Effect of performing the Standing Pilates repertoire on balance in an aging female population

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Dedication

To my husband, I love you and thank you for all of your love, understanding, guidance, and support.

To my children, I love you and thank you for understanding mommy's research time.

Effect of performing the Standing Pilates repertoire on balance in an aging female population, a randomized controlled trial

ABSTRACT

Background: The ability to maintain balance directly affects an individual's capacity to function independently or with confidence. Research shows that balance declines with aging based on many factors. Poor balance can lead to injury, which may further compromise independence, making balance not just an immediate safety concern, but a broader quality of life issue.

Objective: To determine if performing the Standing Pilates repertoire would significantly improve balance compared with a standard exercise program as determined by the Timed Up and Go (TUG) and Berg Balance Scale (BBS) for women aged 65-85 years

Design: Single-blinded randomized controlled trial.

Setting: Community senior facility.

Participants: Fifty-two community dwelling healthy women.

Intervention: Standing Pilates protocol versus standard exercise protocol, performed for three 45 minute exercise sessions each week for a 4-week time period (12 sessions total).

Measurements: Modified Falls Efficacy Scale (MFES), TUG, BBS, and abdominal circumference.

Results: Forty-one women completed a minimum of 10 exercise sessions and participated in the post-assessment. The MFES tool showed no difference pre- and post-assessment and no difference between groups. Statistical significance ($p < 0.05$) was found on the pre- and post-assessment for all participants independent of group assignment on the TUG and BBS. Statistical significance ($p < 0.05$) was found pre- and post-assessment as well as between groups on the abdominal circumference measurement.

Limitations: Small sample size, unequal drop out rate between intervention and standard group, ceiling effect on balance measures used, and no inactive control comparison.

Conclusions: The Standing Pilates repertoire was no more effective at improving balance scores than the standard exercise group.

Key Words: Pilates, Balance, Female, Aging

CHAPTER 1: INTRODUCTION

Introduction & Significance of Problem

One in three adults aged 65 years and older fall each year.[1] In 2007, over 18,000 people aged 65 years and older died from injuries related to unintentional falls. In 2005 nearly 1.8 million people aged 65 years and older were treated in emergency departments for nonfatal injuries from falls, and more than 433,000 of these patients were hospitalized.[2] According to the 2005 statistics from the Centers for Disease Control and Prevention, women are 67% more likely than men to experience a nonfatal fall injury.[2] Women, however, only make up 58% of the 65 years and older population, implying that the fall rate for women is greater than men among this population. In 2000, the total direct cost for nonfatal falls was $19 billion dollars.[1] Poor general health, urge urinary incontinence[3], medications[4], environmental factors[5], and motor impairment are contributors to an increased risk of falling.[6]

Falls or the lack thereof is the ultimate measure of balance. Balance has been defined as the ability to control the center of gravity over the base of support in a given sensory environment.[7] Balance requires maintaining a reference point, making constant corrections, and having an end objective. The integration of a number of working physiological systems is necessary for successful balance. The visual, somatosensory, and vestibular systems integrate to establish the sensory triad of postural control. An individual relies on vision to scan the

environment and to develop an anticipatory control or feedback mechanism. Somatosensory input from sensory receptors is utilized to develop a reactive control mechanism. The vestibular system provides the dominant input about movement and equilibrioception. Vestibular input integrates the ability to distinguish self movement versus environmental motion. (Figure 1)

The integration and interaction between and among the individual components of the musculoskeletal and neurological systems are also essential for postural control. The musculoskeletal system encompasses muscles, bones, and connective tissue to create muscle synergies, joint torques, and kinematic surface forces through range of motion (ROM) and strength. The neurological system provides the ability to perform coordination, strategies for maintaining balance (ankle, hip, stepping response), postural response latencies, spatiotemporal coordination, force control and adaptation of postural strategies. Strategies are neural control processes that provide an action plan based on the particular task, behavioral goals, and environmental constraints. Postural strategies become more efficient and effective in response to a repeated stimulus. Horak et al[8] reviewed the neural control of posture and synthesized research on balance and concluded that balance is ultimately a flexible, functional motor skill that can adapt with training and experience. Cognitive prowess as well as practice of an activity can affect postural control as well.[8]

Programs and activities continue to be designed and implemented to stimulate, challenge, and/or facilitate balance with the goal of promoting an improvement through practice. A significant amount of research exists regarding the impact of exercise on balance with a notable amount in the aging population.[9-14] The underlying theory for this research is that exercise challenging the balance centers (somatosensory, visual, and vestibular) and facilitating trunk stabilization in the aging female will improve balance scores as measured by the Berg Balance Scale (BBS) and the Timed Up and Go test (TUG).

Several authors have looked at balance in the aging population with varied intervention strategies, duration of intervention, use of measurement tools, and comparison groups (active versus inactive control group). Gillespie et al[14] performed a review of methods to prevent falls that were effective for older people living in the community. The review included 111 randomized controlled trials and 55,303 participants. The conclusion related specifically to exercise was that exercise programs that contained two or more of the following components had a reduced rate of falls or number of people falling: strength, balance, flexibility, or endurance.

Research focus on the aging female addresses the potential confounding factors of gender bias, gender issues[15] (females' concern to look inappropriate exercising in front of males), and hormonal influences.[16] Madureira et al[17] used the BBS, TUG, and Clinical Test

Sensory Interaction Balance (CTSIB) to examine the effects of performing a twelve month balance training program on balance, mobility, and falling frequency in women aged sixty-five years and older who were diagnosed with osteoporosis. A total of sixty women completed the study participation following random assignment to a control group (education and medical care for osteoporosis only) or an intervention group (weekly hour long guided exercise sessions). The intervention group improved significantly on all measurements as compared to the control group.

Carter et al[18] also looked at an elderly female population comparing an active group to an inactive group for fall risk. The sample included eighty women aged 65 to 75 years randomly assigned to the active group or inactive group. The active group performed a twice weekly Osteofit exercise class and the inactive group did nothing. The researchers measured changes in static balance (dynamic posturography), dynamic balance (timed figure eight run), and knee extension strength (by dynamometry). The active group compared to the inactive group improved in both dynamic balance as well as lower extremity strength.

A change would be anticipated when comparing a group that performs an activity versus a inactive control group. Judge et al[13], on the other hand, had twenty-one female participants with a mean age of sixty-eight years complete one of two exercise programs aimed at improving static balance. The participants were randomly assigned to

the combined training group or the flexibility training group. The balance assessment via force plate measurement did not reveal any significant changes, but the exercise program was not designed to look at improving postural sway or reflex training, only static balance.

Tai Chi has been a mode of exercise for the aging population and has been researched heavily since an initial study was published in 1996 by the National Institute of Aging. This hallmark study involving Tai Chi and balance in an aging population was performed by Wolf et al at Emory University.[19, 20] Two hundred participants aged 70 years and over were randomized into either the Tai Chi program group, a computerized balance training group, or an education only group. The participants in the Tai Chi group completed a fifteen week program consisting of once weekly sessions with an instructor and fifteen minutes of daily practice on their own. The research resulted in a decrease in falls for the Tai Chi participants with no change in falls for the computer balance training group and education group.

Wolf et al[21] performed a follow up study to the initial hallmark Tai Chi study with a focus on postural sway, comparing the same protocol of computerized based training versus Tai Chi versus an education only group. Tai Chi with this cohort did not improve postural sway, making the authors conclude that the initial improvements seen with Tai Chi may have been more related to improvements in confidence. The authors utilized a simple “Are you afraid of falling” question with the balance

measures assessment to gauge the confidence of the participants. This simple question though, is not effective in determining the psychological status regarding fear or confidence, which limits the ability to make specific conclusions based on the data. The fear of falling, even if a fall has not previously occurred, may be as disabling as a fall itself.[22] Conversely, increased confidence in performing daily tasks without falling is correlated with improved balance.[9, 23, 24] Appropriate measurement tools offer insight into the aging person's perception of their abilities without falling.

Several more studies have continued using Tai Chi and an elderly population to examine the exercise sequence, safety of the exercises, and ease of performing the exercises allowing Tai Chi to continue as an appropriate exercise activity for the aging population.[14, 25-28] Tai Chi has been practiced for several hundred years. It is a Chinese exercise system that uses slow, smooth body movements to achieve a state of relaxation of both body and mind. Pilates, in comparison, also focuses on the body/mind connection, but has only been in existence for about a hundred years. Pilates stresses the importance of posture and alignment with active muscle engagement to achieve controlled, flowing movement.

Pilates is an exercise compilation that was created by Joseph H. Pilates in the 1920s.[29, 30] Pilates follows six principles: (1) breathing, (2) axial elongation/core control, (3) efficient organization of head/neck/shoulder girdle, (4) spine articulation, (5) alignment/

posture, and (6) movement integration.[31] Pilates encompasses a mat repertoire and exercises performed on specialized equipment that uses springs as resistance. The exercise compilation is quite extensive and adaptable to all ages.

