low in self-efficacy on FES also had the greatest decline in activities of daily living after the 18 months ($p < 0.001$). Low scores on FES were shown to be associated with poor testing results of the physical components tests ($p < 0.001$). With age, activities of daily living decreased ($p < 0.001$). The authors conclude that the functional capacity of participants and their self-efficacy with physiological status was shown to have significant interaction (Mendes de Leon et al., 1996). Other studies have sought to intervene with feelings of low self-efficacy.

The purpose of a 2011 study by Huang et al. was to compare the outcomes of three intervention groups with fear of falling, mobility, social support and quality of life. The intervention groups consisted of a cognitive-behavioral group, a Tai Chi with cognitive-behavioral group (TCB), and a control group. The Tai Chi portion consisted of 10 Yang-style poses to strengthen balance. The portions of cognitive-behavioral consisted of discussions of fear of falling. The intervention was five months in duration with a total of 176 community-dwelling participants who were at least 60 years of age. Self-reported falls were assessed three months

before and after the intervention. Mobility was assessed before and after the interventions with the Tinetti Mobility Scale, which evaluates gait and balance. ANOVA and chi-square tests were conducted to determine differences. Although falls reported in the TCB group decreased slightly after the intervention, this was not a significant effect. Post-intervention assessments of balance were significantly higher in the TCB group compared with the other two groups, $p < 0.001$. Based off of the results of the study, the authors conclude that Tai Chi combined with cognitive-behavioral is an effective intervention to decrease fear of falling and increase balance in older adults (Huang et al., 2011). Other studies have also found the impact of Tai Chi on balance and balance confidence.

In 2003, Mihay et al. developed a pilot study intervention of Tai Chi inspired exercise for community-dwelling older adults. A total of 35 participants were divided into either an experimental group or a control group. The mean age of participants was 72.76 years of age. The intervention was six weeks in duration, meeting for 45 minutes for three days a week. Pre- and post-assessments were taken with the Activities-specific Balance Confidence (ABC) Scale, the Berg Balance Scale and the Limits of Stability Assessment. An ANCOVA test revealed that both the ABC scale and Berg Balance Scale were significantly larger in the experimental group than in the control group in post-assessments ($p = 0.001$). The authors conclude that more research needs to be conducted to determine the effectiveness of this type of intervention on the number of falls (Mihay et al., 2003). Other studies have designed similar interventions with the purpose of determining its effect on the number of falls in older adults.

One study sought to elaborate on the effects of Tai Chi on balance and the number of falls (Li et al., 2005). The purpose of this study was to determine if a six-month Tai Chi intervention was effective in reducing falls in older adults and to determine if balance and fear of

falling improved. A total of 256 participants were randomly assigned to a Tai Chi group or a stretching control group. Participants were at least 70 years of age. Assessments of balance, fear of falling, and functionality were taken with the Berg Balance Scale, Dynamic Gait Index, Functional Reach, timed up-and-go (TUG), and the Survey of Activities and Fear of Falling in the Elderly (SAFFE). Measurements were taken at baseline, three months, six months, and six months after the intervention. An ANOVA with repeated measures test was conducted. Results indicated that the Tai Chi group had significantly less falls amongst participants than in the control group at the end of the intervention and six months after the intervention ($p = 0.007$, $p < 0.001$, respectively). Scores of the Berg Balance Scale and TUG significantly improved in the Tai Chi group ($p < 0.001$, $p < 0.001$, respectively). The authors conclude that regular Tai Chi practice can improve balance, functionality, and reduce the fear of falling. Additionally, Tai Chi can decrease the number of falls in older adults (Li et al., 2005).

Limitations to the previously mentioned studies include lack of random assignment or lack of control group. All the studies used numerous forms of assessments of balance, self-efficacy, or number of falls. No study mentioned the inclusion of frail or ill older adults; therefore, the conclusions of the studies may only be applicable to healthy older adults.

**Instruments**

The instruments involved in this research study are timed tandem walk (TTW), timed tandem stand (TTS), the timed up-and-go test (TUG), and the Activities-specific Balance Confidence (ABC) Scale. All instruments have been previously developed specifically for assessment of balance and balance confidence in older adults. Previous research has deemed the instruments appropriate and useful.

One study sought to determine the predictability of falls based on of assessments of balance and strength (Stel, Smit, Pluijm, & Lips, 2003). The secondary purpose of this study was to identify risk factors that are most highly associated with repeated falling occurrences. This study was a subsample of the Longitudinal Aging Study Amsterdam, which included participants ($n$ = 439) who were older adults aged 55 to 85 years. Balance was assessed with a force platform and with TTS; strength was assessed with a leg extension dynamometer and a handgrip dynamometer. Physical performance was assessed with a TUG test and chair stands. Participants were asked to report any falls from the previous year and to report any falls the following year with a fall calendar. Statistical analyses included t-tests, Mann-Whitney tests, and chi-square tests. During the year after the assessments, 21.1% of participants reported to have at least one fall while 23.4% reported to have fallen at least twice. Poor performance on the TTS combined with poor performance in the TUG test was significantly correlated with recurrent falling ($p <$ 0.05). The authors conclude that the TTS test is easily measurable and is a predictor of recurrent falls in older adults (Stel et al., 2003). Other studies have also tested TUG and its use of balance assessment in older adults.

The purpose of this study was to determine if TUG is a better predictor of health in older adults compared to gait speed (Viccaro, Perera, & Studenski, 2011). Participants were at least 65 years of age and considered healthy physically and mentally. Assessments of TUG and gait speed were taken every 12 weeks for one year of the 457 participants; they were also asked to report number of falls in the past year and any hospitalizations. Health status was assessed with surveys, such as EuroQol health-related quality of life scale and the Medical Outcomes Study 36-item Short-Form Health Survey. Also, functional fitness status was assessed with the National Interview Survey (NIS) activities of daily living scale and the SF-36 Physical Function Index

(PFI). Performance measures were analyzed by comparing areas under the curve (AUC) of the receiver operating characteristic (ROC) curves. The TUG and gait speed tests both alone and together were determined to have acceptable discriminative properties when distinguishing between fallers and non-fallers (AUCs = 0.7 - 0.8). Both gait speed and TUG have acceptable predictive qualities for health, falls, and the NIS ADL survey, but both were not acceptable predictors of declines in EuroQol, physical function, or hospitalization (AUC > 0.7, AUC <0.7, respectively). The authors conclude that although both TUG and gait speeds are predictors of health and daily function in older adults, the combination of the two together does not increase predictability (Viccaro et al., 2011). While this study found benefits of TTS and TUG tests, others have also tested validity of timed tandem walk and ABC.

Shimada et al. (2009) conducted a study to assess feasibility and validity of several strength, balance, and gait tests designed for older adults. Tests analyzed included handgrip strength (HG), chair stands (CS), one-leg standing (OLS), functional reach (FR), TTW, six-meter walk test at a comfortable (CWP) and maximum pace (MWP), and the TUG test. The mental status questionnaire (MSQ) was also an assessment tool. Participants were previously involved in the Tsukui Ordered Useful Care for Health (TOUCH) program and at least 65 years of age. Of the 3,340 participants at baseline, 455 participants completed all the assessments. A group t-test to determine validity revealed that those who fell, in comparison to those who did not, had poorer performance measures in OLS ($p = 0.003$), TWT ($p = 0.001$), CWP ($p = 0.013$), MWP ($p = 0.007$), and TUG ($p = 0.011$). A logistic regression analysis revealed that TUG is a significant predictor of falls (*OR* 1.03, 95% CI [1.01-1.06]; $p < 0.02$) and TWT is a significant, yet weak predictor of falls (*OR* .92, 95% CI [0.86-0.98]; $p = 0.01$). With 45 being the maximal score for total feasibility, external validity, sensitivity, and specificity, CWP, TWT, and OLS had the top

three highest scores, total score = 29, 25, 25, respectively. The authors conclude that while no test was shown to have high predictive accuracy, CWP is a superior test to fall predictability. The TWT was best independent predictor but not all participants were able to complete the test so it may not be appropriate for frail populations (Shimada et al., 2009).

The ABC scale was developed to assess balance confidence in specific situations in older adults (Powell & Myers, 1995). The purpose of this study was to create a questionnaire to assess balance confidence and compare it with FES. The FES may have a ceiling effect for individuals who are highly physically active. The first phase of the study consisted of development of the ABC scale by 27 participants of appropriate expertise. The ABC was modeled after the FES, but added six questions, for a total of 16. The questionnaire asks the subject rate confidence on a scale of 0-100% of performing a specific task. The second phase consisted of implementation of the assessment and interview process of participants receiving the assessment. Lastly, the questionnaire was administered to 21 participants. Cronbach's alpha of internal consistency was higher for ABC than FES ($r = 0.96$, $r = 0.90$, respectively). The ABC scale was determined to have high stability ($r = 0.92$, $p < 0.001$). ABC was determined to discriminate between fallers and non-fallers, although non-significantly ($p = 0.058$). Participants who were older, with more reported health problems, and required more assistance for mobility, were more likely to report a fall within the year ($p < 0.001$). The authors note that FES is appropriate for older adults who are frail and not regularly physically active; ABC is appropriate for older adults who have higher functionality and mobility and are physically active. The authors conclude that balance confidence may be just as important as exercise (Powell & Myers, 1995).

The previous studies that evaluated balance instruments are all limited in the fact that these instruments may not be appropriate for frail older adults and may not apply to those who

are not currently active. However, in a society where physical activity is frequently encouraged, older adults often engage in regular physical activity. In this case, these tests are appropriate. Additionally, the results may not be generalizable because the study was limited to one small geographic. The previously mentioned studies had sufficient sample size to find significance.

**Conclusions**

The studies discussed in the literature review support the expected findings of the proposed research study. Yoga has been shown to increase balance in healthy young adults as well as older adults (Hart & Tracy, 2008; Oken et al., 2006; Tuzun et al., 2010). Tai Chi is a popular method for increasing balance in older adults (Huang et al., 2011; Li et al., 2005). Fear of falling has also been shown to reduce due to Tai Chi interventions (Li et al., 2005). Confidence plays a crucial role in functionality in older adults, and is arguably just as important as physical balance (Powell & Myers, 1995). Yoga has been shown to increase balance in as little as eight to 12 weeks (Hart & Tracy, 2008; Schmid et al., 2010; Tuzun et al., 2010). The current intervention is seven weeks in duration, which allows enough time for balance to increase, but short enough to reduce the attrition rate. The researchers expected to find that balance and confidence would increase in participants due to an intervention of yoga, Tai Chi, and fear of falling discussions.

# CHAPTER THREE: METHODOLOGY

The objective of this study was to increase balance and balance confidence in older female adults. The methodology combined yoga, Tai Chi, and meditation as an intervention for older adult females. While yoga and Tai Chi individually may be an effective alternative to traditional strength training for osteoporosis, participants may be able to benefit from a combination of different types of exercises. This study sought to combine traditional osteoporosis exercises with Eastern styles of physical activity. Meditation has been shown to increase concentration when performing balance exercises (Dhume & Dhume, 1991). Tuzun et al. (2010) found that yoga training has been shown to be advantageous in balance in osteoporotic women and may be an effective alternative to strength training exercise; while this study was effective, more research is needed to support yoga and meditation as an alternative exercise intervention strategy.

## Participants

Prior to the study, approval was granted from the University of Central Oklahoma Institutional Review Board (see Appendix A). Participants were recruited from Tealridge, which is a local independent living retirement community, and the surrounding area. Flyers were distributed to promote the program; one information session was held to recruit and inform participants (see Appendix B). Expected sample size was 50 – 60 participants, based on an effect size of .56 with a power of .80, $\alpha = 0.05$ (Schmid et al., 2010). Participants included were older female adults who are at least 65 years of age and are in agreement with the Informed Consent Form (see Appendix C). Pre-screening of participants consisted of a questionnaire of contact information, age, and any previous diagnosis of osteoporosis or osteopenia (see Appendix D). Participants completed the Exercise and Screening for You (EASY) screening tool (see Appendix E). Based on the EASY screening tool, one participant was required to obtain her

physician's consent prior to the intervention. Participants were also asked to volunteer to allow photographs, which was consented with the Photo Release Form (Appendix F). Exclusion criteria included diagnosis of cardiovascular disease, previous severe falls or fractures, current full-time use of a cane or walker, or refusal to participate.

**Instruments**

Assessments of balance and balance confidence were measured at baseline and again at the completion of the seven-week intervention. Assessments included timed tandem walk (TTW), timed tandem stand (TTS), the timed up-and-go test (TUG), and the Activities-specific Balance Confidence (ABC) Scale. The TTW, TTS, and TUG tests measure balance performance; ABC measures confidence. A Qualitative Questionnaire was administered at post-tests (Appendix G). Data collection was obtained on-site of Tealridge Retirement Community and was administered by the researcher (see Appendix H). Assessments took place at baseline and after the intervention. All participants were administered each test, and were told to complete each test to the best of their ability. Participants were informed that they had the option to cease the testing at any point. Tools used included a measurement wheel, cones, tape, and pens. The test administrators were properly trained and most had previous experience in administering these tests to older adults.

**Timed tandem walk (TTW).** The TTW is a dynamic balance assessment test. Participants must walk an eight-foot line heel-to-toe without use of a walking aid. The walk is timed and any errors are recorded. Errors include stepping off the line or the temporary use of a walking aid, such as a wall or chair. Because of its high construct validity ($r = 0.86 – 0.98$, $p = 0.010$), TTW is an ideal predictor of falls in older adults because of its ability to distinguish between fallers and non-fallers ($p = 0.001$) (Shimada et al., 2009). Possible measurement errors

included poor description of instructions. Test instructions from the administrator included explanation that the test is timed; therefore the participant should try to complete the test as soon as possible. The administrator also emphasized that errors can be accrued, but after an error, to resume the test, as it does not cease due to an error. This test was completed one time per assessment.

**Timed tandem stand (TTS).** TTS assesses static balance. The participant stands heel-to-toe for up to 60 seconds. Up to three trials can be used, unless 60 seconds is reached in the previous trial. The best score was used in the data set. Because TTS measures mediolateral sway, it is an appropriate assessment for balance (Stel et al., 2003). This is a test of static balance, while the TUG is an assessment of dynamic balance, gait, and agility.

**Timed up-and-go (TUG).** The TUG test is often used to assess dynamic balance in older adults and also predict falls. Podsiadlo and Richardson created the test in 1991. The American Geriatrics Society recommends the TUG test as an assessment of fall prediction (Viccaro et al., 2011). Steffen, Hacker, and Mollinger (2002) found that the TUG test had an intraclass correlation of $R = .97$. TUG is a significant predictor of discriminating between fallers and non-fallers ($p < 0.02$) (Shimada et al., 2009). This test is recommended for older adults who are healthy and live active lifestyles (Steffen et al., 2002).

The TUG test is quick and relatively simple, but carelessness can result in measurement errors. One possible measurement error is a misunderstanding by the subject that a walking pace should be as quick as possible. Another possible measurement error is if the subject is unfamiliar with the test or has not had an opportunity to warm up. To eliminate, or at least decrease, the chance of these measurement errors, the test administrator clearly explained that the TUG test

should be completed as quickly as possible. The participants were given the opportunity for a practice trial and two actual trials; the best score was accepted for the data set.

**Activities-specific Balance Confidence (ABC) Scale.** Activities-specific Balance Confidence Scale is a self-administered survey to assess individuals balance confidence during daily activities (see Appendix I). The 16-question survey asks the participant to rank confidence by percentage, ranging from zero to 100 (Powell & Myers, 1995). The administrator averages the scores of each ABC survey. The ABC scale is considered to be test-retest reliable, $r = .92$, and approaches significance in discriminative properties between fallers and non-fallers, $p = 0.058$ (Powell & Myers, 1995). The ABC scale is appropriate for independent-living and physically active older adults (Powell & Myers, 1995). Administration of the test included explanation and clarification of test.