Pilates, although studied in a limited manner, has gained immense mainstream popularity.[32-37] Several books have been published illustrating and describing specific Pilates mat exercises and progressions.[38-41] Joan Breibart, founder of Pilates PhysicalMind Institute®, published via a book and DVD her Standing Pilates repetoire in 2005.[42, 43] Standing Pilates retains stability, posture, and alignment as the foundations for the repetoire. Standing Pilates, however, is performed in the vertical plane, like Tai Chi, not the horizontal plane typically applied during Pilates mat exercises. Published case reports show a reduction in pain and improved function following performance of a Pilates program.[44-47] Currently the research focus utilizing the Pilates Method has included the effect on low back pain[10, 44, 48-52], quality of life for women living with breast cancer[46, 53], flexibility and body composition[54-56], tennis serve velocity in collegiate tennis players[57], leaping ability in elite rhythmic gymnasts[45], dynamic posture in dancers[58], determination of muscle activation patterns during certain Pilates movements,[58-62] and many other case studies[47, 63-65]. One of the criticisms of the current body of Pilates research is the lack of consistency in the exercise protocol/performance. Moreover, there has

been little research regarding Pilates and balance. A few studies have been published, but the studies use a mixture of equipment based exercises and mat based exercises. Specifically no research was found applying the Standing Pilates repertoire. The studies found used both male and female participants, varied measurement tools, varied intervention protocols, varied durations, and small sample sizes.

Hall et al[66] examined the effects of Pilates-based training on balance in an elderly population. The study included 24 subjects, men and women, with a mean age of 69.5 years. The subjects were randomly assigned to one of the following groups: (1) traditional strength plus flexibility training, (2) Pilates-based training, and (3) a no exercise control. A ten week training program was completed, but the authors did not mention how often the groups met. Balance was assessed using the BBS and Kinesthetic Ability Training balance platform (KAT). The Pilates-based training group had significant improvement on the static balance scores as compared to the other two groups. Dynamic balance improved in all three groups with no significant difference between groups.

The Pilates reformer repetoire was used by Johnson et al[67] to assess dynamic balance changes in healthy older adults. Forty subjects were randomly assigned to two groups, control and experimental. The experimental group completed ten Pilates sessions within a five week time period. The control group was asked to maintain their current level of activity during the same five week time period. Balance was assessed

using the Functional Reach Test (FRT). A significant change in the functional reach test results was found in the experimental (Pilates) group.

The Pilates balance research that most similarly followed an established standard in balance exercise protocols[68, 69] was performed by Kaesler et al[11]. A cohort of eight elderly men and women participated in a twice-weekly, eight week Pilates-inspired program designed to improve balance in an upright position. The Pilates-inspired program utilized several pieces of the Pilates equipment with some more traditional exercises (resisted band hip abduction and adduction, resisted band seated rowing, step up and over) beginning with a ten minute warm-up, forty minute conditioning phase, and ending with a ten minute cool-down. The program consisted of the same twelve exercises each session. Balance was assessed using the TUG, a sit-to-stand timed test, and four balance measures. The results suggested that the program may improve static balance in well-functioning older adults. The study, however, did not utilize a control group and had a small sample size.

Purpose of Study

Each study identified a need for further research utilizing larger sample sizes, maintaining a reproducible protocol, and focus on specific at risk populations. The research on Pilates is sparse especially related to balance. The purpose of this research is to determine if performing the Standing Pilates repertoire has an effect on a measure of balance

between two groups of aging women. The Standing Pilates repertoire was chosen for the intervention group to maintain a consistent repertoire. This repertoire is a published, organized, and repeatable sequence of exercises with appropriate modifications for all levels of ability.

CHAPTER 2: METHODS

Design Overview

Single-blinded randomized controlled trial.

Setting and Participants

The research took place at a local senior citizen's community that has a community center. Women aged 65 to 85 years were recruited from a local assisted living facility, local senior services center, and the local community via flyers at the assisted living facility, flyers and an article in the senior services center monthly newsletter, and advertisements in the local newspaper. A "meet and greet" was scheduled at the local assisted living facility for the potential research participants to be introduced to the principal investigator, to review the informed consent process, and to discuss the purpose for the research project. The women who were interested in participating signed up for the pre-assessment. The interested women called the facility or came in person to choose a time. Each interested participant attended the pre-assessment which consisted of a medical screening (refer to Appendix A), completion of the informed consent (refer to Appendix C), completion of the Modified Falls Efficacy Scale (refer to Appendix B), anthropometric measurements (height, weight, abdominal circumference), and a balance assessment via the Timed Up and Go (TUG) and Berg Balance Scale (BBS) (refer to Appendix E).

The inclusion criteria were: female; aged 65-85 years; no cardiovascular, neuromuscular, or neurological contraindications to exercise (as noted on participant screening intake form—see list of diagnoses in exclusion criteria); functionally literate in the English language (to assure informed consent and to understand the exercise/activity instruction).

The exclusion criteria were: hearing disorder that would impair the ability to follow oral instructions; visual disorder that would limit ability to visually follow exercise instructor; medical condition that would impair balance, including Parkinson's Disease, Multiple Sclerosis, stroke with residual impairment, severely limiting arthritis, joint instability, total joint replacement within the past 6 months, abdominal surgery within the past 6 months, surgery, chemotherapy, or radiation therapy for cancer treatment within the previous 6 months; history of myocardial infarction, coronary artery bypass, or other cardiac surgery/hospitalization within the past 6 months; have previous participation in a Pilates-based exercise program; and begun a new exercise program in the past 6 months.

The Modified Falls Efficacy Scale (MFES) was used to assess the participants' fear of falling. This 14-item scale was designed by Hill et al[70] to expand the Falls Efficacy Scale (10-item scale) created by Tinneti et al[71]. The scale assesses a person's confidence in her ability to avoid

falling while undertaking activities such as housecleaning, dressing, and outdoor activities.

The anthropometric measurements of height and weight were performed using the Health-0-meter® Professional that was calibrated on January 12, 2011. The participants removed shoes and socks prior to the height and weight measurements and remained with them off until after the balance assessment was completed. The abdominal circumference measurement was taken according to the online Air Force Standards for the Physical Fitness Requirements and the PT test (www.airforce-pt.com/abdominal-circumference.html) using the same fabric measuring tape for every individual. The measurement was taken under clothing in a clockwise direction and counter clockwise direction with the mean being recorded.

The balance assessment tools used in this study were the Timed Up and Go test (TUG) and Berg Balance Scale (BBS). The participants remained in barefoot, without shoes, for the balance assessment as this is how the Standing Pilates repetoire would be performed. The TUG[72, 73] is a simple and easy to administer test in a clinical setting. It is used to measure functional mobility of persons with musculoskeletal conditions. The test consists of measuring the time it takes for an individual to get up from a chair, walk to a 3 meter mark, turn around, come back, and sit down. The BBS[74, 75] is a 14-item scale designed to measure balance of the older adult in a clinical setting. The test requires the following

equipment: a ruler, two standard chairs (one with arm rests and one without), a footstool or step, a stopwatch, and a 15 meter straight walkway. The BBS has a good intratester and test-retest reliability with a high intraclass correlation coefficient (ICC).[74]

The TUG and BBS have established reliability and validity with community dwelling older people.[76] There is fair to moderate inverse correlation between the TUG and the BBS (r = -0.47 to -0.69). The TUG has an inter-rater reliability ICC = 0.98-0.99 and an intra-rater reliability ICC = 0.97-0.98. The BBS has an inter-rater reliability ICC = 0.88-0.98 and intra-rater reliability ICC = 0.68-0.99. The BBS is considered the gold standard comparison for validity among functional balance assessments with adults.

Randomization and Interventions

After the pre-assessment fifty-two women met the criteria to participate, agreed to participate, and were randomly assigned to either the standard exercise group or intervention Pilates group. The group randomization was performed using a table of random numbers. All participants were contacted by the principal investigator the evening of the pre-assessment to notify them of the group assignment. The participants were notified of the class schedule and the importance of attendance at each session.

Each group met for forty-five minutes, three times a week, over a four week time period. Both groups were lead by the same instructor, a

certified Pilates instructor through PHI Pilates, and a research assistant, a third year entry-level doctoral physical therapy student at Georgia State University. Both groups met in the same physical activities room with the standard group having the room from 8:30 a.m. until 9:15 a.m. and the intervention group having the room from 9:30 a.m. until 10:15 a.m. The potential for group interaction was minimized in several ways: 1) the use of shades over the room windows, 2) the research assistant directing the participants in the appropriate direction for either attendance recording or exit from the room, 3) the standard group exercise session ending with a walk out of the room, which limited individuals from waiting around inside the room, and 4) the participants did not live in the same building on the facility premises and several of the participants lived in the general community limiting their interaction to the group meetings.

The protocol for the intervention group is listed in Appendix G. The protocol for the standard group is listed in Appendix H.

Collection of Data

Attendance was taken at the start of each exercise session for each group by the research assistant. Each participant was asked individually upon entering the room if they had experienced a fall since the previous exercise session. For the purposes of this research project a fall was defined as “a loss of balance resulting in using something or someone to protect yourself from coming in contact with the ground or actually

coming in contact with the ground." For compliance to the research protocol, when a participant missed an exercise session she was called by the research assistant to check on her overall status. A participant could miss two exercise sessions out of twelve to continue as a part of the research study. Refer to Appendix F for the Attendance Record template.

During the last week of the exercise sessions, each participant signed up for a post-assessment time. At the post-assessment, each participant repeated the Modified Falls Efficacy Scale, anthropometric measurements (height, weight, abdominal circumference), TUG, and BBS. All participants who attended the post-assessment completed an exit questionnaire (see Appendix I) for the principal investigator to receive feedback on the program in general. On the post-assessment day, the principal investigator contacted all the individuals who did not complete the necessary ten out of twelve exercise sessions.

Outcomes and Follow-up

An intra-rater reliability study was performed by a physician and the principal investigator, a physical therapist and certified Pilates instructor through Polestar Pilates Education. Ten women aged sixty-five to eighty-five years old were assessed by the physician for abdominal circumference measurements according to the online Air Force Standards for the Physical Fitness Requirements and the PT test (www.airforce-pt.com/abdominal-circumference.html) using the same

fabric measuring tape for every individual. The measurement was taken under clothing in a clockwise direction and recorded by the physician. The measurement was then immediately retaken in a counterclockwise direction and recorded by the physician. The fabric tape used for the reliability study was also used during the pre-assessment and post-assessment. The same ten women were assessed by the principal investigator for the TUG and BBS. The principal investigator videotaped her assessment with verbal and written clearance of the participants. The videotape was reviewed two weeks later by the principal investigator and rescored for a new measurement to be compared to the initial assessment. The intra-rater reliability for abdominal circumference as measured by the physician was determined to be 0.998 ($ICC_{3,1}$). The intra-rater reliability for the principal investigator was determined to be 1.000 ($ICC_{3,1}$) for the BBS and 0.998 ($ICC_{3,1}$) for the TUG.

Statistical Analysis

A separate mixed analysis of variance (ANOVA) was used to analyze each dependent variable (MFES, abdominal circumference, BBS and TUG). The repeated factor was trial and the independent factor was group with the primary interest being an interaction. An Intention-to-Treat (ITT) analysis was also performed to include the individuals who did not complete the required number of exercise sessions. The last observation was carried forward for imputation of missing data. The Minimum Clinically Important Difference (MCID) on the BBS was

determined to be 4 points if the score is between 45-56, 5 points if the score is between 35-44, 7 points if the score is between 25-34, and 5 points if the score is between 0-24.[77] The MCID on the TUG was determined to be 4.09 seconds.[78] No published MCID has been reported for the MFES. The statistical analysis was performed using the PASW Statistics 18 (SPSS Software version 18).

Role of Funding Source

No external funding was received for this research project.

CHAPTER 3: RESULTS OF STUDY

Fifty-two women attended the pre-assessment, completed the medical screening, and agreed to participate in the research study (Figure 2). Table 1 includes the descriptive data for the pre-assessment group after random group assignment and Table 2 represents the sample after the post-assessment. In the standard group two people were unable to complete the required ten exercise sessions out of twelve. One individual had to be out of town for an extended period of time and the other individual was diagnosed with breast cancer. In the Standing Pilates (intervention) group nine individuals were unable to complete the required sessions. Two individuals fell at home between the pre-assessment day and the first exercise session and had pain causing them to no longer wish to participate in the study. Four individuals discontinued due to health issues (an upper respiratory infection). One individual sustained a knee injury unrelated to the exercise program. Two individuals discontinued due to increased pain after performing the Standing Pilates exercises. One individual discontinued due to foot pain. She had a history of stress fractures in her feet and she felt the exercises aggravated her feet as shoes were not worn during the Standing Pilates exercise performance. The other individual reported increased back pain while performing the exercises. Both individuals reported the increase in pain lasting for a few days, but then returned to their normal baseline after that time. The average exercise session attendance for the standard

exercise group was 11.3 sessions and the average exercise session attendance for the Standing Pilates (intervention) group was 11.1 sessions.

Table 3 represents the study population results for MFES, BBS, TUG, and abdominal circumference measurements.. The mixed ANOVA statistical analysis results are in Table 4. There was no statistical significance between trials or between groups on the MFES. Statistical significance was found between trials, but not between groups on the TUG and BBS. Statistical significance between trials and an interaction based on group assignment was found on the abdominal circumference measurements. The Minimal Clinically Important Difference Score (MCID) and Number Needed to Treat (NNT) data for the TUG and BBS are reported in Table 5.

Falls were recorded throughout the study at the check-in of each exercise session. Only one fall was reported during the data collection period and the individual was in the standard exercise group.

An Intention-to-Treat analysis was also performed on all measures with no change in the results. Figures 3-6 were created for the abdominal circumference, BBS, MFES, and TUG measures using the Intention-to-Treat data. The trend of the abdominal circumference, BBS, and TUG measurements show an improvement from the pre- to post-intervention assessment data.

CHAPTER 4: DISCUSSION OF STUDY

Following a three time per week exercise program over four weeks, improvements in abdominal circumference and balance measures, as assessed by the TUG and BBS, occurred. Even though the study duration was short in comparison to the current body of balance literature, statistically significant changes occurred. Moreover, the interaction time with study participants was similar to the treatment time of average physical therapy interventions among the senior population. In a December 2010 report, the Office of the Inspector General determined the national average for outpatient physical therapy utilization based on the Medicare 2009 claims was 49 services per beneficiary, with a service defined as a single Healthcare Common Procedure Coding System (HCPCS) code.[79] As most therapy HCPCS codes are defined in fifteen minute increments, recasting the twelve visit study protocol into these terms would yield 36 services per participant, which is below the national average. These findings suggest that the three times per week, four week protocol may yield positive results due to the consistent reinforcement and attention level afforded.

Regarding the specific findings, abdominal circumference measurements improved in both groups from pre- to post-assessment with an interaction between groups. The focus of the Standing Pilates (intervention) group was on postural awareness, upright positioning, explanation of transverse abdominus contraction (drawing the naval

inward, draw the naval toward the spine, draw the skin away from the waist band of the pants), and proper breathing instruction. The standard exercise program included a singing activity and general movement activities with no instruction on abdominal contraction or breathing pattern. With aging, cells age and function less optimally contributing to the body changing.[80] Body composition changes as fat, lean muscle, bones, water, and other substances change in amount and distribution. Fat tissue may increase toward the center of the body by as much as 30%.[81] Increased abdominal fat places the individual at risk for health concerns, such as hypertension, diabetes, and colorectal cancer.[82] Lifestyle, especially exercise, is the best way to combat abdominal fat. Davidson et al[83] reported that increasing physical activity in middle-aged women decreased abdominal fat gain. This may be true for the women involved in this research as the sample for this particular research project had a mixture of active individuals already exercising and women who were not exercising at all allowing all the women to have an increase in physical activity.

The feedback from the standard exercise group was that the activity was fun, very interactive, and maybe a little too easy. The participants in the standard exercise group all reported a positive experience from being a part of the research process and disappointment that the class would not continue to meet. The Standing Pilates (intervention) group participants reported feeling challenged with the

activity and an improved awareness of balance. The Standing Pilates (intervention) group did report on the exit questionnaire consistently an improved awareness of body position and alignment from practicing the repertoire each session along with the education given at each session by the instructor.

The standard exercise protocol involved the group performing a fun movement activity involving both social interaction, memory games, and exercise. The standard exercise group improved on both balance measures from pre- to post-assessment, consistent with the findings within the current body of literature on exercise and balance in the aging population.[6, 9, 17, 19] The standard exercise group, however, averaged faster times on the TUG compared to the Standing Pilates group. This improvement was not anticipated. The movement activity may have trained the group to move at a particular pace, the pace of the instructor or the group in general. Walking speed, as measured by the TUG, may have increased from specific training. Studenski et al[89] analyzed baseline gait speed data on more than 34,485 community dwelling older adults aged 65 years and older. The researchers associated gait speed with survival in older adults. An inverse correlation between all-cause mortality and gait speed was found for both sexes.

The Standing Pilates (intervention) group also improved on the balance measures from the pre-assessment to the post-assessment. The focus of the repertoire was on static balance with posture and alignment

cues. The purpose of performing the Pilates exercises, which are typically performed in a horizontal plane, in the standing position was to place the participant into the vertical plane, which is arguably the more functional plane. The repertoire was given in the same order every session allowing each participant to experience success and balance challenges. The activity progression of the Standing Pilates repertoire focused on stabilizing the body over a base of support (unilateral or bilateral lower extremities) and then moving a part or multiple parts of the body.

With respect to the balance measures, both groups improved from pre-assessment to post-assessment, but there was no difference between groups. The Standing Pilates repertoire was not more effective than the standard exercise group according to the balance measures used.

The limitations of this study were the small sample size (the *a priori* power estimate for this particular research revealed a recommended 60 participants), the unequal drop out rate between groups, the absence of a control group that did not perform any activity, and the balance measures used. The BBS is considered the gold standard for balance assessment with well established norms and MCID[76-78], but it has been shown to be an ineffective measure to detect a change for this particular population.[75, 84, 85] The BBS was used due to its ease to administer, low cost, and established validity and reliability. Larger changes may have been seen if the group was limited to 70 years

and older. The inclusion of the 65 to 69 year old women showed a ceiling effect on the BBS.

The MFES was used to assess the participant's fear of falling as this has been shown to increase with age and is more prevalent in women[86-88]. The MFES, however, was not an effective tool to measure this particular cohort's fear of falling. Even with a thorough explanation regarding the MFES rating scale, including emphasis of the completely confident rating, each participant rated herself completely confident in performing most of the listed items. A majority of the participants, however, reported a desire to be included in this particular research study as they had been noticing a decrease in their abilities to balance. Because of this observation, though the MFES is reliable, further investigation of its validity is warranted.

The TUG is considered another gold standard test for assessing risk of falling particularly in the aging population.[73, 76, 78] The population involved in this research process for the most part did not show a significant risk of falling.