**Procedures**

The purpose of this intervention was to increase balance and confidence in older adult female participants. The intervention consisted of a program of yoga and basic Tai Chi. Balance was addressed with yoga and Tai Chi exercise intervention. Balance confidence was addressed with guided meditations. Participants were randomly assigned to one of two groups. Both the control group and experimental group received yoga and Tai Chi balance exercises; only the experimental group received meditation, which took place before the exercise.

The intervention was seven weeks in duration. Participants were encouraged to join the group exercise intervention twice a week for 30 minutes, which was the duration of each class. If participants missed more than two consecutive classes without notifying the instructor, the participant was contacted to determine if she was still interested in the program. The primary investigator was the class instructor and is certified as a yoga instructor and a Tai Chi for

Balance instructor (Yoga Alliance, 2010; Oklahoma City-County Health Department Tai Chi Certification, 2012).

**Program Schedule in Detail.** Every class began with a warm-up. A week-by-week schedule is detailed in Appendix J. Participants were encouraged to stand for the warm-up, but were welcome to remain seated. Most warm-up movements could be modified for those in the seated position. The warm-up consisted of gentle rotation or movement of most major points, including neck, shoulders, wrists, hips, knees, and ankles.

After the warm-up, participants were instructed to join the Tai Chi portion, which started with 'steps'. Stepping includes side-to-side toe tapping, with an emphasis in heel-to-toe stepping. This method is a beneficial practice for heel-to-toe walking to avoid tripping or falling and is an encouraged form of stepping throughout Tai Chi practices. The portion titled 'ball' includes stepping side-to-side with the hands forming a position as if holding a ball close to the torso of the body.

Following the Tai Chi movements was the yoga portion of the intervention, which began with 'Warrior Three' and 'Tree' poses. Both are static standing balance poses. Participants were highly encouraged to practice at their level and use a chair to hold on to with one or both hands, if needed. Those seeking advanced balance practice were advised to begin practicing the poses without full-time use of a chair for support. 'Warrior Two' was initially practiced in the seated position, but participants were encouraged to practice this pose standing, if appropriate. The poses were held for one to two seconds; participants were encouraged to slowly return to the initial position. Cueing into and out of these poses was coordinated with breath. Over the duration of the intervention, participants were encouraged to hold isometric poses for up to five

seconds. Instead of statically holding the poses for longer durations, participants held each posture for short amounts of time, but were repeated up to five times.

The experimental group class began in the seated position in a chair to follow a guided meditation with visualizations. Participants were guided through a meditation that describes them feeling confident with walking independently. Meditations also included visualizations of walking and body awareness to increase confidence. The meditation portion lasted approximately five to 10 minutes.

**Special Considerations.** Modifications for each exercise were given as options to all participants. Chairs were utilized for modifications. Because repeated trunk flexion and extension movements are a contraindication of osteoporosis, these movements were avoided (Mishra, 2011; Krucoff, C., Carson, Peterson, Shipp, & Krucoff, 2010).

**Design & Analysis**

After the completion of the seven-week intervention, pre- and post-assessment data were analyzed. The hypothesis ($H_1$) was that with an intervention of balance exercises, including yoga and Tai Chi, balance in both groups would improve, and balance confidence would improve in the experimental group. The dependent variables are balance and confidence; the independent variables are the group assignment and time. One participant's TTW score was deleted due to incorrect completion of the test, both during pre- and post-assessments. Descriptive statistics were analyzed to determine if any outliers existed; all outliers were reasonable and were kept in the data (Figures 1 – 3). Independent t-tests were conducted to compare groups' scores and age at baseline. Interaction, group, and time effects were analyzed using a 2 x 2 ANOVA with repeated measures for each dependent variable. During post-tests, participants also answered a Qualitative Questionnaire, to assess their experiences of the program.

# CHAPTER FOUR: RESULTS

The purpose of this study was to increase balance confidence in older female adults through a yoga, Tai Chi, and meditation intervention. Balance was predicted to improve with yoga and Tai Chi balance exercises. Balance confidence was predicted to increase with guided mindful meditations.

The mean age for the experimental group and control group was 77.80±5.93 and 81.80±10.23, respectively. The mean age for the entire sample was 81.44±6.67. Independent t-test revealed that no significant differences in age existed between groups at baseline ($t$ = -.756; $p$ = .471). Descriptive statistics for TTW, TTS, TUG, and ABC can be seen in Table 1; descriptive statistics for variables by group are in Table 2, along with effect sizes and mean differences calculations. Independent t-tests revealed that no significant differences existed between the experimental and control group at baseline (Table 3). TTW Errors was nearing significance ($p$ = .087). Statistical tests of 2 X 2 ANOVA with repeated measures were conducted for TTW, TTW Errors, TTS, TUG, and ABC.

**Timed Tandem Walk**

The means for TTW pre-test and post-test in the experimental group were 14.89±8.30 seconds and 14.94±7.36 seconds, respectively. TTW means for pre-test and post-test in the control group were 14.75±6.44 seconds and 14.16±7.00 seconds, respectively. Kurtosis of -2.99 was found for TTW pre-test in the experimental group. Skewness of 1.21 was found in the post-test for the experimental group. Both Skewness and Kurtosis were found in the control group's post-tests (-1.99 and 3.98, respectively). No outliers were found for TTW in either group.

The 2 X 2 ANOVA with repeated measures revealed that the group by time interaction was non-significant ($F$ = .061; $p$ = .812). Time effect differences from pre-test to post-test were non-

significant ($F$ = .043; $p$ = .841). Group effect differences between subjects for TTW was non-significant ($F$ = .009; $p$ = .926). Results for these statistical analyses of TTW can be viewed in Table 4; the time effect can be viewed in Figure 4. Effect sizes and mean differences were calculated and are displayed in Table 2. A small effect size of -0.01 was found for TTW in the experimental group. A mean difference of -0.05 exists in the experimental group for TTW. The increase in time by 0.05 seconds in the experimental group from pre-test to post-test indicates a decline in performance, as the TTW is intended to be completed as quickly as possible. However, the performance change is minute. A mean difference of 0.59 exists for the control group in TTW, which resulted in a small effect size of 0.09 for TTW in the control group. The control group improved their overall performance by decreasing their mean time by 0.59 seconds.

**Timed Tandem Walk Errors**

Pre-test and post-test TTW Errors in the experimental group for were 4.80±3.35 and 3.80±2.86, respectively. The mean for the control group in TTW for pre-test were 1.25±1.26; the post-test mean was 3.50±3.32. Both Skewness and Kurtosis (1.13 and 2.23, respectively) were found in the control group of TTW Errors pre-test. Kurtosis was found in both groups' post-tests; the experimental group had Kurtosis of 1.67 and the control group had Kurtosis of 1.93. No outliers were found. The TTW balance test requires participants to tandem walk without a walking aid. If the participant steps off the line or touches the wall, an error is counted. One participant was unable to successfully complete the TTW balance test without full use of the wall at pre-test and post-test; therefore, the data for that for TTW and TTW Errors only includes nine participants. All other tests included all 10 participants.

The 2 X 2 ANOVA with repeated measures test revealed that TTW Errors group by time

interaction was significant ($F$ of 6.639; $p$ = .037). TTW Errors time within subjects and group effect differences between subjects were non-significant ($F$ = .982; $p$ = .355, $F$ = 1.120; $p$ = .325, respectively). Results for TTW Errors can be seen in Table 5; the time effect graph can be seen in Figure 5. Two separate dependent t-tests were conducted to determine any significant change from pre-test to post-test in either group. The change in the experimental group from pre-test to post-test was non-significant ($t$ =1.29; $p$ = .266); the change in the control group from pre-test to post-test was also non-significant ($t$ = -2.18; $p$ = .117). TTW Errors experimental group had a mean difference of 1.00 with a small effect size of 0.30; this indicates an improvement in performance, as errors indicate lack of stability. The control group had a mean difference of -2.25 and a large effect size of -1.79. The control group declined in performance, as seen by the increase of 2.25 on average in TTW errors.

**Timed Tandem Walk and Errors Correlation**

A Pearson Correlation was conducted to determine if a relationship existed between the time of TTW and the errors accrued. Correlations were conducted by sample and by group. There was a non-significant, positive, and moderate correlation between TTW and Errors at pre-test ($r$ = .597; $p$ = .090). A significant correlation was found between TTW and Errors at post-test; this correlation was strong and positive ($r$ = .805; $p$ = .009). Table 6 displays the results of the correlations by sample; a scatterplot of this correlation is Figure 6.

The experimental group had significant correlations at pre-test and post-test; both were strong and positive (pre-test: $r$ = .885; $p$ = .046; post-test: $r$ = .878; $p$ = .050). At pre-test, the control group had a positive, small, and non-significant correlation between TTW and Errors ($r$ = .235; $p$ = .765). At post-test, the control group had a positive, moderate, and non-significant correlation between TTW and Errors ($r$ = .724; $p$ = .276). Table 7 displays the results of the

correlations by sample; Figures 7 and 8 display scatterplots of the experimental group correlations at pre-test and post-test.

**Timed Tandem Stand**

The TTS balance test can be timed for up to 60 seconds; the longer the test is held by the participant, the stronger the indication of balance. The mean for TTS experimental group pre-test was 40.10±27.065 seconds; the TTS experimental group post-test mean was 41.89±24.34 seconds. The mean for TTS control group pre-test was 38.97±24.47 seconds; the TTS control group post-test mean was 35.01±28.91 seconds. The distribution for TTS pre-tests was not normal. Kurtosis of -2.58 existed in the experimental group; Kurtosis of -5.55 existed in the control group. Skewness and Kurtosis were found in the experimental group's post-tests (-1.5 and 1.98, respectively). Kurtosis (-5.89) was found in the control group. One outlier was found for TTS post-test, but was kept in the data set because it is a feasible outcome (Figure 1).

The 2 X 2 ANOVA with repeated measures tests revealed that no significance was found for group by time interaction, time effect, and group effect differences ($p$ = .242, $p$ = .578, $p$ = .555, respectively); results of this test are shown in Table 8. A graph of change is in Figure 9. The mean difference for the experimental group was -1.79; the effect size was small at -0.06. The increase in time of 1.79 seconds indicates an improvement in performance of this test. The control group mean difference from pre-test to post-test was 3.96, with a small effect size of 0.16. The average decrease of 3.96 seconds in the control group indicates a decline in performance in TTS.

**Timed Up-and-Go**

The experimental group pre-test mean was 9.06±6.02 seconds; the post-test mean was 9.01±5.65 seconds. The control group pre-test and post-test means were 8.01±1.86 seconds and

7.79±1.61 seconds, respectively. The experimental group pre-test had Skewness of 1.90 and Kurtosis of 3.87. The control group pre-test also had Skewness of -1.61 and Kurtosis of 3.03. The experimental group post-tests had both Skewness (1.88) and Kurtosis (3.49). The control group also had Skewness (-1.53) and Kurtosis (2.37). One outlier was found for TUG post-test, but was kept in the data set because it is a feasible outcome (Figure 2).

The group by time interaction was non-significant (F = .395, $p$ = .547). The time effect within subjects was non-significant (F = .286, $p$ = .608); group effect for TUG was also non-significant (F = .036, $p$ = .855; Table 9). A graph of change is Figure 10. Effect sizes and mean differences were calculated and are displayed in Table 2. A small effect size of 0.01 was found for TUG in the experimental group; a small effect size of 0.12 was found for TUG in the control group. A mean difference of 0.05 exists in the experimental group, while a mean difference of 0.23 exists for the control group. This indicates that both the experimental and control group improved their performance by decreasing their mean time from pre-test to post-test.

**Activities-specific Balance Confidence Scale**

The means for the experimental group pre-test and post-test were 65.40±35.98% and 73.06±19.34%, respectively. The control group mean for pre-test was 78.13±28.24%; the control group mean for post-test was 73.06±28.64%. The experimental group pre-test had Kurtosis of -2.60. The control group had Skewness and Kurtosis (-1.86 and 3.60, respectively). The post-tests of the experimental group had both Skewness (-1.09) and Kurtosis (1.49); the post-tests of the control group also had Skewness (-1.42) and Kurtosis (2.56). One outlier was found for TTS post-test, but was kept in the data set because it is a feasible outcome (Figure 3).

The results for the ANOVA with repeated measures were non-significant for group by time interaction (F = 1.993, $p$ = .196); results are displayed in Table 10. A graph of change is found in

Figure 11. Non-significance was also found for the time effect (F = .066, $p$ = .803) and group effect (F = .014, $p$ = .919). A small improvement (ES = -0.21) was found in the experimental group with a mean difference of -7.66. The control group had a reduction in the mean difference of 5.06% and an effect size of 0.18.

# CHAPTER FIVE: DISCUSSION

It was predicted that balance would improve in both groups; however, only the Timed Tandem Walk (TTW) Errors in the experimental group had significant improvement from pre-test to post-test and had a large difference in effect size. Both groups received the same exercise intervention and progressions were applied to both groups simultaneously. The primary investigator also predicted that balance confidence would improve with meditation in the experimental group. Although the results were non-significant, there was a trend as seen in the effect sizes. Assessments taken at baseline and after the intervention included TTW, timed tandem stand (TTS), the timed up-and-go test (TUG), and the Activities-specific Balance Confidence (ABC) Scale.

## Balance

**Timed Tandem Walk.** The TTW had no significant changes from pre-test to post-test in either group. The mean differences and effect sizes also displayed that differences from pre-test to post-test were very minor differences. The timed portion of the test may have not changed from pre-test to post-test but the number of errors counted did change. The 2 X 2 ANOVA with repeated measures test revealed that TTW Errors group by time interaction was significant. The mean differences and effect sizes further detailed the differences. The experimental group improved; the post-test revealed a total average of one less error than in the pre-test. The control group decreased in performance and had an average of 2.25 more errors in the post-test than in the pre-test.

For both the entire sample and by group, correlations of TTW and Errors were positive relationships; this interprets that for every correlation, the slower the speed to complete the test was correlated with higher errors. This suggests that this assessment tested balance ability as a

whole. Only the experimental group had significant and strong relationships between TTW and Errors, but all correlations were in a positive direction.

The TTW measures dynamic balance and can be a difficult test to perform. The 12-week yoga intervention conducted by Tuzun et al. (2010) found significant improvements in the experimental (yoga) group from pre-test to post-test in static balance, as assessed with the one-legged stance test, but not in dynamic balance, as assessed with the tandem walk. The TTW assessed dynamic balance performance; yoga balance postures often require static balance strength, which may explain why yoga does not improve dynamic balance in short-term interventions. The current intervention sought to increase dynamic balance with the inclusion of Tai Chi. The lack of time change in the TTW suggests that the test may have been too difficult to perform for the participants; one participant was unable to successfully complete the test at both pre-test and post-test. Future studies should include two dynamic balance assessments that vary in level, or include a progressive dynamic balance test.

The improvement of errors in the experimental group and the decline in performance in the control group suggest that concentration, as enriched by the meditation portion, is an important component of maintaining dynamic balance. Although the experimental group did not improve in performance time, there was an improvement in the ability to maintain independent stability during the test.

The American College of Sports Medicine (ACSM) recommends dynamic movements, such as the tandem walk, to disturb an individual's center of gravity (Thompson, Gordon, & Pescatello, 2009). Dynamic balance is important for older adults to maintain independence and fulfill their everyday activities and needs.

**Timed Tandem Stand.** Although non-significant, the experimental group improved on average in performance for the TTS balance test by 1.7 seconds; the control group decreased on average by 3.96 seconds.

Hart and Tracy (2008) conducted a yoga balance intervention study for young adults; although the investigators did not use TTS, a similar test of one-legged balance test was used for static balance assessment. No significant results were found although 90% of participants in the yoga group improved their time in the balance test (Hart & Tracy, 2008). Another yoga intervention for older adults also found a significant increase in yoga participant's static balance measures after a six-month yoga trial; this study also assessed static balance with the one-legged balance test (Oken et al., 2006). In the study conducted by Oken et al. (2006), the mean age of the yoga group was 71.5±4.9 years of age, while in the study conducted by Hart and Tracy (2008), the yoga group had a mean age of 29.0±6.0 years of age. Although the study conducted by Oken et al. (2006) includes older adults, the yoga group was younger than this study's experimental group (77.80±4.933 years). The age difference may explain why the one-legged test was suitable for the study by Oken et al. (2006), and why there was an improvement in static balance performance.