Further research using the Standing Pilates repertoire may utilize different balance measures to detect a potentially greater change, an assessment of compensatory stepping and grasping reactions[90], testing reaction time, and a longer duration of activity performance. All the participants reported feeling better after the exercise sessions based on the exit questionnaire which is consistent with Joseph Pilates "tag line"

for his work: “You will feel better in 10 sessions, look better in 20 sessions, and have a totally new body in 30 sessions.”[30] A longer duration of exercise sessions may have contributed to greater changes on the balance measures and abdominal circumference measurements.

The American College of Sports Medicine promotes exercise and physical activity in older adult populations, not to slow down the biological aging process, but to limit the development and progression of chronic disease and disabling conditions, reduce the physiologic harms of an otherwise sedentary lifestyle, and improve active life expectancy.[9, 91]

Conclusion/Summary of Study

Balance is maintained through practice. The Standing Pilates repertoire provided challenges to the balance centers (visual, somatosensory, and vestibular). Standing Pilates was not more effective than a standard exercise protocol in improving balance in this population based on the balance measures used. With a short duration study and only ten to twelve sessions of generalized physical activity or the Standing Pilates repertoire, there was a measurable change in a functional activity and abdominal circumference. Given that with such a small dose of intervention, being able to measure a change is meaningful, and suggests a higher dosage or the use of more precise measurements may be warranted.

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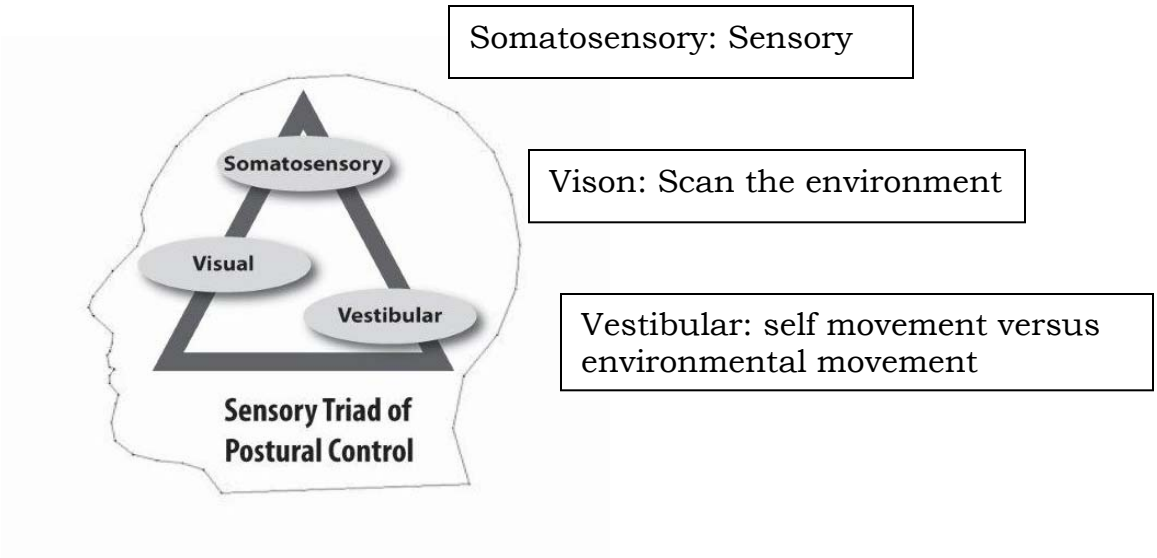

Figure 1: Sensory Triad of Postural Control

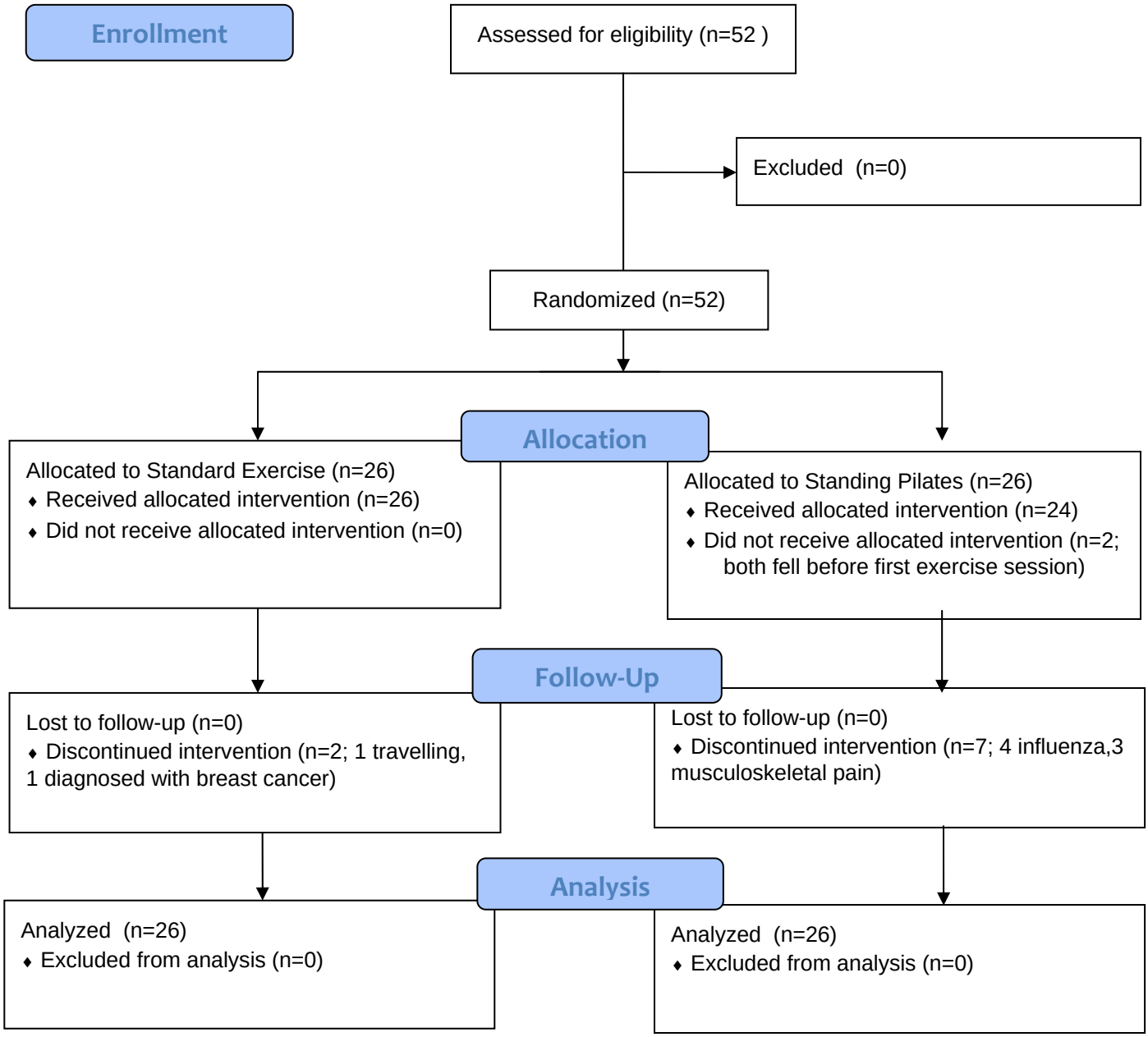

Figure 2: CONSORT Flow diagram

Table 1: Descriptive Statistics Pre-Assessment
Mean (Standard Deviation)

Group	Age (years)	Height (inches)	Weight (pounds)
Standard Group (n=26)	68.6 (5.19)	63.4 (2.29)	165.9 (36.70)
Intervention Group (n=26)	71.2 (5.32)	63.2 (2.49)	165.2 (25.62)

Table 2: Descriptive Statistics Post-Assessment
Mean (Standard Deviation)

Group	Age (years)	Height (inches)	Weight (pounds)
Standard Group (n=24)	69.0 (5.29)	63.5 (2.29)	166.8 (37.70)
Intervention Group (n=17)	72.4 (5.57)	62.7 (1.72)	152.5 (19.78)

Table 3: Means for MFES, BBS, TUG, Abdominal Circumference

Modified Falls Efficacy Scale

Group	Mean	Std Dev	95% confidence interval lower bound	95% confidence interval upper bound
Pre-Assessment	9.82	0.463	9.68	9.95
Post-Assessment	9.85	0.606	9.66	10.04

Timed Up and Go

Group	Mean	Std Dev	95% confidence interval lower bound	95% confidence interval upper bound
Pre-Assessment	8.66	4.006	7.244	10.075
Post-Assessment	7.72	3.499	6.517	8.913

Berg Balance Scale

Group	Mean	Std Dev	95% confidence interval lower bound	95% confidence interval upper bound
Pre-Assessment	50.688	3.274	49.554	51.821
Post-Assessment	54.304	2.779	53.492	55.116

Abdominal Circumference

Group	Mean	Std Dev	95% confidence interval lower bound	95% confidence interval upper bound
Pre-Assessment	37.486	4.7140	36.165	38.806
Post-Assessment	36.663	4.6710	35.350	37.977
Standard Group Pre-Assessment	37.904	5.0542	36.036	39.772
Standard Group Post-Assessment	36.51	4.8133	34.652	38.367
Standing Pilates Group Pre-Assessment	37.067	4.4071	35.199	38.935
Standing Pilates Group Post-Assessment	36.817	4.6144	34.96	38.675

Table 4: ANOVA

Modified Falls Efficacy Scale

Source	SS	*df*	MS	*F*	*p*
Group	0.151	1	0.151	0.423	0.519
Error	13.936	39	0.357		
Trial	0.019	1	0.019	0.1	0.753
Group x Trial	0.056	1	0.056	0.299	0.588
Error	7.306	39	0.187		

Timed Up and Go

Source	SS	*df*	MS	*F*	*p*
Group	76.1	1	76.1	2.36	0.132
Error	1255.4	39	32.1		
Trial	17.8	1	17.8	13.9	0.001
Group x Trial	0.26	1	0.26	0.2	0.656
Error	49.8	39	1.28		

Berg Balance Scale

Source	SS	*df*	MS	*F*	*p*
Group	21.953	1	21.953	1.27	0.267
Error	673.95	39	17.281		
Trial	260.294	1	260.294	158.741	$\leq$0.01
Group x Trial	2.099	1	2.099	1.28	0.265
Error	63.95	39	1.64		

Abdominal Circumference

Source	SS	*df*	MS	*F*	*p*
Group	1.818	1	1.818	0.041	0.84
Error	2209.573	50	44.191		
Trial	17.573	1	17.573	33.618	$\leq$0.01
Group x Trial	8.51	1	8.51	16.281	$\leq$0.01
Error	26.136	50	0.523		

Table 5: MCID and NNT
A = Standard Exercise Group
B = Standing Pilates (intervention) Group

Berg Balance Scale

	Failed to Improve		
	Yes	No	
A	12	12	Risk 12/12 = 0.5000
B	7	10	Risk 7/17 = 0.4118

Absolute Risk Reduction 0.088, $CI_{95\%}$ = -0.206 to 0.358

NNT = 11.3, $CI_{95\%}$ = - 5 to infinity and 3 to infinity

Timed Up and Go

	Failed to Improve		
	Yes	No	
A	23	1	Risk 23/24 = 0.9583
B	16	1	Risk 16/17 = 0.9412

Absolute Risk Reduction 0.088, $CI_{95\%}$ = -0.206 to 0.358

NNT = 11.3, $CI_{95\%}$ = - 5 to infinity and 3 to infinity

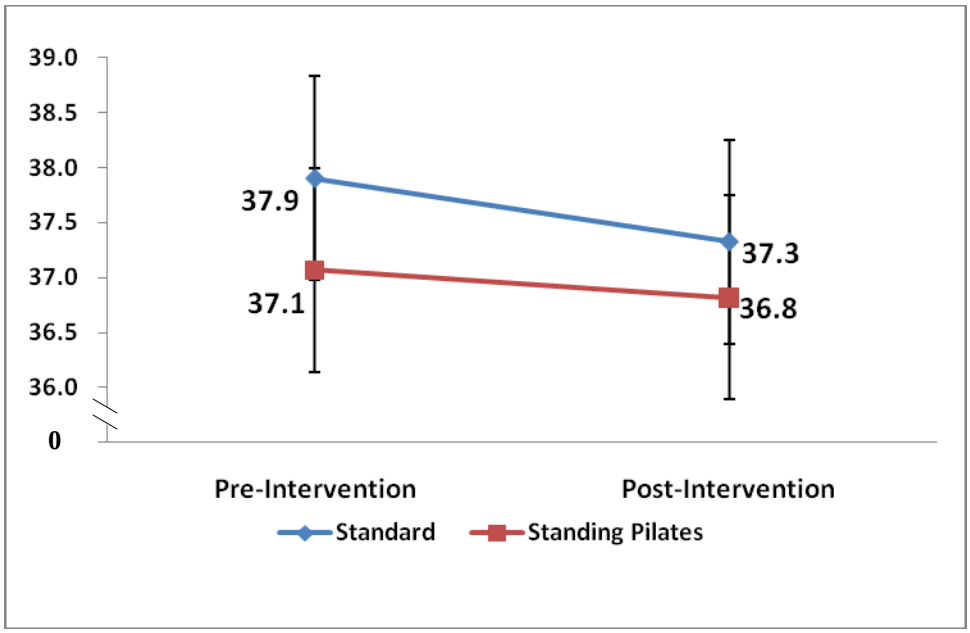

Figure 3: Abdominal Circumference (inches)

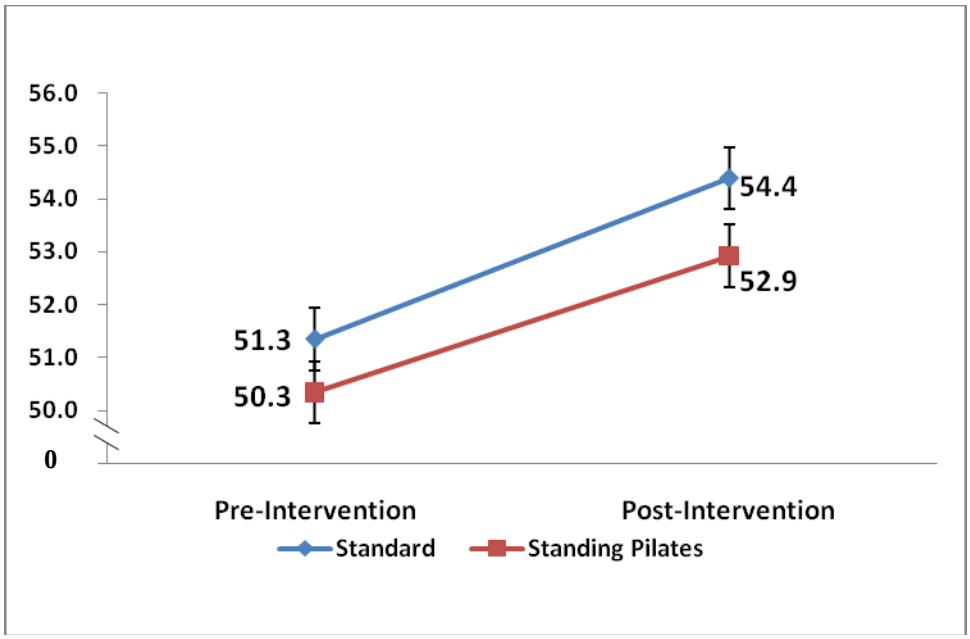

Figure 4: Berg Balance Scale (0-56)

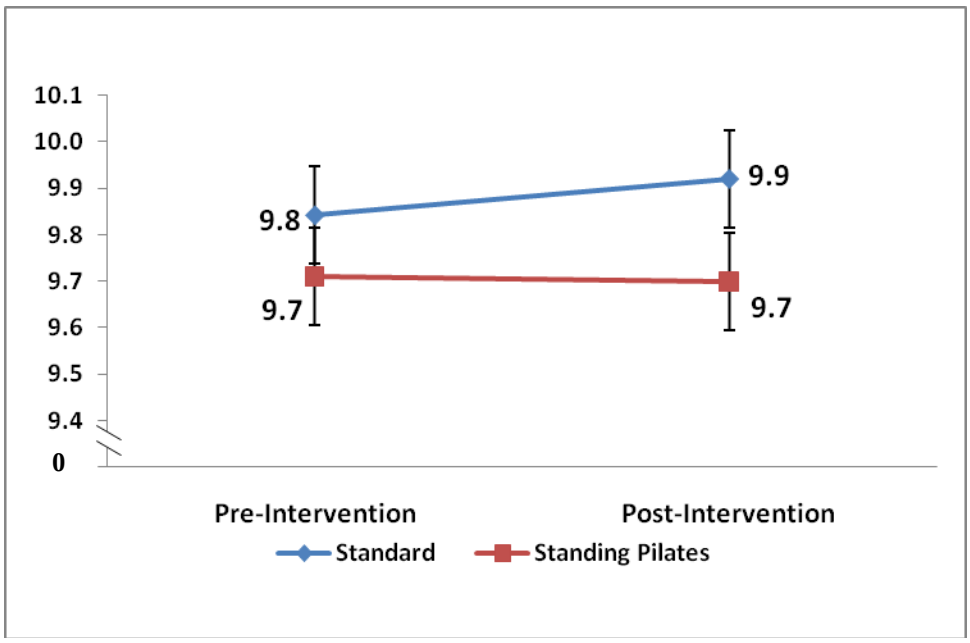

Figure 5: Modified Falls Efficacy Scale (0-10)

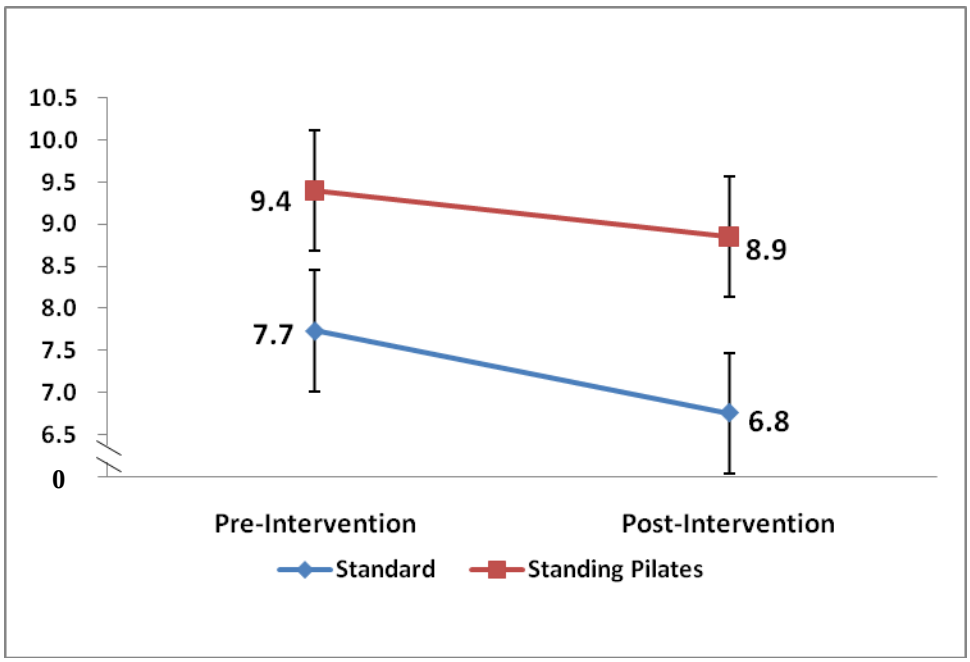

Figure 6: Timed Up and Go (seconds)