Overall, for this study, the TTS was an appropriate test for the age and level of this sample. However, for the younger participants, the ceiling of this test, which was reaching 60 seconds, was easily obtainable. Future studies should include either multiple tests or progressive tests.

The aforementioned studies had yoga balance interventions for older adults, but did not include a meditation portion. It was expected that both groups would improve in balance in the current study; perhaps the mindful meditation prior to the balance exercises allowed for body

awareness, which improved static balance measures, in addition to added concentration during the TTW. Participants in the experimental group were guided through mindful meditation, with the aim of cultivating balance confidence and body awareness, especially in the lower extremities. This practice may have impacted their balance exercises, which was displayed in the balance assessment of TTS. The decline of TTS in the control group suggests that body awareness, confidence, and possibly concentration may be larger factors in balance than previously thought.

The American College of Sports Medicine (ACSM) recommends that older adults with a history of falls or mobility problems should practice postures that compromise the base of support (Thompson et al., 2009). This intervention's yoga postures sought to improve static balance by challenging participant's base of support.

**Timed Up-and-Go.** The TUG test also had non-significance in the 2 X 2 ANOVA with the repeated measures tests. The effect sizes showed that no differences existed from pre-test to post-test. A major component of the TUG test is gait, especially walking speed. DiBenedetto et al. (2005) determined that an eight-week yoga intervention can improve stride length, and therefore, walking speed. Tai Chi has been shown to significantly increase TUG performance, as seen in a six-month intervention for participants of 70 years or older (Li, Harmer, Fisher, McAuley, Chaumeton, Eckstrom, & Wilson, 2005). A hatha yoga program of eight weeks in duration also saw improvements in TUG in adults 68-90 years of age (Galantino et al., 2012). The three previously mentioned studies focused on primarily Tai Chi or yoga, whereas, this study combined the two. The hatha yoga study conducted by Galantino et al. (2012) met for 60 minutes, twice a week. The current study met for half that time: only 30 minutes per session,

twice a week. The investigators recommend for future Tai Chi and yoga balance interventions consist of 60-minute class times to allow enough time for advancement.

The TUG test requires strength, speed, coordination, and ability to adjust to change in momentum. Because of this, Viccaro et al. (2011), along with the American Geriatrics Society, recommend this test to assess fall risk in the older adult population. The current intervention sought to improve components of strength, coordination, gait, balance, and agility with yoga and Tai Chi. Based on the previous research (Hart & Tracy, 2008; Huang et al., 2011; Li et al., 2005; Oken et al., 2006; Tuzun et al., 2010; Xu, Hong, Li, & Chan, 2004) that these exercises have increased such physical components, one would expect TUG performance to improve. The lack of change in the TUG performance in the current study suggests that the intervention was not sufficient in either duration or programming to strengthen the participants' TUG scores. Future studies should seek to improve TUG because of its high predictability power, but should not forego the functionality of balance exercises by focusing on only test scores.

**Balance Confidence**

Although the 2 X 2 ANOVA with repeated measures displayed non-significant changes, the effect size in the experimental group was a small difference. The mean difference in the experimental group was -7.66, which means that the experimental group improved their mean ABC score by 7.66%. The control group decreased their ABC score by 5.06% from pre-test to post-test. It was predicted that with mindful meditation, the balance confidence of the experimental group would improve. Previous yoga programs that focused just on the physical practices of yoga actually saw a decrease in balance confidence after the three-month intervention; the authors suggested that throughout the program, participants became more aware of how their balance was impaired (Brown, Koziol, & Lotz, 2008). One participant of the current

study commented in the Qualitative Questionnaire that, “I am not as ‘stable’ balanced as I thought and probably overly confident.” Practicing balance exercises that are challenging may lead the individuals to feel less confident. The use of meditation for body awareness is a practice that participants can also use during physical balance exercises.

A one-year study, focusing on just Tai Chi in participants ages 70 years and older, found that ABC improved more in the Tai Chi group when compared to an comparison group of wellness education (Sattin et al., 2005). Zhang, Yamazaki, Morita, and Ohta (2006) conducted a short-term Tai Chi intervention for participants of at least 60 years of age; in this study, eight weeks was enough time to find a significant improvement of the Falls Efficacy Scale (FES). The FES is similar to the ABC scale, but assesses fear of falling rather than balance confidence. The Zhang et al. (2006) study was only eight weeks in duration, but met seven days a week for one hour per session. However, studies with short-term interventions also found an improvement in ABC scores; the Tai Chi for balance study conducted by Mihay et al. (2003) was a six-week program that met three days per week for 45 minutes per session. The eight-week study by Hakim et al. (2010) compared Tai Chi with yoga and no exercise to determine the effectiveness of the intervention on balance and balance confidence; although balance was shown to improve, balance confidence, as assessed by ABC, did not. Perhaps the same intervention of longer duration would have discovered changes in ABC scores. It is recommended that future studies conducting interventions similar to the current one be of longer duration, or consist of more sessions per week.

The ABC scale has a wide variety of questions with the intention of avoiding a ceiling affect (Powell & Myers, 1995). Because of the participants’ age range of nearly three decades in this study, such a variable scale is necessary. Future researchers utilizing the ABC scale should

also consider the Mini-Mental State Examination (MMSE) at pre-test to discern if any participants are affected by short-term or long-term memory issues.

**Meditation**

The instructor verbally led the meditation and guided participants to visualize and sense each body part. Other meditations included visualizing themselves walking. The visualizations were intended to cultivate body awareness. To the researcher's knowledge, no research on body awareness for balance in healthy adults or healthy older adults has been conducted. However, studies have been conducted for participants with fibromyalgia, anorexia, and other disorders. One study assessed qualitative measures on participants with schizophrenia or other psychiatric disorders (Gyllensten, Hansson, & Ekdahl, 2003). In this study, physiotherapists guided participants one-on-one through body awareness therapy (BAT) for three sessions. Participants reported feeling an improvement in balance and posture and more in control of their movements. The researchers of this study suggested the importance of BAT to improve such measures (Gyllensten et al., 2003).

Body awareness requires mindfulness of one's actions. Although body awareness is now in the stage of exploration in research, the idea is not new. Many exercise gurus, especially Joseph Pilates, incorporated mindfulness into exercise (Pilates & Miller, 1960). One of the major principles of Pilates is concentration (Siler, 2000). However, little research exists that connects body awareness to physical components and performance. Certainly, a major portion of exercise research is missing.

In addition to physical measures of participants, future studies should include evaluations of the meditation itself and participants' perceptions of the effects during the meditation and its effects after. The Effects of Meditation (EOM) scale, developed by Reavley and Pallant (2009),

is comprised to two parts: the EOM Experiences During Meditation and the EOM in Everyday Life. An instrument such as this would inform the researchers on the method of meditation and how participants receive it.

**Strengths and Limitations**

Although this study was exploratory research, a strength of this study was the innovative use of both physical and mental awareness to increase physical balance and balance confidence. Shumway-Cook et al. (1997) suggest there is a the need for multidimensional balance interventions for older adults. This intervention has created a multidimensional balance intervention by combining yoga, Tai Chi, and meditation. Previous research, such as reviewed by Fox (1999), have established that physical activity is beneficial for mental well-being for both the healthy and those with mental disorders, such as depression or anxiety; however, to the researcher's knowledge, no studies seek to determine the opposite: mental well-being in the form of body awareness and its impact on physical functions.

The intervention was strengthened by the dedication of participants; there was an attrition rate of zero. This may be because of the small number of participants involved and the short duration. The class time took place in the morning, which was a convenient time for the participants. Additionally, if participants had missed without notifying the instructor, those participants were called and reminded of the next class time.

Limitations of this study included a small sample size. Fifty to 60 participants were needed for sufficient statistical power; however, due to lack of resources and personnel, the sample size was 10 participants. Future studies of similar interventions should include a larger sample size. This may require multiple times and locations, such as retirement communities and

senior centers, to hold the intervention. A larger sample size may also require multiple instructors or staff for recruiting and management of the program.

This study was also limited by the short duration of the intervention of seven weeks. Although other studies focusing on yoga in older adults found differences in as little as eight weeks (DiBenedetto et al., 2005; Hart & Tracy, 2008), a longer duration of at least 12 weeks would be beneficial to allow enough time for improvement. Additionally, a longer class time of 60 minutes would be beneficial and may speed up the progression of exercises. It is suggested that participants also practice balance exercises on their own outside of class time. Participants could track their at-home exercises with log sheets. This strategy might also foster independence and balance confidence. The balance exercises of the current study did not progress as quickly as the investigator and instructor expected. This may be the result of the wide range of age (65 to 93 years) and ability. A longer duration and more class time or independent practice could allow for the balance exercises to progress to more difficult levels.

Future studies of longer duration could progress Tai Chi movements to include sequences as described by Dang (1994), such as ‘Part the Horse’s Mane’, ‘Single Whip’, ‘Repulse Monkey’, ‘Wave Hands Like Clouds’, and ‘Brush Knees’. Due to learning pace, physical abilities, and time allotment of the class, these sequences were excluded in the current intervention. These Tai Chi sequences improve balance and coordination; perhaps if the class time would have allowed these sequences the balance assessments would have improved significantly.

Classical yoga practices include pranayama (breathing exercises) prior to meditation (Dass, 1981). Pranayama is intended to be a calming practice to prepare for meditation. Due to the time constraints, this was excluded from the intervention. Meditation portions of yoga

practices typically occur at the end of the class. However, the instructor chose to lead the guided meditation at the beginning of the class instead to avoid interruptions that frequently took place at the end of the class time. This change could have resulted in a change in the progression of the class. The meditation was relaxing and calming, which may have been more difficult to transition to standing balance exercises. If the meditation was at the end of the class, participants could progress in balance exercises more quickly since they will not be transitioning from a state of relaxation. On the contrary, the mindful meditation was intended to cultivate body awareness, which may have sustained throughout the balance exercise practices.

Inclusion criteria for participants initially included previous diagnoses with osteoporosis or osteopenia. The required was lifted to include those who were not diagnosed but wanted to join the intervention. Had the criteria remained, the sample size would have been reduced. Additionally, studies have shown that many women with low BMD are undiagnosed with osteoporosis or osteopenia (Siris et al., 2001).

**Future Research**

Tai Chi balance research is extensive and well established, even in balance programs for older adults. However, yoga and meditation are in the early stages of research. Both areas are vast and vary in types. While this allows for an abundance of research studies to occur, studies often differ in intervention type, which limits support for other studies. Yoga and meditation is in the exploratory stages. Future research following this intervention of combining yoga, Tai Chi, and meditation should include a larger sample size; a longer duration of at least 12 weeks should be considered, as well as class time of at least 60 minutes per session. Many participants commented in the Qualitative Questionnaire that they would have enjoyed, and maybe seen increased benefits, if the study was longer in duration (Appendix K). This study can be used to

instigate other studies, such as if meditation is beneficial for creating body awareness to increase balance confidence, and if the timing of such makes a difference.

Future studies should carefully determine the appropriate instruments to be utilized. The decision process should consider the age and ability of participants, but also the availability of personnel to administer the assessments and instruct classes. As previously suggested, the addition of the MMSE to interventions assessing balance confidence should be considered. Meditation studies could seek to determine if meditation before, after, or both is more beneficial than the other. Additionally, a meditation scale, such as EOM by Reavley and Pallant (2009), should be included in assessments.

Specifically, the succeeding study should use the intervention of Yoga, Tai Chi, and meditation, but with a duration of at least 12 weeks, three to five days per week at 45 to 60 minutes per session. The meditation portion should take place at the beginning of this session and be approximately 15 minutes in duration. Additionally, the EOM scale should be included at the mid-way point and after the intervention.

ACSM suggests that older adults with a history of falls or mobility issues should practice balance exercises. This is a major flaw in the research; prevention of lack of stability and mobility is lacking in the research. Researchers often focus on reestablishing balance for frail older adults, but rarely seek to prevent loss of balance. The youngest participant of this study described the intervention as “awakening”, in reference to the lack of balance performance in the other participants. The American Geriatrics Society (2001) recommends balance exercises to prevent falls; however, more emphasis should be in the prevention of loss of balance. Although research should continue to focus on improvement of balance, research in effective prevention tactics should not be forgotten.

**Summary**

The purpose of this study was to determine the effects of combined intervention of yoga, Tai Chi, and meditation on balance and balance confidence in older female adults. While this study was exploratory research, concentration and body awareness, as enhanced by meditation, can increase stability. Based off the results of this study, it is recommended that more research in meditation and body awareness be conducted to support the idea of mindfulness to improve physical performance measures, such as balance.

## REFERENCES

American Geriatrics Society. (2001). Guideline for the Prevention of Falls in Older Persons [Special series]. AGS Panel on Falls Prevention*, 49*(5).

Brown, K. D., Koziol, J. A., & Lotz, M. (2008). A yoga-based exercise program to reduce the risk of falls in seniors: a pilot and feasibility study. *The Journal of Alternative and Complementary Medicine*, *14*(5), 454-457. doi: 10.1089/acm.2007.0797

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822-848. doi: 10.1037/0022-3514.84.4.822

Chen, K., Tseng, W., Ting, L., & Huang, G. (2007). Development and evaluation of a yoga exercise program from older adults. *Journal of Advanced Nursing, 57*(4), 432-441. doi: 10.1111/j.1365-2648.2006.04115.x

Dass, B.H. (1981). *Ashtanga Yoga Primer*. Santa Cruz, CA: Sri Rama Publishing.

Dang, T.T. (1994). *Beginning Tai Chi*. Rutland, VT: Charles E. Tuttle Company.

de Kam, D., Smulders, E., Weerdesteyn,V., & Smits-Englesmann, B.C. (2009). Exercise interventions to reduce fall-related fractures and their risk factors in individuals with low bone density: a systematic review of randomized controlled trials. *Osteoporosis International, 20*, 2111-2125. doi: 10.1007/s00198-009-0938-6

Dhume, R.R., & Dhume, R. A. (1991). A comparative study of the driving effects of dextroamphetamine and yogic meditation on muscle control for the performance of balance on balance board. *Indian Journal of Physiology and Pharmacology, 35*(3), 191-194. Retrieved from http://www.ijpp.com/

DiBenedetto, M., Innes, K. E., Taylor, A. G., Rodeheaver, P. F., Boxer, J. A., Wright, H. J., & Kerrigan, D. C. (2005). Effect of a gentle Iyengar yoga program on gait in the elderly: an exploratory study. *Archives of physical medicine and rehabilitation*, *86*(9), 1830-1837. doi: 10.1016/j.apmr.2005.03.011

Fox, K. R. (1999). The influence of physical activity on mental well-being. *Public Health Nutrition*, *2*(3a), 411-418. doi: 10.1017/S1368980099000567.

Galantino, M.L., Green, L, DeCesari, J.A., MacKain, N.A., Rinaldi, S.M., Stevens, M.E.,… Mao, J.J. (2012). Safety and feasibility of modified chair-yoga on functional outcome among elderly at risk for falls. *International Journal of Yoga, 5,* 146-150. doi: 10.4103/0973-6131.98242

Gyllensten, A. L., Hansson, L., & Ekdahl, C. (2003). Patient experiences of basic body awareness therapy and the relationship with the physiotherapist. *Journal of Bodywork and Movement Therapies*, *7*(3), 173-183. doi: 10.1016/S1360-8592(02)00068-2

Hakim, R. M., Kotroba, E., Cours, J., Teel, S., & Leininger, P. M. (2010). A cross-sectional study of balance-related measures with older adults who participated in Tai Chi, Yoga, or no exercise. *Physical & Occupational Therapy in Geriatrics*, *28*(1), 63-74. doi: 10.3109/02703181003605861

Hart, C. & Tracy, B. (2008). Yoga as steadiness straining: effects on motor variability in young adults. *Journal of Strength and Conditioning, 22*(5), 1659-1669.

Huang, T., Yang, L., & Liu, C. (2011). Reducing the fear of falling among community-dwelling elderly adults through cognitive-behavioral strategies and intense Tai Chi exercise: a randomized controlled trial. *Journal of Advanced Nursing, 67*(5), 961-971. doi: 10.1111/j.1365-2648.2010.05553.x

Hui, S., Slemenda, C., & Johnston, C. (1988). Age and bone mass as predictors of fracture in a prospective study. *Journal of Clinical Investigation, 81*, 1804-1809. doi: 10.1172/JCI113523

Kanis, J., Melton, J., Christiansen, C., Johnston, C., & Khaltaev, N. (1994). The diagnosis of osteoporosis. *Journal of Bone and Mineral Research, 9*(8), 1137-1141. doi: 10.1002/jbmr.5650090802

Kraemer, J. & Marquez, D. (2009). Psychosocial correlates and outcomes of yoga or walking among older adults. *The Journal of Psychology, 143*(4), 390-404.

Krucoff, C., Carson, K., Peterson, M., Shipp, K., & Krucoff, M. (2010). Teaching yoga to seniors: essential considerations to enhance safety and reduce risk in a uniquely vulnerable age group. *The Journal of Alternative and Complementary Medicine, 16*(8), 899-905. doi: 10.1089/acm.2009.0501

Lamb, S., Jorstad-Stein, E., Hauer, K., & Becker, C. (2005). Development of a common outcome data set for fall injury prevention trials: the prevention of falls network Europe consensus. *American Geriatrics Society, 53*, 1618-1622. doi: 10.1111/j.1532-5415.2005.53455.x

Li, F., Harmer, P., Fisher, K.J., McAuley, E., Chaumeton, N., Eckstrom, E., & Wilson, N. (2005). Tai Chi and Fall Reductions in Older Adults: A Randomized Controlled Trial. *Journal of Gerontology: Medical Sciences, 60A*(2), 187 -194. Retrieved from http://biomedgerontology.oxfordjournals.org

Lidell, L. (1983). *The sivananda companion to yoga.* New York, NY: Simon & Schuster Inc.

Looker, A.C., Melton, L.J., Harris, T.B., Borrud, L.G., & Shepherd, J.A. (2010). Prevalence and trends in low femur bone density among U.S. adults: NHANES 2005-2006 compared with NHANES III. *Journal of Bone and Mineral Research, 25*(1), 64-71. doi:10.1359/jbmr.090706

Mendes de Leon, C., Seeman, T., Baker, D., Richardson, E., & Tinetti, M. (1996). Self-efficacy, physical decline, and change in functioning in community-living elders: a prospective study. *Journal of Gerontology: Social Sciences, 51B*(4), S183-S190. Retrieved from http://pychsocgerontology.oxfordjournals.org

Mihay, L., Iltzsche, E., Tribby, A., Rushing, K., Spears, J., Wiltfong, H.,… Chronister, A. (2003). Balance and perceived confidence with performance instrumental activities of daily living: a pilot study of Tai Chi inspired exercise with elderly retirement-community dwellers. *Physical & Occupational Therapy in Geriatrics, 21*(3), 75-86. doi: 10.1300/J148v21n03_06

Mishra, N. (2011). Exercise beyond menopause: Dos and Don'ts. *Journal of Mid-life Health, 2*(2), 51-56. doi: 10.4103/0976-7800.92524

Nachreiner, N., Findorff, M., Wyman, J., & McCarthy, T. (2007). Circumstances and consequences of falls in community-dwelling older women. *Journal of Women's Health, 16*(10), 1437-1446. doi: 10.1089/jwh.2006.0245

Oken, B., Zajel, D., Kishiyama, S., Flegal, K., Dehen, C., Haas, M., Kraemer, D.,… & Leyva, J. (2006). Randomized, controlled, six-month trial of yoga in healthy seniors: effects on cognition and quality of life. *Alternative Therapies in Health & Medicine, 12*(1), 40-47. Retrieved from http://www.alternative-therapies.com

Oklahoma City-County Health Department. (2012) Tai Chi: Moving for Better Balance Certification. Retrieved from http://www.occhd.org/community/taichi

Ospina, M.B., Bond, K., Karkhaneh, M., Buscemi, N., Dryden, D.M., Barnes, V.,… Shannahoff-Khalsa, D. (2008). Clinical trials of meditation practices in health care: characteristics and quality. *The Journal of Alternative and Complimentary Medicine, 14*(10), 1199-1213. doi: 10.1089/acm.2008.0307

Perez-De-Albeniz, A. & Holmes, J. (2000). Meditation: concepts, effects, and uses in therapy. *International Journal of Psychotherapy, 5*(1), 49-58. Retrieved from http://www.ijp.org.uk/

Pilates, J. H., & Miller, W. J. (1960). *Return to life through contrology*. Boston, MA. Christopher Publishing House.

Podsiadlo, D., & Richardson, S. (1991). The timed" Up & Go": a test of basic functional mobility for frail elderly persons. *Journal of the American geriatrics Society*, *39*(2), 142.

Powell, L.E., & Myers, A.M. Activities-specific Balance Confidence (ABC) Scale. *Journal of Gerontology: Medical Sciences*, *50A*(1), M28-M34.

Reavley, N., & Pallant, J. F. (2009). Development of a scale to assess the meditation experience. *Personality and individual differences*, *47*(6), 547-552. doi: 10.1016/j.paid.2009.05.007

Ross, A., & Thomas, S. (2010). The health benefits of yoga and exercise: a review of comparison studies. *The Journal of Alternative and Complementary Medicine, 16*(1), 3-12. doi: 10.1089/acm.2009.0044

Sattin, R. W., Easley, K. A., Wolf, S. L., Chen, Y., & Kutner, M. H. (2005). Reduction in fear of falling through intense tai chi exercise training in older, transitionally frail adults. *Journal of the American Geriatrics Society*, *53*(7), 1168-1178. doi: 10.111 l/j. 1532-5415.2005..53375.X

Schmid, A., Van Puymbroeck, M., & Koceja, D. (2010). Effect of a 12-week yoga intervention on fear of falling and balance in older adults: a pilot study. *Archives of Physical Medicine and Rehabilitation, 91*, 576-583. doi: 10.1016/j.apmr.2009.12.018

Shimada, H., Suzukawa, M., Tiedemann, A., Kobayashi, K., Yoshida, H., & Suzuki, T. (2009). Which neuromuscular or cognitive test in the optimal screening tool to predict falls in frail community-dwelling older people? *Gerontology, 55*, 532-538. doi: 10.1159/000236364

Shumway-Cook, A., Gruber, W., Baldwin, M., & Liao, S. (1997). The effect of multidimensional exercises on balance, mobility, and fall risk in community-dwelling older adults. *Journal of the American Physical Therapy Association, 77*, 45-57. Retrieved from http://ptjournal.apta.org

Siris, E., Miller, P., Barrett-Connor, E., Faulkner, K., Wehren, L., Abbott, T.,… Sherwood, L. (2001). Identification and fracture outcomes of undiagnosed low bone mineral density in postmenopausal women. *Journal of the American Medical Association, 286*(22), 2815-2822. Retrieved from http://jama.jamanetwork.com

Siler, B. (2000). *The pilates body*. New York, NY: Broadway books.

Sivan, M., Sawyer, C., & Brown, J. (2010). The role of exercise therapy in the secondary prevention of falls in elderly people. *International Musculoskeletal Medicine, 32*(4), 168-172. doi: 10.1179/1753615410Y.0000000002

Stel, V., Smit, J., Pluijm, S., & Lips, P. (2003). Balance and mobility performance as treatable risk factors for recurrent falling in older persons. *Journal of Clinical Epidemiology, 56*, 659-668. doi: 10.1016/S0895-4356(03)00082-9

Steffen, T.M., Hacker, T.A., & Mollinger, L. (2002). Age- and Gender-Related Test Performance in Community-Dwelling Elderly People: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and Gait Speeds. *Journal of American Physical Therapy Association, 82*, 128-137. Retrieved from http://ptjournal.apta.org/content/82/2/128

Stevens, J.A., Corso, P.S., Finkelstein, E.A., & Miller, T.R. (2006). The costs of fatal and non-fatal falls among older adults. *Injury Prevention, 12*, 290-295. doi:10.1136/ip.2005.011015

Stevens, J.A. & Sogolow, E. (2005). Gender differences for non-fatal unintentional fall related injuries among older adults. *Injury Prevention, 11*, 115-119. doi: 10.1136/ip.2004.005835

Thompson, W. R., Gordon, N. F., & Pescatello, L. S. (Eds.). (2009). ACSM's Guidelines for Exercise Testing and Prescription (8th ed). Baltimore, MD: Lippincott Williams & Wilkins.

Tinetti, M. & Williams, C. (1998). The effect of falls and fall injuries on functioning in community-dwelling older persons. *Journal of Gerontology: Medical Sciences, 53A*(2), M112-M119. Retrieved from http://biomedgerontology.oxfordjournals.org/

Tuzun, S., Aktas, I., Akarirmak, U., Sipahi, S., & Tuzun, F. (2010). Yoga might be an alternative training for the quality of life and balance in postmenopausal osteoporosis. *European Journal of Physical and Rehabilitation Medicine, 46*(1), 69-72.

Viccaro, L., Perera, S., & Studenski., S. (2011). Is timed up and go better than gait speed in predicting health, function, and falls in older adults? *The American Geriatrics Society, 59*, 887-892. doi: 10.1111/j.1532-5415.2011.03336.x

Xu, D., Hong, Y., Li, J., & Chan, K. (2004). Effect of tai chi exercise on proprioception of ankle and knee joints in old people. *British Journal of Sports Medicine*, *38*(1), 50-54. doi: 10.1136/bjsm.2002.003335

Yoga Alliance. (2010). 200-hour standards. Retrieved from http://yogaalliance.org

Zhang, J. G., Ishikawa-Takata, K., Yamazaki, H., Morita, T., & Ohta, T. (2006). The effects of Tai Chi Chuan on physiological function and fear of falling in the less robust elderly: an intervention study for preventing falls. *Archives of gerontology and geriatrics*, *42*(2), 107-116. doi: 10.1016/j.archger.2005.06.007

## Tables

Table 1

*Descriptive Statistics for Timed Up-and-Go, Timed Tandem Walk, Errors, and Timed Tandem Stand, and the Activities-specific Balance Confidence Scale.*

| Variable | *N* | Mean | SD | min | *Max* | *Skewness* | *Kurtosis* |
|---|---|---|---|---|---|---|---|
| Timed Up-and-Go (*Sec*) | 10 | | | | | | |
| Pre | 10 | 8.64 | 4.19 | 4.28 | 19.50 | 2.15 | 5.88 |
| Post | 10 | 8.9 | 4.17 | 5.38 | 18.75 | 1.68 | 2.94 |
| Timed Tandem Walk (*Sec*) | 9 | | | | | | |
| Pre | 9 | 14.83 | 7.07 | 6.28 | 23.31 | -.09 | -1.77 |
| Post | 9 | 14.59 | 6.75 | 3.66 | 26.53 | .87 | .16 |
| Errors | 9 | | | | | | |
| Pre | 9 | 3.22 | 3.11 | 0 | 8 | .69 | -.85 |
| Post | 9 | 3.67 | 2.87 | 0 | 8 | .43 | -.37 |
| Timed Tandem Stand (*Sec*) | 10 | | | | | | |
| Pre | 10 | 36.64 | 25.04 | 3.62 | 60 | -.11 | -2.32 |
| Post | 10 | 35.12 | 26.29 | 1.75 | 60 | -.31 | -2.10 |
| ABC (*percentage*) | 10 | | | | | | |
| Pre | 10 | 69.64 | 30.02 | 18.25 | 98.16 | -.754 | -1.29 |
| Post | 10 | 70.82 | 22.16 | 32.19 | 98.81 | -.65 | -.73 |

*Note.* Activities-specific Balance Confidence Scale (ABC) is a scale of 0-100%; The larger the score number of ABC and TTS indicates an improved score.

Table 2

*Effect Sizes for Timed Up-and-Go, Timed Tandem Walk, Errors, and Timed Tandem Stand, and the Activities-specific Balance Confidence (ABC) Scale*

| | | Pre | | Post | | | |
|---|---|---|---|---|---|---|---|
| Variable | *N* | Mean | SD | Mean | SD | Mean Diff. | ES |
| Timed Tandem Walk (*s*) | | | | | | | |
| Experimental | 9 | 14.89 | 8.30 | 14.94 | 7.36 | -0.05 | -0.01 |
| Control | 9 | 14.75 | 6.44 | 14.16 | 7.01 | 0.59 | 0.09 |
| Errors | | | | | | | |
| Experimental | 9 | 4.80 | 3.35 | 3.80 | 2.86 | 1.00 | 0.30 |
| Control | 9 | 1.25 | 1.26 | 3.50 | 3.32 | -2.25 | -1.79 |
| Timed Tandem Stand (*s*) | | | | | | | |
| Experimental | 10 | 40.10 | 27.65 | 41.89 | 24.34 | -1.789 | -0.06 |
| Control | 10 | 38.97 | 24.47 | 35.01 | 28.91 | 3.96 | 0.16 |
| Timed Up-and-Go (*s*) | | | | | | | |
| Experimental | 10 | 9.06 | 6.02 | 9.01 | 5.65 | 0.05 | 0.01 |
| Control | 10 | 8.01 | 1.86 | 7.79 | 1.61 | 0.23 | 0.12 |
| ABC (*percentage*) | | | | | | | |
| Experimental | 10 | 65.40 | 35.98 | 73.06 | 19.34 | -7.66 | -0.21 |
| Control | 10 | 78.13 | 28.24 | 73.06 | 28.64 | 5.06 | 0.18 |

*Note.* Effect size (ES) for change over time within each group ($M_{pre} - M_{post}/ SD_{pre}$).

Table 3

*Independent t-test for Timed Up-and-Go, Timed Tandem Walk, Errors, and Timed Tandem Stand, and the Activities-specific Balance Confidence (ABC) Scale*

| Variables at Pre-Test | *t* | *df* | *p* |
|---|---|---|---|
| Timed Up-and-Go (*Sec*) | 0.300 | 8 | .772 |
| Timed Tandem Walk (*Sec*) | 0.028 | 7 | .979 |
| Errors | 1.989 | 7 | .087* |
| Timed Tandem Stand (*Sec*) | 0.417 | 8 | .688 |
| ABC (*%*) | -0.426 | 8 | .682 |

*Nearing significance.