APPENDIX A: Participant Medical Screening

Effect of Performing the Standing Pilates Repertoire on Balance
In an Aging Female Population

Participant Medical Screening

Name: _____

Date of Birth: _____

Date: _____

Medical Screening: (Please check if you have any of the following)

- ☐ Hearing disorder that would impair the ability to follow oral instructions
- ☐ Visual disorder that would limit ability to visually follow an exercise instructor
- ☐ Parkinson's Disease
- ☐ Multiple Sclerosis
- ☐ Stroke with residual impairment
- ☐ Severely limiting arthritis, joint instability
- ☐ Total joint replacement within the past 6 months
- ☐ Abdominal surgery within the past 6 months
- ☐ Surgery, chemotherapy, or radiation therapy for cancer treatment within the previous 6 months
- ☐ History of myocardial infarction, coronary artery bypass, or other cardiac surgery/hospitalization within the past 6 months
- ☐ Have previously participated in a Pilates-based exercise program
- ☐ Have begun a new exercise program in the past 6 months

APPENDIX B: Modified Falls Efficacy Scale

The Modified Falls Efficacy Scale (MFES)

Working together to prevent falls

Form developed by: National Ageing Research Institute and North West Hospital Falls Clinic (adpated from Tinetti et al., 1990)

A one-page form, consisting of 14 questions each related to a particular activity (eg getting dressed, taking a bath, crossing roads etc). Unlike the original Falls Efficacy Scale (developed by Tinetti et al, 1990), this scale includes a greater range of outdoor activities. The questions aim to determine how confidently seniors feel they are able to undertake each activity on a scale of 0 (not confident at all) to 10 (completely confident).

An evaluation of the MFES was reported in: Hill, K., J. Schwarz, et al (1996). Fear of falling revisited. *Archives of Physical Medicine and Rehabilitation* 77: 1025-1029. These preliminary findings indicated that the MFES was both a reliable and valid measure of falls self-efficacy.

(Downloadable)

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In 2005 the Department of Human Services funded the National Ageing Research Institute to review and recommend a set of falls prevention resources for general use. The materials used as the basis for this generic resource were developed by the National Ageing Research Institute and the North West Hospital Falls Clinic, Parkville (adapted from Tinetti et al., 1990). This and other falls prevention resources are available from the department's Aged Care website at: http://www.health.vic.gov.au/agedcare.

Department of Human Services

Victoria
The Place To Be

The Modified Falls Efficacy Scale

Adapted from Tinetti et al, 1990; Hill et al, 1996

On a scale of 0 to 10, how confident are you that you can do each of these activities without falling, with 0 meaning "not confident/not sure at all", 5 being "fairly confident/fairly sure", and 10 being "completely confident/completely sure"?

NOTE:

- If you have stopped doing the activity at least partly because of being afraid of falling, score a 0;
- If you have stopped an activity purely because of a physical problem, leave that item blank (these items are not included in the calculation of the average MFES score).
- If you do not currently do the activity for other reasons, please rate that item based on how you perceive you would rate if you had to do the activity today.

		Not confident at all — Fairly confident — Completely confident 0 1 2 3 4 5 6 7 8 9 10
1.	Get dressed and undressed	0 5 10
2.	Prepare a simple meal	0 5 10
3.	Take a bath or a shower	0 5 10
4.	Get in/out of a chair	0 5 10
5.	Get in/out of bed	0 5 10
6.	Answer the door or telephone	0 5 10
7.	Walk around the inside of your house	0 5 10
8.	Reach into cabinets or closet	0 5 10
9.	Light housekeeping	0 5 10
10.	Simple shopping	0 5 10
11.	Using public transport	0 5 10
12.	Crossing roads	
13.	Light gardening or hanging out the washing*	0 5 10
14.	Using front or rear steps at home	0 5 10

* rate most commonly performed of these activities

Average score/item rated = ……../…….

= ……..

1. Hill K, Schwarz J, et al. Fear of falling revisited. Archives Phys Med Rehabil 1996; 77:1025-1029.
2. Tinetti M, Richman D, Powell L. Falls efficacy as a measure of fear of falling. J Gerontology 1990; 45:P239-43.

In 2005 the Department of Human Services funded the National Ageing Research Institute to review and recommend a set of falls prevention resources for general use. The materials used as the basis for this generic resource were developed by the National Ageing Research Institute and the North West Hospital Falls Clinic, Parkville (adapted from Tinetti et al., 1990). This and other falls prevention resources are available from the department's Aged Care website at: http://www.health.vic.gov.au/agedcare.

APPENDIX C: Consent Form

Rocky Mountain University of Health Professions

Consent to Participate as a Research Subject

The Effect of Performing the Standing Pilates Repertoire on Balance in an Aging Female Population

Investigators

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Kedron Medical Center
(770) 487-0808

Investigators' Statement

We are asking you to be in a research study. The purpose of this consent form is to give you information you will need to help you decide whether to be in the study. Please read the consent form very carefully. You may ask questions about the purpose of the research, what we would ask you to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this consent form that is not clear. When we have answered all your questions, you can decide if you want to be in the study or not. This process is called 'informed consent.' We will give you a copy of this form for your records.

Purpose of the Study

I am Karyn Staples, a doctoral student at Rocky Mountain University of Health Professions. I am pursuing my doctoral research on balance in the aging woman. Balance usually worsens as an individual ages. The ability to move through the world

with confidence and independence is important. The reason we are doing this research is to find out if a certain exercise regimen will help improve balance.

Description of the Study

We will be recruiting 60 healthy women aged 65 to 85 years to participate in the research study. To determine if you are eligible to participate, you will be asked to complete a questionnaire about your health history. If your responses indicate that you are eligible, you will be asked to participate in the testing and training portion of this study. If you are not eligible to participate, the information obtained from you during the screening will be omitted from this study and shredded to protect your privacy. The research will be conducted at Wesley Woods Newnan-Peachtree City, using the activities room for the assessments and the exercise sessions. If you are decide to participate, then you will be asked to

- Undertake a Medical Screening
- Complete a questionnaire describing your physical activity level, level of social interaction, and feedback on the exercise experience. You will be free to no answer any question that you do not wish to answer.
- Have a balance assessment using two standardized tests and measurements of your height, weight, and abdominal circumference. The private assessment will take approximately 30 minutes.
- Attend three group exercise sessions per week over a four week period. Each exercise session will last 45 minutes.
- Record if any falls had occurred since the prior exercise session. A fall for the study purposes will be defined as a loss of balance resulting in using something or someone to protect yourself from coming in contact with the ground or actually coming in contact with the ground.
- Please wear comfortable exercise clothing—shorts/exercise pants, t-shirt/exercise top, socks, and sneakers.
- Have the private balance assessment repeated after all twelve exercise sessions have been completed.

What is Experimental in This Study

None of the procedures, assessments, or questionnaires used in this study are experimental in nature. The only experimental aspect of this study is the gathering of information for the purpose of analysis.

Potential Risks, Stress, or Discomfort

There are minimal risks to you from participation in this study. You may develop muscle fatigue or general soreness as a result from testing procedures and the exercise program. Usual methods of rest, ice, or common over-the-counter medication (as suggested by your family physician) may help to decrease the discomfort. The study

program is designed to assess balance. Your safety is of most concern and any risk of falling will be minimized. Falls and fall related injuries are a risk of participation.

Potential Benefits

There may be no direct benefits to you. The results of this study may provide health professionals who work with the aging female population insight regarding an exercise program that may improve balance. Through the pre-assessment we will determine a potential fall risk for you. By participating in the study you may benefit from being more physically active. We cannot guarantee, however, that you will receive any benefits from participating in this study.

Confidentiality

With this research, something out of the ordinary is being done in your community. It is possible that if others in the community are aware that you are participating, they may ask you questions. However, we will not be sharing the identity of those participating in the research.

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no one but the investigators will be able to see it. Any information about you will have a number on it instead of your name. Only the investigators will know what your number is and we will keep that information under lock and key. A master list of code numbers will be kept confidential by the investigators and will be stored in a locked file cabinet. All other data pertaining to you and other subjects will be kept in a separate locked file in the investigator's office. Confidentiality will be maintained to the extent allowed by law. All original hardcopy data will be shredded seven (7) years after the completion of the study.

The knowledge that we get from doing this research will be shared with you through community meetings before it is made widely available to the public. Confidential information will not be shared. There will be small meetings in the community and these will be announced. After these meetings, we will publish the results in order that other interested people may learn from our research. All data will be presented in aggregate so that no personal information will be identifiable.