Table 4

*ANOVA with Repeated Measures for Timed Tandem Walk*

| | Between Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Group | 1 | .009 | .926 |
| Error | 7 | | |

| | Within Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Time | 1 | .043 | .841 |
| Time * Group | 1 | .061 | .812 |
| Error | 7 | | |

Table 5

*ANOVA with Repeated Measures for Timed Tandem Walk Errors*

| | Between Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Group | 1 | 1.120 | .325 |
| Error | 7 | | |

| | Within Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Time | 1 | .982 | .355 |
| Time * Group | 1 | 6.639 | .037 |
| Error | 7 | | |

Table 6

*Correlations of Timed Tandem Walk (s) and Errors by Sample*

| Variables | Errors Pre | Errors Post |
|---|---|---|
| Timed Tandem Walk Pre | .597 | ---- |
| Timed Tandem Walk Post | ---- | .805* |

* indicates statistical significance ($p < 0.05$)

Table 7

*Correlations of Timed Tandem Walk (s) and Errors by Group*

| | Experimental Group | | Control Group | |
|---|---|---|---|---|
| Variables | Errors Pre | Errors Post | Errors Pre | Errors Post |
| Experimental Group | | | | |
| Timed Tandem Walk Pre | .885* | ---- | ---- | ---- |
| Timed Tandem Walk Post | ---- | .878* | ---- | ---- |
| Control Group | | | | |
| Timed Tandem Walk Pre | ---- | ---- | .235 | ---- |
| Timed Tandem Walk Post | ---- | ---- | ---- | .724 |

* indicates statistical significance ($p < 0.05$)

Table 8

*ANOVA with Repeated Measures for Timed Tandem Stand*

| | | Between Subjects | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Group | 1 | .380 | .555 |
| Error | 8 | | |

| | | Within Subjects | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Time | 1 | .336 | .578 |
| Time * Group | 1 | 1.599 | .242 |
| Error | 8 | | |

Table 9

*ANOVA with Repeated Measures for Timed Up-and-Go*

| | Between Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Group | 1 | .036 | .855 |
| Error | 8 | | |

| | Within Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Time | 1 | .286 | .608 |
| Time * Group | 1 | .395 | .547 |
| Error | 8 | | |

Table 10

*ANOVA with Repeated Measures for Activities-specific Balance Confidence Scale*

| | Between Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Group | 1 | .014 | .909 |
| Error | 8 | | |

| | Within Subjects | | |
|---|---|---|---|
| | *df* | *F* | *p* |
| Time | 1 | .066 | .803 |
| Time * Group | 1 | 1.993 | .196 |
| Error | 8 | | |

## Figures

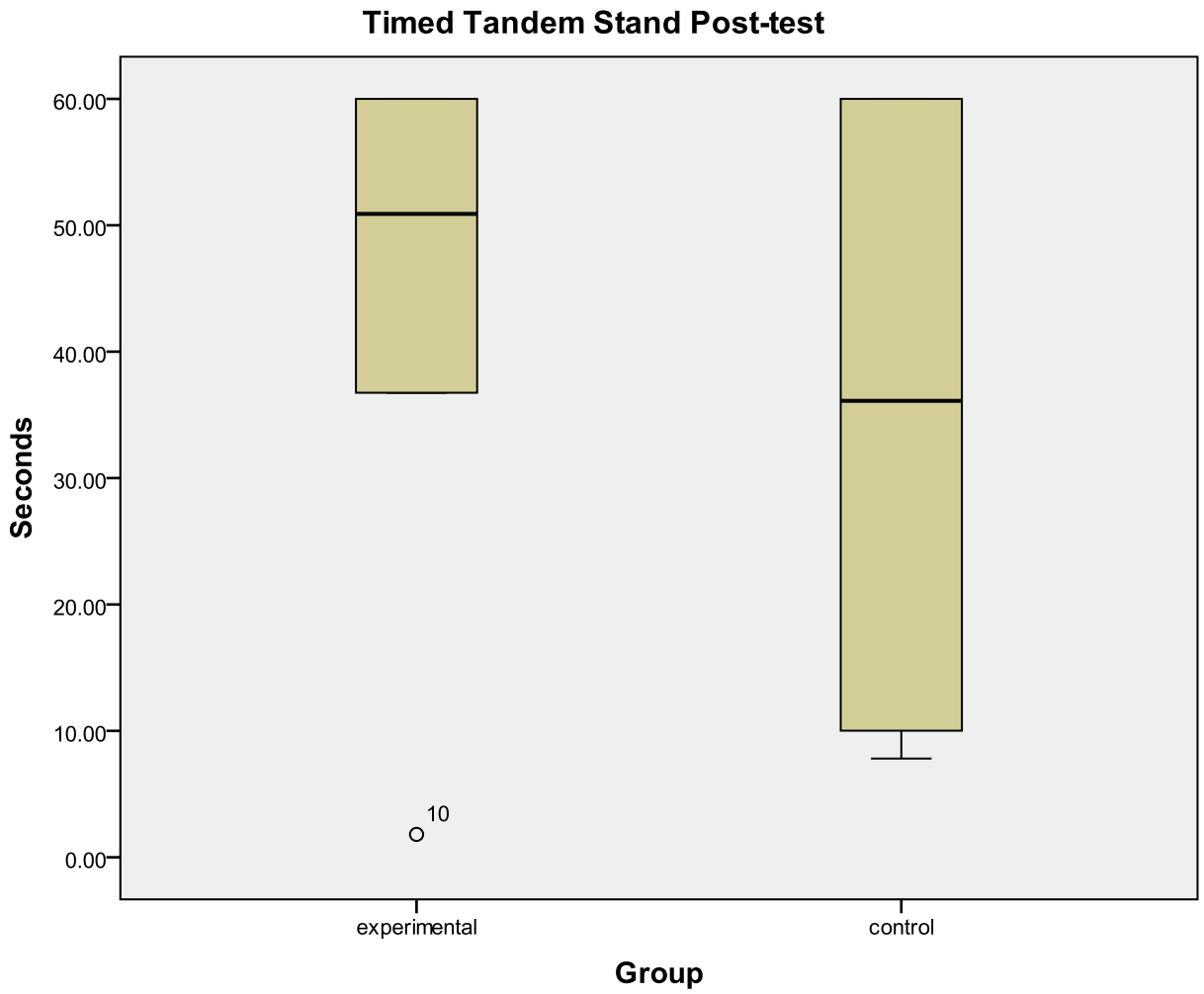


*Figure 1*. Box plot for TTS post-test by group.

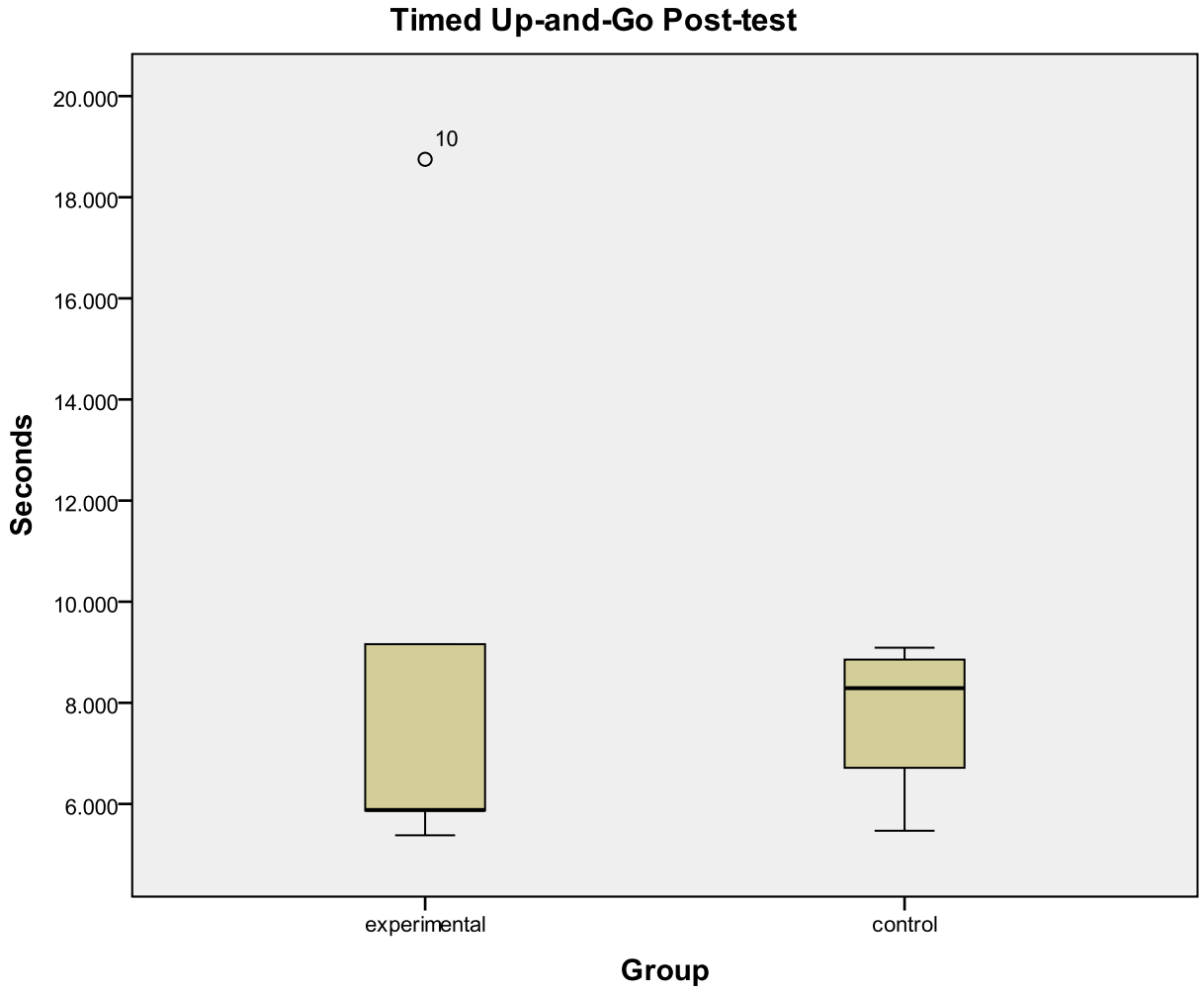


*Figure 2*. Box plot for TUG post-tests.

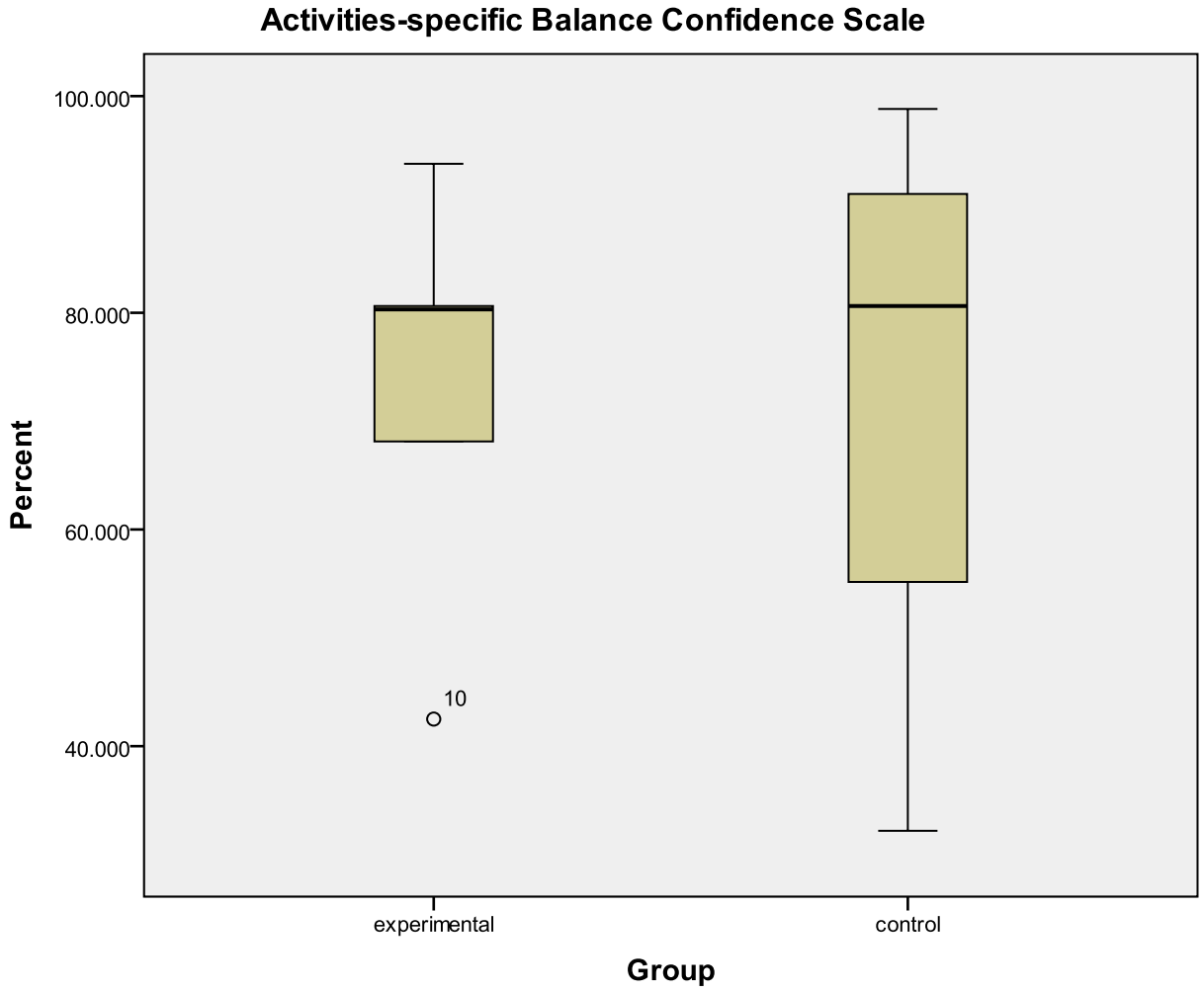


*Figure 3*. Box plot for ABC post-tests.

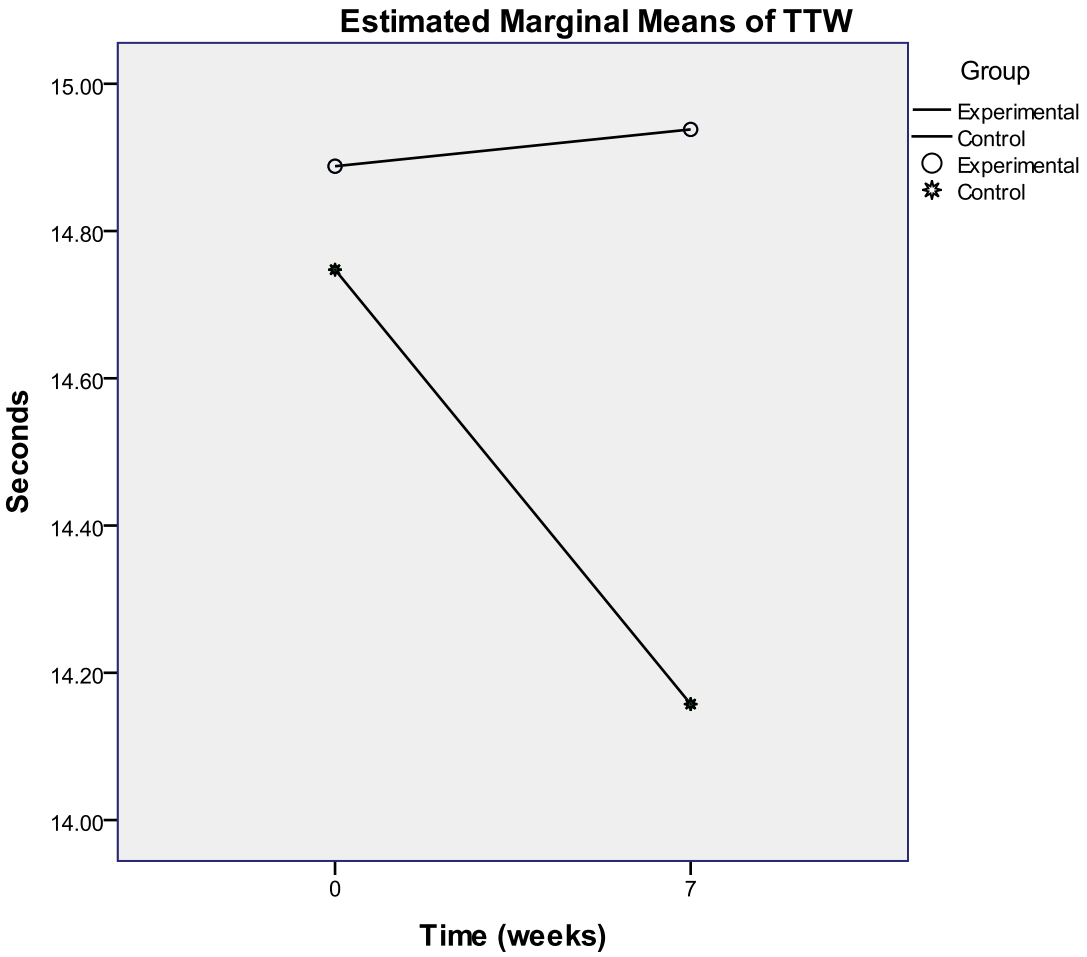


*Figure 4*. Graph displaying change in TTW from pre-test to post-test.

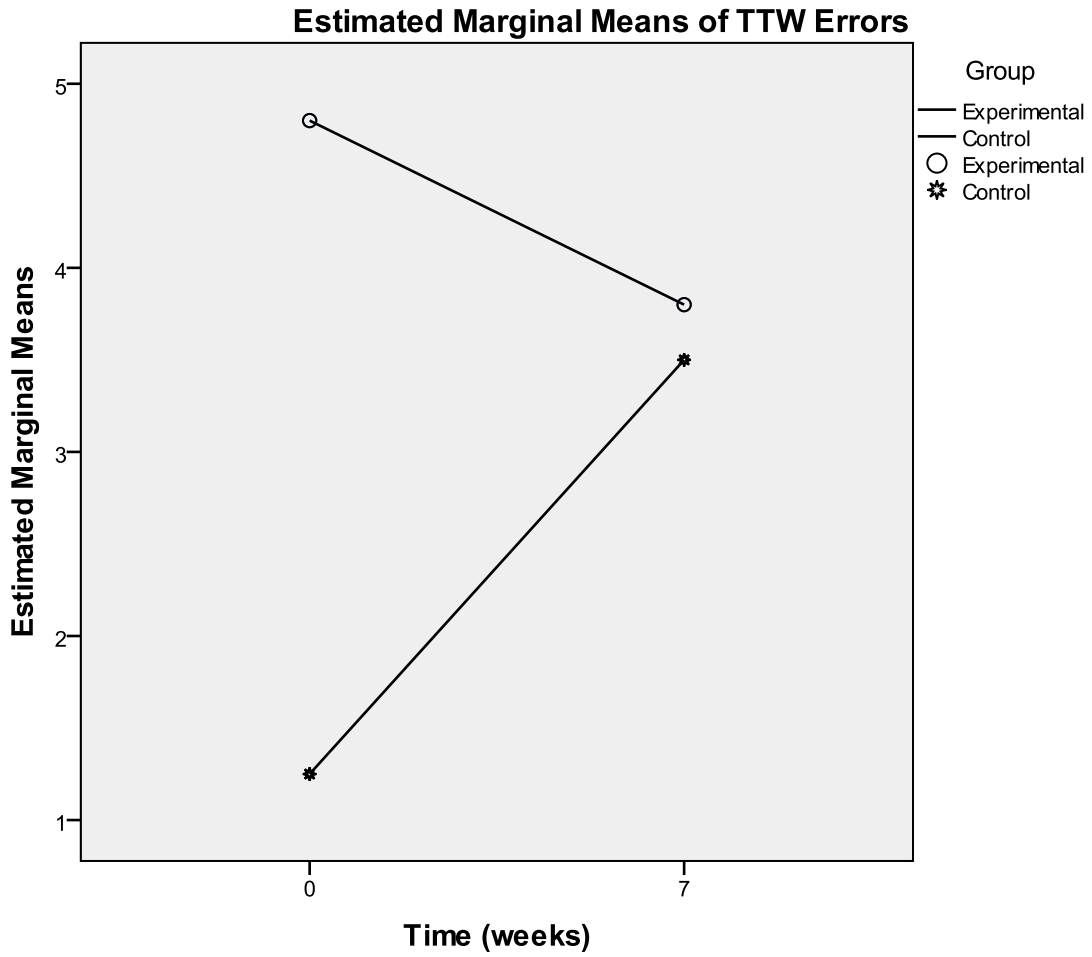


*Figure 5*. Graph displaying change in TTW Errors from pre-test to post-test.

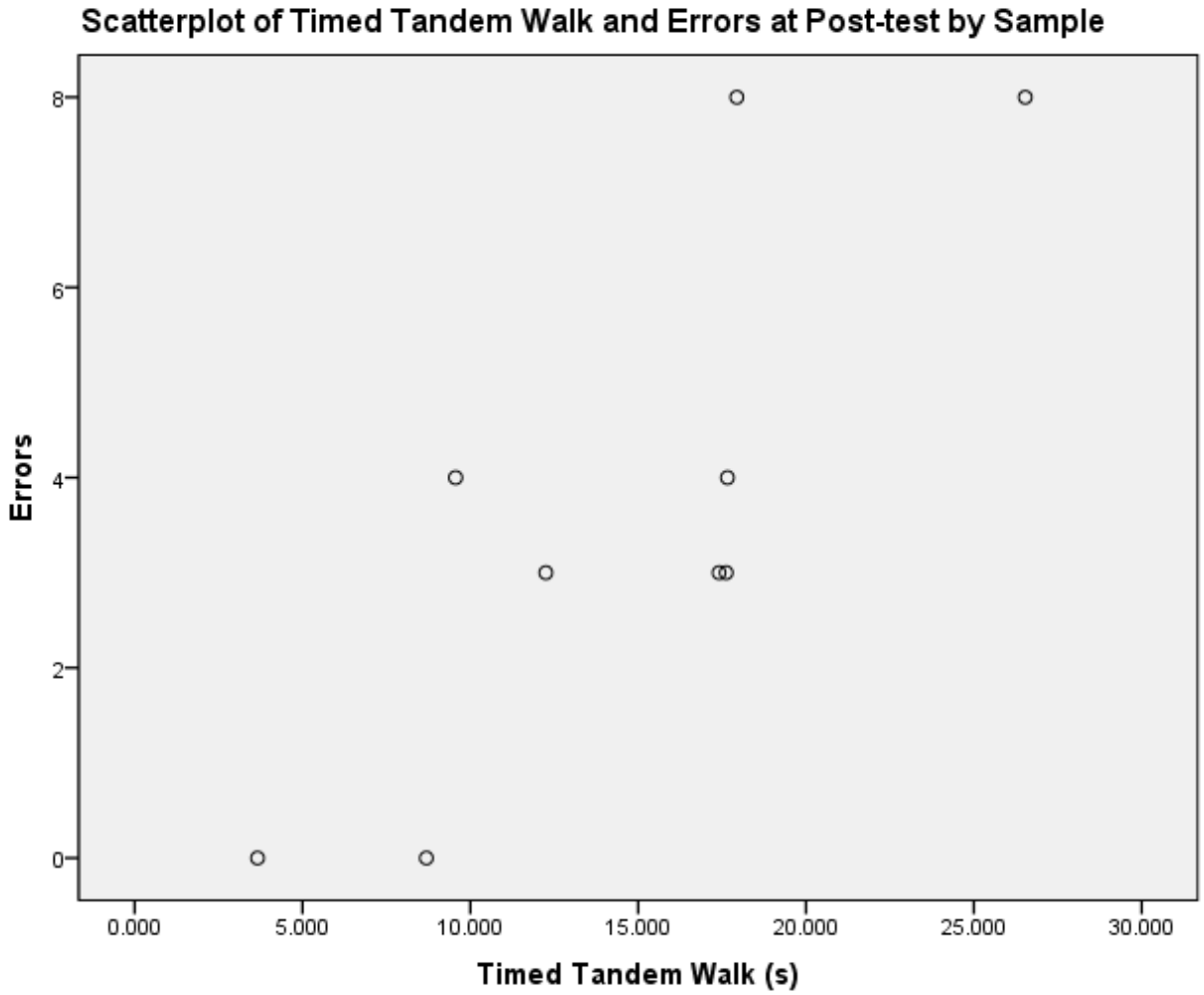


*Figure 6*. Scatterplot of TTW and Errors at post-test by sample.

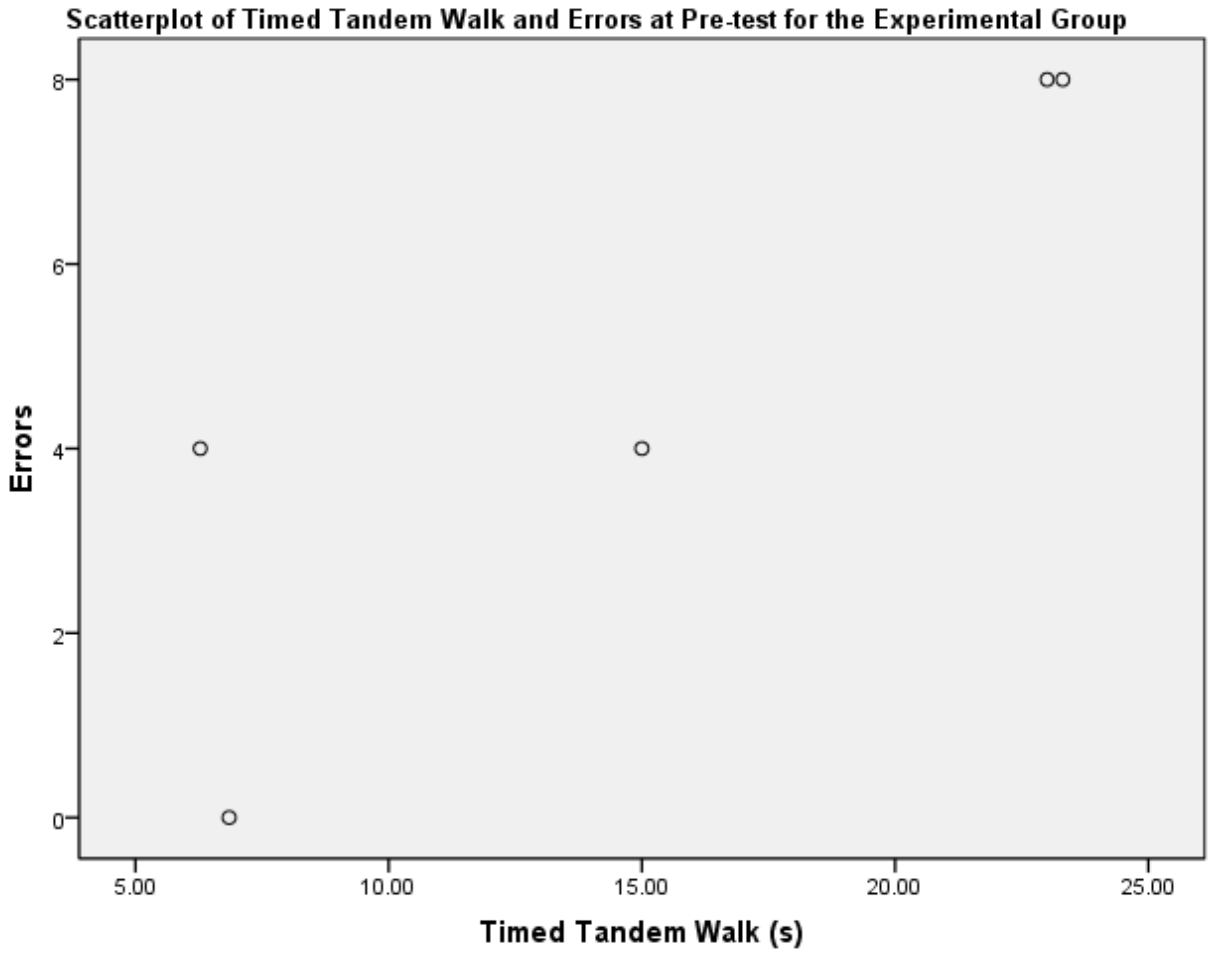


*Figure 7*. Scatterplot of TTW and Errors at pre-test for the experimental group.

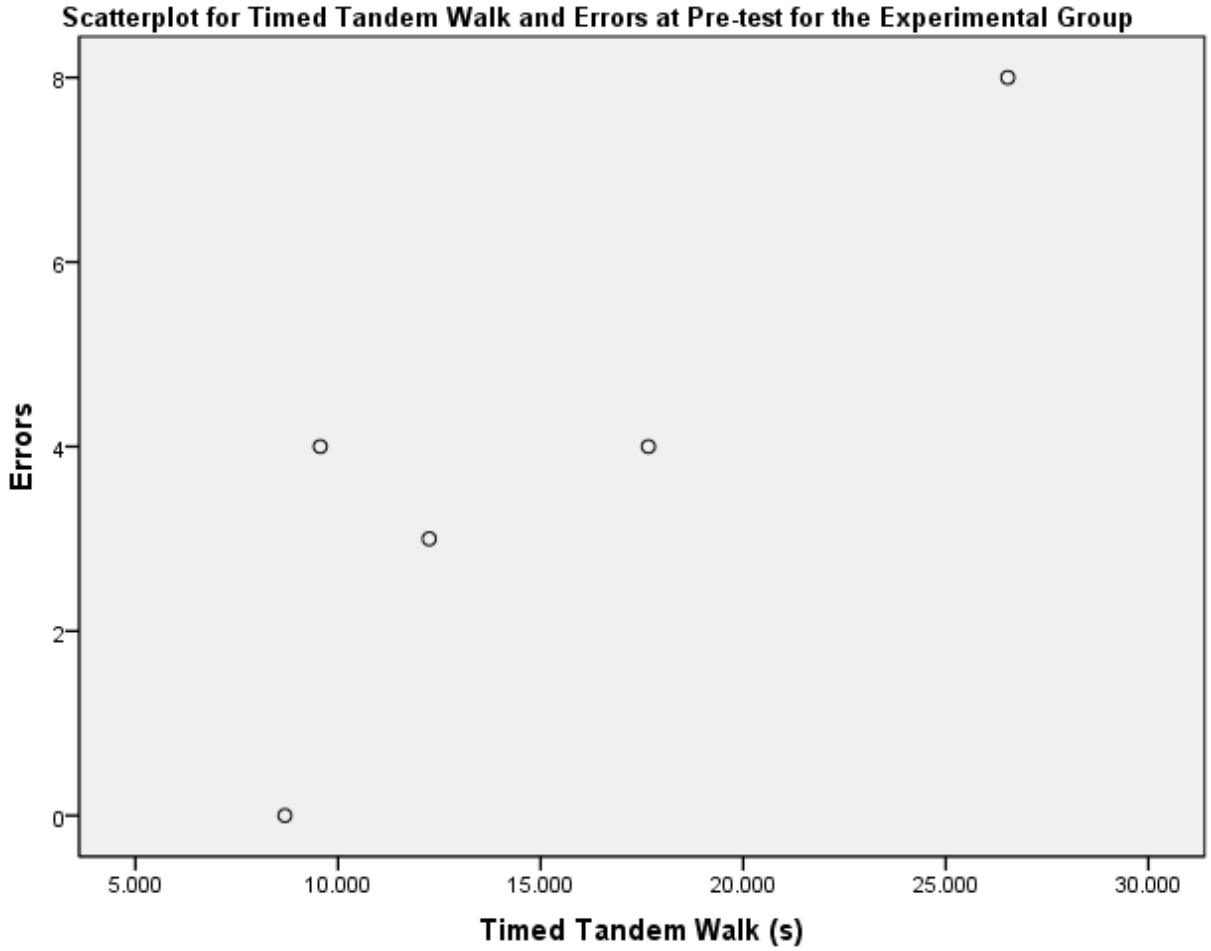


*Figure 8*. Scatterplot of TTW and Errors at post-test for the experimental group.