Incentives to Participate

You will not be given money or gifts to take part in this research.

Costs and/or Compensation for Participation

There will be no cost incurred to the participant to participate in this study.

Voluntary Nature of Participation

Participation in this study is voluntary. Your choice of whether to participate will not influence your future relations with Rocky Mountain University of Health Professions or Wesley Woods Newnan-Peachtree City (Newnan, GA). If you decide to participate, you are free to withdraw your consent and to stop your participation at any time without penalty or loss of benefits to which you are allowed.

Questions About This Study

If you have any questions about the research now, please ask. If you have questions later about the research, you may contact Karyn Staples, MPT, OCS at (770) 487-1931.

If you have questions regarding your rights as a human subject and participant in this study, you may call the Institutional Review Board at Rocky Mountain University of Health Professions. The telephone number of the IRB is (443) 926-6243. You may also write to the committee at: Institutional Review Board, Rocky Mountain University of Health Professions (irb@rmuohp.edu) or fax 801-734-6771.

Consent to Participate

The Institutional Review Board Committee at Rocky Mountain University of Health Professions has approved this consent form as signified by the Committee's stamp. This consent form must be reviewed at least once every year and expires one year from the approval date indicated on the stamp.

Subject's Statement

"This study has been explained to me. I volunteer to take part in this research. I have had a chance to ask questions. If I have questions later about the research, I can ask one of the researchers listed above. If I have questions about my rights as a research subject, I can call the Rocky Mountain University of Health Professions Institutional Review Board Committee at (443) 926-6243. My signature also indicates that I can change my mind and withdraw my consent to participate at any time without penalty. I will receive a copy of this consent form."

Printed name of Participant	Date	Signature of Participant	Date
Printed Name of Witness	Date	Signature of Witness	Date

ROCKY MOUNTAIN UNIVERSITY OF HEALTH PROFESSIONS
Institutional Review Board
Approved: October 21, 2010
Valid for no more than one year

APPENDIX D: Pre and Post-Assessment Intake Form

Name: _____

Date of Birth: _____

	Pre-assessment	Post-assessment
	DATE:	DATE:
Modified Falls Efficacy Scale		
Abdominal Circumference (measured in inches)		
Height (measured in inches)		
Weight (measured in pounds)		
Timed Up and Go		
Berg Balance Scale		

APPENDIX E: Berg Balance Scale

Description:
14-item scale designed to measure balance of the older adult in a clinical setting.

Equipment needed: Ruler, 2 standard chairs (one with arm rests, one without) Footstool or step, Stopwatch or wristwatch, 15 ft walkway

Completion:

Time: 15-20 minutes

Scoring: A five-point ordinal scale, ranging from 0-4. "0" indicates the lowest level of function and "4" the highest level of function. Total Score = 56

Interpretation:
41-56 = low fall risk
21-40 = medium fall risk
0 –20 = high fall risk

Criterion Validity:
"Authors support a cut off score of 45/56 for independent safe ambulation".

Riddle and Stratford, 1999, examined 45/56 cutoff validity and concluded:

- Sensitivity = 64% (Correctly predicts fallers)
- Specificity = 90% (Correctly predicts non-fallers)
- Riddle and Stratford encouraged a lower cut off score of 40/56 to assess fall risk

Comments: Potential ceiling effect with higher level patients. Scale does not include gait items

Norms:
Lusardi, M.M. (2004). Functional Performance in **Community Living Older Adults**. *Journal of Geriatric Physical Therapy*, 26(3), 14-22.

Berg Balance Scale

Name: _____ Date: _____

Location: _____ Rater: _____

ITEM DESCRIPTION	SCORE (0-4)
Sitting to standing	_____
Standing unsupported	_____
Sitting unsupported	_____
Standing to sitting	_____
Transfers	_____
Standing with eyes closed	_____
Standing with feet together	_____
Reaching forward with outstretched arm	_____
Retrieving object from floor	_____
Turning to look behind	_____
Turning 360 degrees	_____
Placing alternate foot on stool	_____
Standing with one foot in front	_____
Standing on one foot	_____

Total _____

GENERAL INSTRUCTIONS
Please document each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item.

In most items, the subject is asked to maintain a given position for a specific time. Progressively more points are deducted if:

- the time or distance requirements are not met
- the subject's performance warrants supervision
- the subject touches an external support or receives assistance from the examiner

Subject should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring.

Equipment required for testing is a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5, and 10 inches. Chairs used during testing should be a reasonable height. Either a step or a stool of average step height may be used for item # 12.

Berg Balance Scale

SITTING TO STANDING
INSTRUCTIONS: Please stand up. Try not to use your hand for support.
( ) 4 able to stand without using hands and stabilize independently
( ) 3 able to stand independently using hands
( ) 2 able to stand using hands after several tries
( ) 1 needs minimal aid to stand or stabilize
( ) 0 needs moderate or maximal assist to stand

STANDING UNSUPPORTED
INSTRUCTIONS: Please stand for two minutes without holding on.
( ) 4 able to stand safely for 2 minutes
( ) 3 able to stand 2 minutes with supervision
( ) 2 able to stand 30 seconds unsupported
( ) 1 needs several tries to stand 30 seconds unsupported
( ) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL
INSTRUCTIONS: Please sit with arms folded for 2 minutes.
( ) 4 able to sit safely and securely for 2 minutes
( ) 3 able to sit 2 minutes under supervision
( ) 2 able to able to sit 30 seconds
( ) 1 able to sit 10 seconds
( ) 0 unable to sit without support 10 seconds

STANDING TO SITTING
INSTRUCTIONS: Please sit down.
( ) 4 sits safely with minimal use of hands
( ) 3 controls descent by using hands
( ) 2 uses back of legs against chair to control descent
( ) 1 sits independently but has uncontrolled descent
( ) 0 needs assist to sit

TRANSFERS
INSTRUCTIONS: Arrange chair(s) for pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.
( ) 4 able to transfer safely with minor use of hands
( ) 3 able to transfer safely definite need of hands
( ) 2 able to transfer with verbal cuing and/or supervision
( ) 1 needs one person to assist
( ) 0 needs two people to assist or supervise to be safe

STANDING UNSUPPORTED WITH EYES CLOSED
INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.
( ) 4 able to stand 10 seconds safely
( ) 3 able to stand 10 seconds with supervision
( ) 2 able to stand 3 seconds
( ) 1 unable to keep eyes closed 3 seconds but stays safely
( ) 0 needs help to keep from falling

STANDING UNSUPPORTED WITH FEET TOGETHER
INSTRUCTIONS: Place your feet together and stand without holding on.
( ) 4 able to place feet together independently and stand 1 minute safely
( ) 3 able to place feet together independently and stand 1 minute with supervision
( ) 2 able to place feet together independently but unable to hold for 30 seconds
( ) 1 needs help to attain position but able to stand 15 seconds feet together
( ) 0 needs help to attain position and unable to hold for 15 seconds

Berg Balance Scale continued…..

REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING
INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at the end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the fingers reach while the subject is in the most forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)
( ) 4 can reach forward confidently 25 cm (10 inches)
( ) 3 can reach forward 12 cm (5 inches)
( ) 2 can reach forward 5 cm (2 inches)
( ) 1 reaches forward but needs supervision
( ) 0 loses balance while trying/requires external support

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION
INSTRUCTIONS: Pick up the shoe/slipper, which is place in front of your feet.
( ) 4 able to pick up slipper safely and easily
( ) 3 able to pick up slipper but needs supervision
( ) 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance
independently
( ) 1 unable to pick up and needs supervision while trying
( ) 0 unable to try/needs assist to keep from losing balance or falling

TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING
INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.
( ) 4 looks behind from both sides and weight shifts well
( ) 3 looks behind one side only other side shows less weight shift
( ) 2 turns sideways only but maintains balance
( ) 1 needs supervision when turning
( ) 0 needs assist to keep from losing balance or falling

TURN 360 DEGREES
INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.
( ) 4 able to turn 360 degrees safely in 4 seconds or less
( ) 3 able to turn 360 degrees safely one side only 4 seconds or less
( ) 2 able to turn 360 degrees safely but slowly
( ) 1 needs close supervision or verbal cuing
( ) 0 needs assistance while turning

PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED
INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touch the step/stool four times.
( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds
( ) 3 able to stand independently and complete 8 steps in > 20 seconds
( ) 2 able to complete 4 steps without aid with supervision
( ) 1 able to complete > 2 steps needs minimal assist
( ) 0 needs assistance to keep from falling/unable to try

STANDING UNSUPPORTED ONE FOOT IN FRONT
INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width.)
( ) 4 able to place foot tandem independently and hold 30 seconds
( ) 3 able to place foot ahead independently and hold 30 seconds
( ) 2 able to take small step independently and hold 30 seconds
( ) 1 needs help to step but can hold 15 seconds
( ) 0 loses balance while stepping or standing

STANDING ON ONE LEG
INSTRUCTIONS: Stand on one leg as long as you can without holding on.
( ) 4 able to lift leg independently and hold > 10 seconds
( ) 3 able to lift leg independently and hold 5-10 seconds
( ) 2 able to lift leg independently and hold ≥ 3 seconds
( ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently.
( ) 0 unable to try of needs assist to prevent fall

( ) TOTAL SCORE (Maximum = 56)

APPENDIX F: Attendance Record

ATTENDANCE RECORD

DATE:

GROUP:

Participant	**Check Attendance**	**Have you fallen since the previous exercise session?**	**If yes, how many times?**

- A fall for the study purposes will be defined as a loss of balance resulting in using something or someone to protect yourself from coming in contact with the ground or actually coming in contact with the ground.