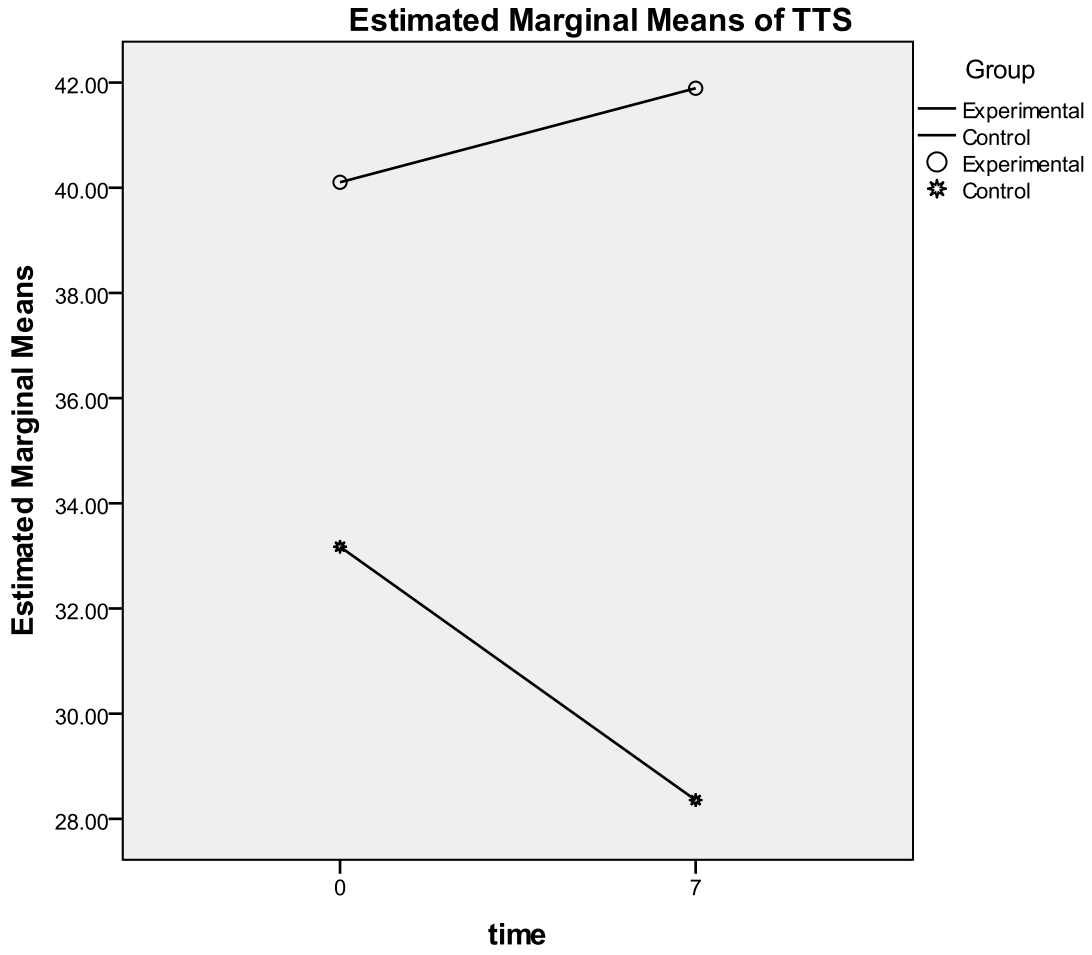


*Figure 9*. Graph displaying change in TTS from pre-test to post-test.

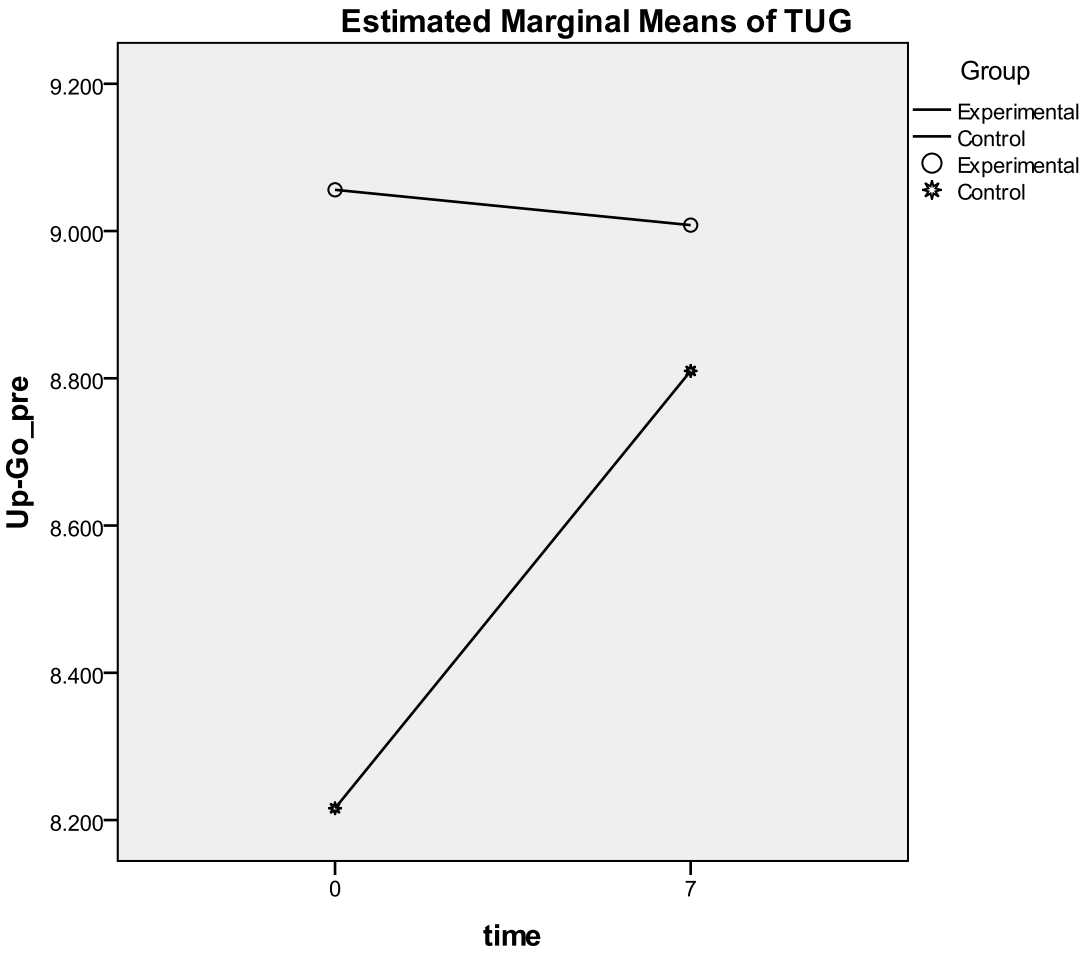


*Figure 10*. Graph displaying change in TUG from pre-test to post-test.

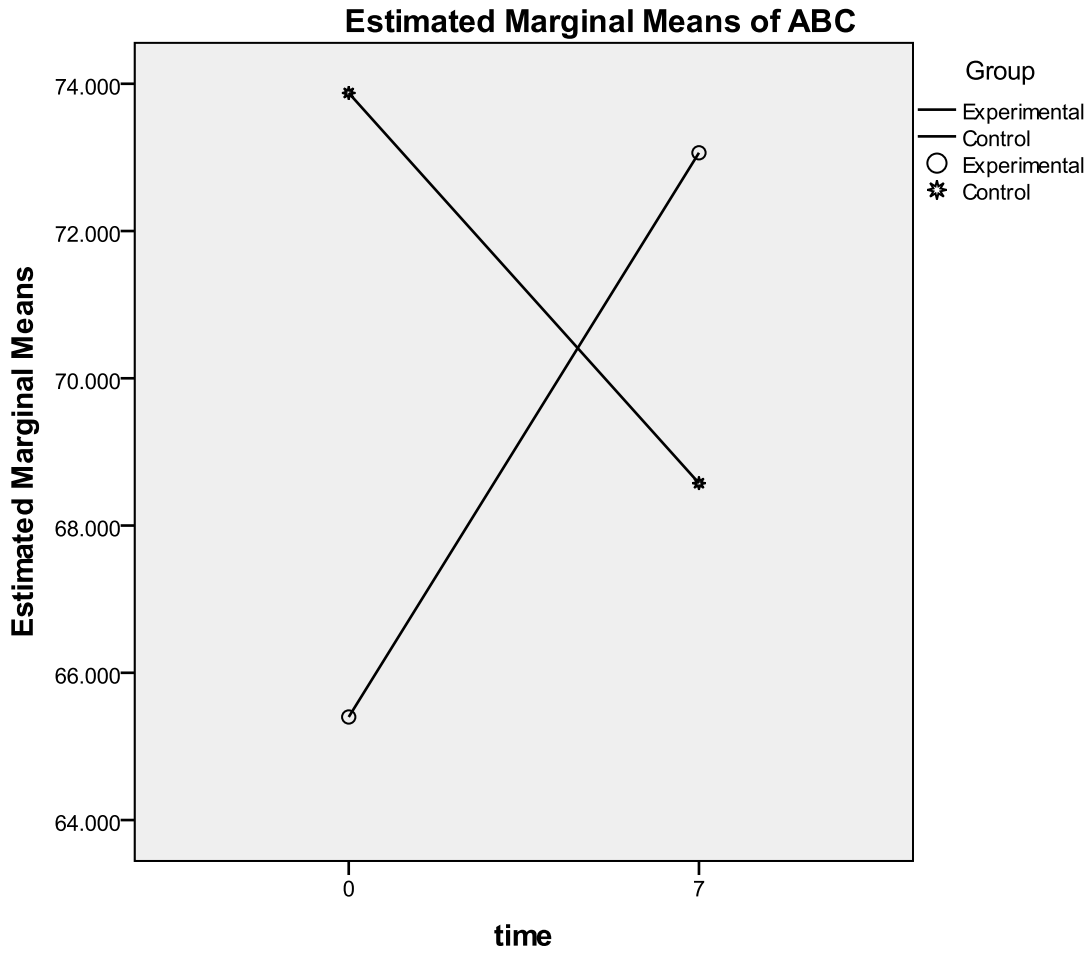


*Figure 11*. Graph displaying change in ABC from pre-test to post-test.

# Appendices

# Appendix A

Institutional Review Board Approval

September 28, 2012 IRB Application #: 12090

Proposal Title: A Ten-Week Yoga and Tai Chi Intervention to Increase Balance and Confidence

Type of Review: Full Board

Investigators:

Ms. Kelsey Hubble
Dr. Melissa Powers
Department of Kinesiology and Health Studies
College of Education & Professional Studies
Campus Box 189
University of Central Oklahoma
Edmond, OK 73034

Dear Ms. Hubble and Dr. Powers:

**Re: Application for IRB Review of Research Involving Human Subjects**

We have received your revised materials for your application. The UCO IRB has determined that the above named application is APPROVED BY FULL BOARD REVIEW.

Date of Approval: 09/28/2012
Date of Approval Expiration: 09/27/2013

If applicable, informed consent (and HIPAA authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. A stamped, approved copy of the informed consent form will be sent to you via campus mail. The IRB-approved consent form and process must be used. While this project is approved for the period noted above, any modification to the procedures and/or consent form must be approved prior to incorporation into the study. A written request is needed to initiate the amendment process. You will be contacted in writing prior to the approval expiration to determine if a continuing review is needed, which must be obtained before the anniversary date. Notification of the completion of the project must be sent to the IRB office in writing and all records must be retained and available for audit for at least 3 years after the research has ended.

It is the responsibility of the investigators to promptly report to the IRB any serious or unexpected adverse events or unanticipated problems that may be a risk to the subjects.

On behalf of the UCO IRB, I wish you the best of luck with your research project. If our office can be of any further assistance, please do not hesitate to contact us.

Sincerely,

Jill A. Devenport, Ph.D.
Chair, Institutional Review Board
Director of Research Compliance, Academic Affairs
Campus Box 159
University of Central Oklahoma
Edmond, OK 73034
405-974-5479
jdevenport@uco.edu

## Appendix B

Recruitment Flyer

## Appendix C

Informed Consent Form

**University of Central Oklahoma**

**Informed Consent Form**

**Research Project Title:** The Effects of a Ten-Week Yoga Intervention to Increase Balance and Confidence

**Purpose.** The purpose of this study is to determine if a 10-week yoga class will increase balance and confidence. The class will include yoga exercises, basic Tai Chi movements, breathing practices, brief relaxation, and meditation.

**Procedures.** You will be asked to fill out this form, the EASY Tool (Exercise and Screening for you), and a general information survey. The EASY screening tool is to ensure that we don't need medical clearance from your doctor. However, if we do need medical clearance for you, you will be responsible for this and we may need contact information of your doctor. Once you agree to participate, you will be randomly assigned to one of two groups that slightly differ in programming. Both groups will receive a class of yoga and Tai Chi.

At the beginning of this study, at 5-weeks, and at the end of this study, you may be asked to participate in balance assessments, such as:

- Tandem stand: How long you can stand with one foot stacked in front of the other for up to 60 seconds.
- Tandem walk: How quickly and efficiently you can walk a 10-foot line with one foot in front of the other.
- Eight-foot up-and-go test: How long it takes you to stand up from a chair, walk 8 feet, walk back to the chair and sit down.
- Activities-specific Balance Confidence scale: how you rank your confidence for a daily activity on a scale of 0-100%.

**Expectations and length of participation.** You will be expected to wear loose, comfortable clothing. Shoes and socks are not required, but may be worn if you prefer. Both groups' class will be 10 weeks in duration, meeting twice a week for 60 minutes per session. You will be expected and highly encouraged to attend all or as many sessions as possible. Entire duration of the study should be no longer than four months.

**Potential benefits.** This class includes potential benefits of increasing physical activity, increasing balance, increasing balance confidence, exploring new types of exercise, and gaining social support. This study will give us more insight into the effects of yoga on balance. You may be randomly assigned to a group that receives no direct benefit from the program.

**Potential risks or discomforts.** There are possible risks or discomforts. Exercise or fitness tests may cause tiredness or muscle soreness. Potential risks are injury or pain, although these are rare and can be reduced with caution. If you ever feel pain or dizziness, let us know immediately and stop any exercise or fitness test. We will also take caution and pay attention to you; if we feel you are at a risk for danger or pain, we may ask you to stop. If you are injured during the class or fitness test, you will be responsible for any costs due to injury. When you sign this form, you are in agreement that UCO is not responsible for any injuries that may occur during this study.

**Medical health contact information.** We may need contact information of your personal physician.

**Explanation of confidentiality and privacy.** All data, including electronic and paper copies, will be stored and locked. Only the researchers will have access to the data. All participants will be given code numbers to ensure all data is confidential. Individual results will not be used, nor reported; only group data will be analyzed.

**Assurance of voluntary participation.** Participation is completely voluntary at all times during the course of this research study. However, if you wish to withdraw from the research study, you may remain in the class. Signature of this form allows the researchers to use your results for a research study.

**Contact Information.** For any questions about this research study, contact:

Kelsey Hubble

University of Central Oklahoma

100 N. University Drive

Edmond, OK 73034

(580) 370.0184

kelseyhubble@gmail.com

OR

Dr. Melissa Powers

University of Central Oklahoma

100 N. University Drive

Edmond, OK 73034

(405) 974.5309

mpowers3@uco.edu

For any questions about your participation rights in research studies, contact:

Dr. Jill A. Devenport

Chair, UCO Institutional Review Board

Director, Office of Research Compliance

Academic Affairs

(405) 974.5479

irb@uco.edu

**Affirmation by Research Subject.** I hereby voluntarily agree to participate in the above listed research project and further understand the above listed explanations and descriptions of the research project. I also understand that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty. I have read and fully understand this Informed Consent Form. I sign it freely and voluntarily. I acknowledge that I am over the age of 18 years and a copy of this Consent Form has been given to me to keep.

Research Subject's Name: _____

Signature: _____ Date: _____

## Appendix D

Participant Contact Questionnaire

**Participant Contact Questionnaire**

We're excited to have you in our study! Please fill out your contact information and a few questions below.

Name:_____ Age:_____

Address:_____

City:_____ State:_____ Zip:_____

Phone:_____ Email_____

1. Have you participated in a yoga class before? (Check one) ____Yes ____No

2. Have you participated in a Tai Chi class before? (Check one) ____Yes ____No

3. Have you ever been diagnosed with osteoporosis or osteopenia?

(Check one) ____Yes ____No

## Appendix E

Exercise and Screening for You

Nearly all older adults can safely meet the national recommendations of engaging in moderate intensity physical activity (such as brisk walking or gardening) for at least 30 minutes a day, most days of the week. The EASY tool helps you know when to see a health care provider to discuss your exercise plan and how to choose activities for optimal benefit if you have any health problems.

# Getting Started

It is always a good idea to start at a level that is easy for you and to build up slowly. See the attached safety tips.

While it is generally not necessary to see a health care provider before beginning every-day physical activities that are of light or moderate intensity, we encourage you to talk with your health care provider about your health and exercise as part of your regular visits.

The EASY tool at www.easyforyou.info helps identify ways you can be active safely.

For more information
on using the EASY tool please contact:
Phone: 979-458-3507
Email: ahpp@srph.tamhsc.edu

# Answering the Six Easy Questions:

EASY QUESTIONS (Circle Response):

| | |
|---|---|
| 1) Do you have pains, tightness or pressure in your chest during physical activity (walking, climbing stairs, household chores, similar activities)? | Yes No |
| 2) Do you currently experience dizziness or lightheadedness? | Yes No |
| 3) Have you ever been told you have high blood pressure? | Yes No |
| 4) Do you have pain, stiffness or swelling that limits or prevents you from doing what you want or need to do? | Yes No |
| 5) Do you fall, feel unsteady, or use assistive device device while standing or walking? | Yes No |
| 6) Is there a health reason not mentioned why you would be concerned about starting an exercise program? | Yes No |

Please see the answer sheets for recommended actions and for how to get additional information

# EASY RECOMMENDATIONS BASED ON RESPONSES

If you answer No to all of the questions on the EASY, follow these four steps to begin or continue your exercise program:

1. Choose enjoyable activities that fit into your everyday routine.

2. Set a goal of being active 30 minutes daily most days of the week (it is best to work toward this goal slowly).

3. Review the safety tips in this packet.

4. Request a free copy of the NIA Exercise Guide by calling 1-800-222-2225 or go to www.easyforyou.info for additional exercise options.

If you answered Yes to any of the EASY questions, use the recommendations sheet for exercising safely with your condition. It is always a good idea to review the safety hints and be aware of what the experts say are the most appropriate exercises for any specific condition. For each question, we provide a link for further information. Talk with your healthcare provider about your exercise program during your regular visits.

Answering Yes to any of the EASY Questions:

| Question | YES |
|---|---|
| 1. Do you have pain, tightness or pressure in your chest during physical activity (walking, climbing stairs, household chores, similar activities)? | If you answered yes to this question and this is a NEW problem, see your health care provider first before starting any exercises.<br><br>Ask your health care provider "Are there any exercises that I can not do"? Work with your doctor to identify activities that are appropriate for you.<br><br>If it is not new, or has already been evaluated, begin or continue your exercise program.<br><br>American Heart Association 1-800-242-8721<br>http://www.americanheart.org |
| 2. Do you currently experience dizziness or lightheadedness? | If you answered yes, it is recommended that you talk with your health care provider before initiating a new activity program.<br><br>Ask if there are any exercises you cannot do. Work with your provider to identify exercises good for you.<br><br>NIH SeniorHealth 1-800-222-2225<br>http://seniorhealth.gov/exercise/toc.html |

| Question | Helpful Tips |
|---|---|
| 3. Have you ever been told you have high blood pressure? | If your blood pressure has not been checked in the last 6 months, get it checked by a healthcare provider.<br><br>If you answered yes, you may continue to exercise to improve your overall heart health and prevent disease.<br><br>American Heart Association 1-800-242-8721<br>http://www.americanheart.org |
| 4. Do you have pain, stiffness or swelling that limits or prevents you from doing what you want or need to do? | If you answered yes, continue to enjoy your exercise to prevent worsening of your arthritis and help manage your pain. If you have osteoporosis always avoid stretches that flex your spine or cause you to bend at the waist, and avoid making jerky, rapid movements.<br><br>Call the Arthritis Foundation 1-800-283-7800 for the local office number and for specific exercises for people who have arthritis.<br><br>Arthritis Foundation 1-800-283-7800<br>http://www.arthritis.org |

| | |
|---|---|
| 5. Do you fall, feel unsteady, or use an assistive device while standing or walking? | If you answered yes, it is recommended that you talk with your health care provider before initiating a new activity program.<br><br>Ask if there are any exercises you cannot do. Work with your provider to identify exercises good for you.<br><br>NIH SeniorHealth 1-800-222-2225<br>http://seniorhealth.gov/exercise/toc.html |
| 6. Is there a health reason not mentioned why you would be concerned about starting an exercise program? | If you answered yes, SHARE this information with your health care provider<br><br>Most reasons can be addressed and you can begin an exercise program that will improve your overall health and well-being. |

# SAFETY TIPS

Follow these EASY safety tips for when to start and stop exercise. Use the recommendations below for exercising safely with your condition.

## Exercise Safety Tips to Always Consider Prior to Starting Exercise

- Always wear comfortable, loose-fitting clothing and appropriate shoes for your activity.
- Warm up: Perform a low to moderate intensity warm-up for 5-10 minutes.
- Drink water before, during and after your exercise session.
- When exercising outdoors, evaluate your surroundings for safety: traffic, pavement, weather, and strangers.
- Wear clothes made of fabrics that absorb sweat and remove it from your skin.
- Never wear rubber or plastic suits. These could hold the sweat on your skin and make your body overheat.
- Wear sunscreen when you exercise outdoors.

## Exercise Safety Tips for When to STOP Exercising

Stop exercising right away if you:

- Have pain or pressure in your chest, neck, shoulder, or arm.
- Feel dizzy or sick.
- Break out in a cold sweat.
- Have muscle cramps.
- Feel acute (not just achy) pain in your joints, feet, ankles, or legs.
- Slow down if you have trouble breathing. You should be able to talk while exercising without gasping for breath.

## Exercise Safety Tips to Recognize Days/Times When Exercise Should NOT be Initiated:

- Avoid hard exercise for 2 hours after a big meal. (A leisurely walk around the block would be fine).
- Do not exercise when you have a fever and/or viral infection accompanied by muscle aches.

- Do not exercise if your systolic blood pressure is greater than 200 and your diastolic is greater than 100.
- Do not exercise if your resting heart rate is greater than 120.
- Do not exercise if you have a joint that you are using to exercise (such as a knee or an ankle) that is red and warm and painful.
- If you have osteoporosis, always avoid stretches that flex your spine or cause you to bend at the waist, and avoid making jerky, rapid movements.
- Stop exercising if you experience severe pain or swelling in a joint. Discomfort that persists should always be evaluated.
- Do not exercise if you have a new symptom that has not been evaluated by your health care provider such as pain in your chest, abdomen or a joint, swelling in an arm, leg or joint, difficulty catching your breath at rest, or a fluttering feeling in your chest.

Additional Safety Information is provided at the National Institute of Health Web page www.nlm.nih.gov/medlineplus/safety.html

## How To Learn More About the EASY Recommendations:

**Additional information and readings about the EASY recommendations are readily available on the Internet. You do not have to be an expert on computers to be able to access this information. All public libraries and most senior centers have public access computers.**

## SIMPLE INSTRUCTIONS ON HOW TO ACCESS MORE INFORMATION:

**Tip: If you are not sure about any of these steps ask your librarian at the public library.**

1. **Open any internet web browser program.**

2. **Type www.easyforyou.info in the address line at the top of the page**

3. **Click on the "links and resources" box at the top of the page**

4. **If you would like to take the information home with you ask how to the print the web pages you are most interested in.**

## Supporting links and websites:

**The following links are included on the easyforyou.info website. For easy access to this information follow the instructions listed immediately above.**

**Links for General Exercise Options:**

American Heart Association: www.americanheart.org/ presenter.jhtml?identifier=1200013

International Council on Active Aging: www.icaa.cc/ PressInfo/onehouradayrelease.htm

International Society for Aging and Physical Activity: www.isapa.org/ISAPA_Newsletter

National Blueprint: Increasing Physical Activity Among Adults Age 50 and Older: www.agingblueprint.org/tips.cfm

NIH SeniorHealth: www.nihseniorhealth.gov/exercise/toc.html

Novartis Health and Age: www.healthandage.org

President's council on Physical Fitness and Sports: www.fitness.gov

The Canadian Centre for Activity and Aging's Home Support Exercise Program. Geriatrics and Aging: www.geriatricsandaging.ca/ PDF/PDFJuly2003/ 0607homesupport.pdf

**Links for Exercises for Dizziness or Lightheadedness:**

AARP- Better Ballance Prevents Falls: www.aarp.org/health/staying_healthy/prevention/better_balance_prevents_falls.html

American Physical Therapy Association- Head To Toe Program (Level 1): http://headtotoe.apta.org/kbase/frame/ug117/ug1176/frame.htm

American Physical Therapy Association- Head To Toe Program (Level 2): http://headtotoe.apta.org/kbase/frame/ug128/ug1287/frame.htm

American Physical Therapy Association- What You Need To Know About Falls: http://physicaltherapy.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=physicaltherapy&cdn=health&tm=26&gps=146_677_685_561&f=11&tt=13&bt=1&bts=1&zu=http%3A//www.apta.org/AM/Template.cfm%3FSection%3DConsumer_Awareness%26CONTENTID%3D24756%26TEMPLATE%3D/CM/HTMLDisplay.cfm

Mayo Clinic- Senior Health on Balance Exercises: www.mayoclinic.com/health/balance-exercises/SM00049/RETURNTOOBJID=5275756E-2AEC-4537-B8886B71D55BD479&RETURNTOLINK=1&slide=1

**Links for Cardiovascular Specific Exercise Programs/Information:**

American College Sports Medicine- Exercise and the Older Adult: www.acsm.org/pdf/EOA.pdf

Cardiovascular Institute and Center for Cardiovascular Health Cardiovascular: www.mssm.edu/cvi/exercise.shtml

Centers for Disease Control- Strength Training for Older Adults: Why Strength Training? www.cdc.gov/nccdphp/dnpa/ physical/growing_ stronger/why.htm

Human Kinetics: Benefits of Aerobic Endurance Training for Older Adults: www.humankinetics.com/products/ showproduct.cfm?isbn=0736045139

The Physician and Sports Medicine: www.physsportsmed.com/issues/ 1999/10_15_99/kligman.htm

Women's Heart Foundation: www.womensheartfoundation.org/ content/Exercise/intro_to_exercise.asp

**Links for Exercises for Joint problems:**
American College of Rheumatology: www.rheumatology.org/ public/factsheets/ exercise_new.asp

American Physical Therapy Association-Exercising with Osteoarthritis: http://headtotoe.apta.org/kbase/as/tr4782/actionset.htm

Arthritis Foundation- The 12-week Walking Plan: www.arthritis.org/media/12%20week%20walking%20plan%20pdf.pdf

Arthritis Organization: www.arthritis.org/conditions/exercise

Centers for Disease Control: www.cdc.gov/ nccdphp/dnpa/physical/ growing_stronger/ exercises/warmup.htm

Human Kinetics: www.humankinetics.com/products/ showproduct.cfm?isbn=0736045139

National Arthritis Foundation: www.arthritis.org.sg/ 101/treat/exercise.html

National Guideline Clearing House- Exercise Program for Osteoarthritis: www.guideline.gov/ summary/summary.aspx?

National Institute of Arthritis and Musculoskeletal and Skin Disorders: www.niams.nih.gov/ hi/topics/arthritis/ arthexfs.htm

**Links for Exercises with assistive devices:**
American Heart Association: Description of Exercise Recommendations for Stroke Patients: http://circ.ahajournals.org/ cgi/content/full/ 109/16/2031

The Center for Neurological Study: www.cnsonline.org/ www/archive/ parkins/park-03.html

Cleveland Clinic: www.webmd.com/ content/article/46/ 1833_50756

Victorian Government- Regular Exercise Program for Parkinson's Disease Patients: www.betterhealth.vic.gov.au/ bhcv2/bhcarticles.nsf/ pages/Parkinson's_disease _and_exercise?OpenDocument

## Appendix F

Photo Release Form

**University of Central Oklahoma**
Yoga & Tai Chi Balance Training Study

PHOTO RELEASE FORM

The Yoga & Tai Chi Balance Training Study team requests permission to take and use your photograph during this research study. Photos may be taken at any time during the study period. The photos will be used to showcase the Yoga & Tai Chi Balance Training Study. Photos may be used in a variety of media, including newsletters, brochures, slide shows, multimedia presentations, or display boards. The photos taken may be kept for up to three years. No compensation is paid to individuals or organizations for this use. To remain in this study, you are not required to sign this photo release form. If you have any questions or concerns, please contact:

Kelsey Hubble, Primary Investigator: (580) 370-0184
Melissa Powers, Assistant Professor: (405) 974-5309

By signing below, I give permission for photographs to be taken of me during my participation in the Yoga & Tai Chi Balance Training Study. I understand that these photos will be used to showcase the Yoga & Tai Chi Balance Training Study.

Name: _____

Phone/Email: _____

Signature: _____ Date: _____

## Appendix G

Qualitative Questionnaire

Date_____ Code_____

**Qualitative Questionnaire**

1. How has your experience been throughout this program?

2. Have you experienced any outcomes (positive or negative) as a result of this program?

3. If you could describe this program in one word, what would it be?

4. Would you change, add, or remove anything to this program? If so, what?

## Appendix H

Data Collection Sheet

Data Collection Instrument Code _____ Tester Initials_____ Date_____

| Test Item | | Score | Comment |
|---|---|---|---|
| ***Timed tandem walk*** | | _____ | _____ |
| | | | Errors_____ |
| ***Timed tandem stand*** | (trial one) | _____ | _____ |
| | (trial two) | _____ | _____ |
| | (trial three) | _____ | _____ |
| ***Timed up-and-go*** | (trial one) | _____ | _____ |
| | (trial two) | _____ | _____ |

**Comments**
Use this space to provide feedback to the research team about this participant. Please include your name with the comment.

# Appendix I

Activities-specific Balance Confidence Scale

# The 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 form 0% to 100%. If you do not currently do the activity in question, try and imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as it you were using these supports. If you have any questions about answering any of these items, please ask the administrator.

## The Activities-specific Balance Confidence (ABC) Scale*

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 parcels such that you cannot hold onto the railing? ____%
16. …walk outside on icy sidewalks? ____%

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

## Appendix J

Program Schedule by Week

*Program Schedule by Week*

| | **Tai Chi** | | | | **Yoga** | | | |
|---|---|---|---|---|---|---|---|---|
| **Week** | Warm-up | Steps | Ball | | Tree | Warrior 3 | Warrior 2 | Meditation* |
| **1** | X | X | | | X | X | | X |
| **2** | X | X | | | X | X | | X |
| **3** | X | X | | | X | X | | X |
| **4** | X | X | X | | X | X | | X |
| **5** | X | X | X | | X | X | X | X |
| **6** | X | X | X | | X | X | X | X |
| **7** | X | X | X | | X | X | X | X |
| **8** | X | X | X | | X | X | | X |
| **9** | X | X | X | | X | X | | X |
| **10** | X | X | X | | X | X | | X |

Note: *Meditation took place in the experimental group only.

## Appendix K

Qualitative Questionnaire Comments

| | Qualitative Questionnaire Comments |
|---|---|
| How has your experience been throughout this program? | ● Good<br>● The balance exercises are excellent<br>● Positive. I enjoyed it<br>● Very slow<br>● Enjoyable, relaxing, fun<br>● Very good<br>● 100%<br>● OK and enlightening<br>● Very beneficial to my bone structure and mind<br>● Have not had enough time to really get into it |
| Have you experienced any outcomes (positive or negative) as a result of this program? | ● More thoughtful about balance<br>● I gained an awareness that I am not as "stable" balanced as I thought<br>● I feel it has given me some tools to continue to use in the future to improve my balance<br>● A small positive<br>● It made me aware of the importance of good balance and a reason to strive to maintain what I still have<br>● Better understanding of how to handle my balance problems<br>● No<br>● It has helped me try to relax<br>● Positive. I can see its benefits mentally and physically<br>● It was positive experience. Because at least I can talk to others about what this program really meant |
| If you could describe this program in one word, what would it be? | ● Necessary<br>● A gentle exercise program<br>● "Awakening"<br>● Helpful<br>● Refreshing<br>● Informative<br>● Good<br>● Different for me<br>● Mind and body exercise<br>● Just try and keep going |
| Would you change, add, or remove anything to this program? If so, what? | ● I wouldn't change anything<br>● A longer period of time would be beneficial<br>● A longer program<br>● Longer class and more often |

| | |
|---|---|
| | • I'm sure there could be something added to it. However nothing comes to mind and there really would not be time in the period of time allotted<br>• No<br>• Can't think of anything only enjoy and might like a few more times a week<br>• I would like to have more explanation on this program at the beginning so I would have (been) more prepared |