APPENDIX G: Protocol for Intervention group

Monologue: Thank you for coming and participating in this research project. Please sign in on the attendance sheet. Also, please remove your socks and shoes and place (name designated area of the room) to make sure no one will trip over them. Please find a comfortable place to stand keeping an arm's length distance from the person next to you. Feel free to introduce yourselves as everyone arrives and gets settled.

As you were getting situated, I gave each of you a small racquetball. Please place the ball on the floor underneath one of your feet. If you need to move closer to the wall for balance support, then please do so. Roll your foot around on the racquetball. The purpose of this exercise is to wake up the sensory fibers in the bottom of your foot to make them more alert for the work we will be doing today. Once done with both feet, please collect the racquetballs.

Educate on posture: I want to educate you on a few important points for standing posture. I will be reminding you of these cues throughout the exercise routine.

Weight on ball of feet
Unlock knees
Arms by side
Draw navel in
Breastbone reaches toward chin

The Hundred

1. Start
    a. Legs side by side
    b. Arm beats and breath
2. Progression
    a. Bring one leg in front, 50 breaths each leg
    b. Lift front leg, 50 breaths on each leg

Leg Circles

1. Start
    a. Hands on pelvis
    b. Toes on floor
    c. 5 circles each direction on each leg
2. Progression
    a. Arms actively reaching toward the floor
    b. Lift front leg off the floor
    c.

The Roll-Up (5 repetitions)

Rolling Like A Ball

1. Start
    a. Hands on pelvis, lift knee to chest
    b. 5 repetitions
2. Progression
    a. Both legs on floor forward roll down with slight knee bend
    b. Start to combine forward roll down with lifting one heel off the floor
    c. Progress to combined forward roll down with lifting one knee to chest, hands to breastbone

Single-Leg Stretch

1. Early introduction
    a. Rock moving leg from heel to toe as weightbearing on other leg
    b. Add breath
    c. Cue abdominal connection
    d. 5 repetitions on each leg
2. Starting
    a. Lift right leg into chest with hand in proper position then add chest bow
    b. Lift chest then lower leg
    c. Pause
    d. Lift left leg into chest with hands in proper position then add chest bow
    e. Lift chest then lower leg
3. Progression
    a. Bow chest and lift leg at same time
    b. Lift chest and lower leg together
    c. Pause
    d. Switch to other side
4. Last Progression
    a. Quicken speed between switching

Double Leg Stretch

1. Start
    a. Arms by side
    b. Watch speed of forward bend
    c. Cue abdominal connection
    d. Watch depth of knee bend
    e. 5 repetitions
2. Progression
    a. Arms overhead
    b. Reach hands behind knees

Spine Stretch

1. Japanese bow—watch weightshift, meaning keep weight on balls of feet

2. Add forward spine stretch
3. Unroll
4. Return to standing
5. 5 repetitions

Open Leg Rocker

1. Starting
    a. Hands on pelvis
    b. Weight forward
    c. Slight forward lean
    d. Knees bend slightly
    e. Slide one foot out to side straight and then bring it in
    f. Complete 3 reps on the right and then move to the left
2. Progression
    a. Alternate sides, keep same form but widen stance
    b. Alternate sides with arms out to the side
    c. Alternate sides with arms out to the side and toes lift off the ground

Spine Twist

1. Weight on tripod (60% forward)
2. Arms in “I Dream of Jeannie”
3. Chest lift cue (breastbone toward chin)
4. 3 repetitions to each side

The Corkscrew

1. Starting
    a. Arms in “I Dream of Jeannie”
    b. Rotate left and bring left leg forward at a 45 degree angle
    c. Rotate right and bring left leg behind at a 45 degree angle
    d. Keep toes on the floor
2. Progression
    a. Toe is off the floor with arms out to side
    b. Arms overhead rotate to the right and bring right leg toward the front at a 45 degree angle, keep arms overhead and rotate torso to the left and bring right leg behind body at a 45 degree angle

The Saw

1. Legs wider than shoulder width apart
2. Start
    a. Hands on pelvis
    b. Bow to right
    c. Return to standing
    d. Bow to left
    e. 2 repetitions to each side

3. Progression
    a. Add arms overhead
    b. Arms overhead and reach for foot with a roll down
    c. Arms overhead and reach opposite hand only for foot

Standing Swan

1. Weight forward on feet
2. Hands on back of thighs
3. Reach hands toward knees
4. Avoid pinch in lower back
5. 3 repetitions
6. Progression
    a. Arms overhead

Leg Kick-Back

1. Start
    a. Hands on pelvis
    b. Slide one leg back as the body teeters forward
    c. Cue weightbearing, keep standing knee slightly bent, and abdominal connection
    d. 3 repetitions on each side
2. Progression
    a. Arms reach forward as leg slides back
    b. Arms reach forward as leg slides back and lifts
    c. Arms reach forward, legs slides back and lifts, chest moves to parallel to floor

Neck Pull

1. Start
    a. Hands on pelvis
    b. Slide one leg forward adding pelvic tilt
    c. Return to upright
    d. 3 repetitions on each side
2. Progression
    a. Hands together at breastbone
    b. Slide one leg forward adding pelvic tilt
    c. Return to upright
3. Progression
    a. Hands behind head
    b. Slide one leg forward adding forward bend and pelvic tilt

Side Kick

1. Start
    a. Hands on pelvis
    b. Slide one leg out to side
    c. Return to upright

d. 5 repetitions on each side

2. Progression
    a. Hands on pelvis
    b. Slide one leg out to side and lift leg
    c. Lower leg and return to upright
3. Progression
    a. Add arms out to side
        i. Start with hands on pelvis and then move arms out with leg
        ii. Keep arms out the entire time

The Teaser

1. Start
    a. Hands on pelvis
    b. Lift straight leg forward
    c. Repeat 3 repetitions on each side
2. Progression
    a. Hands out to side
    b. Lift straight leg forward

Swimming

1. Start
    a. Bow forward with hands on thighs (the hands will slide down toward knees)
    b. Lift alternate arm overhead
    c. 5 repetitions on each side
2. Progression
    a. Bow forward with hands on thighs
    b. Lift both arms overhead
    c. Swimming arms
    d. Cue breath

Kicks

1. Start
    a. Hands on pelvis
    b. Feet in Pilates V
    c. Kick (lift) leg out at a 45 degree angle
    d. Repeat 3 repetitions on each side
2. Progression
    a. Hands out to side
    b. Kick leg out at a 45 degree angle

Push-Up against a wall

1. Tricep push up
2. Vary distance from wall
3. 5 repetitions

The Star

1. Against the wall, weight on balls of the feet
2. Arm on wall is slightly bent
3. Lift same side arm and leg
4. Repeat 3 times on each side

APPENDIX H: Protocol for Standard Group

Walk in and sign in
Memory Game
Waltz/movement to music
Memory Game
Sing Along Song
Pass the item
Place Around Room
Walk out

Themes for each session were designed to keep the activity interesting to the participants.

APPENDIX I: Post Assessment Questionnaire

1. Was the instructor pleasant?
    a. Yes
    b. No
2. Did you have difficulty knowing how to do the exercise movements based on the directions provided by the instructor?
    a. Yes
    b. No
3. Did you have major difficulty doing some of the exercises?
    a. Yes
    b. No
4. Did you have minor difficulty doing some of the exercises?
    a. Yes
    b. No
5. Did you have excessive fatigue or pain or muscle soreness after the exercise sessions?
    a. Yes
    b. No
6. Do you think that your exercise tolerance or physical fitness was improved by the sessions?
    a. Yes
    b. No
7. Was the social interaction pleasant?
    a. Yes
    b. No
8. Did you leave the session in a …..
    a. Better mood
    b. Worse mood
    c. The same mood
9. Would you participate in this kind of activity again?
    a. Yes
    b. No
10. Select as many of the following that apply to you:
    c. Participating in this class improved my mood
    d. Participating in this class made no change in my mood
    e. I felt that I did well enough with the class and enjoyed following the directions of the instructor
    f. Participating in the class motivated me to add more physical activity to my day
    g. I did not do very well and sometimes felt unhappy with my efforts
    h. I did not like or was upset by some of the social activities
11. Would you change any part of the activity and why?

Curriculum Vitae

Karyn Lynn Staples

Education:

2011 Rocky Mountain University of Health Professions, Orthopedics/Sports, Provo, UT, Doctor of Philosophy

1998 University of Evansville, Program in Physical Therapy, Evansville, IN Bachelor of Science and Master's Degree in Physical Therapy

Licensure: Physical Therapist; State of Indiana and Georgia

Clinical Experience:

06/05 to Pres Local Operator, Physical Therapist
ProHealth Physical Therapy and Pilates Studio
Peachtree City, GA

03/01 to 06/05 Clinical Site Manager, Physical Therapist
ProgressiveHealth Rehabilitation
Evansville, IN

06/98 to 03/01 Staff Physical Therapist
St. Mary's Medical Center
Evansville, IN

Professional Affiliations:

Member, Georgia American Physical Therapy Association (2005-present)
Member, American Physical Therapy Association (1995-present)
APTA section: Women's Health (2003-present)
APTA section: Orthopedics (2003-present)
Member, Pilates Method Alliance (2005-present)