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Hadley Lewis

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Examining Different Exercise Types on Falls Efficacy in Older Adults

A thesis submitted in partial fulfillment
of the requirements for the degree of
Bachelors of Kinesiology

by

Hadley Lewis

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University of Arkansas

Introduction

There is a varying level of anxiety associated with falling for older adult populations. The fear of falling acts as a hindrance to many with the simplest of task, like brushing your hair without resting a hand on the counter or reaching to grab something from the top shelf. Not only does this act as a hindrance for activities of daily living (ADLs), but it also leads to an increased number of falls as well as decreased walking speeds, balance performance, and physical function (Halvarsson, Franzén & Ståhle, 2015). Fear of falling causes a decrease in quality of life and prevents the healing process of health care. There is a need to find a solution that can help to decrease this fear and to increase the confidence adults have in themselves to ambulate without falling. Tinetti created the Fall Efficacy Scale to quantify the fear associated with falling (Tinetti, Richman & Powell, 1990). The confidence someone has to complete daily tasks without falling, will decrease their likelihood of falls (Tinetti et al., 1990).

Many older adults, associate their growing timidity with aging, and do not realize they have developed a fear of falling. Due to this, they do not understand that this unknown fear is crippling. This fear of falling can also affect the hospital stay of an older adult (Gettens & Fulbrook, 2015). A patient who measured low on the Modified Fear Efficacy Scale (MFES), meaning they indicated a high fear of falling, showed a significantly longer hospital stay (Gettens, et al., 2015). Older adults are prone to health issues that cause hospitalization. Finding a way to decrease these medical bills could be a substantial benefit for health care. One method is exercise intervention programs and many have been found this to reduce the fear of falling. The possibility of decreasing the fear of falling prior to hospitalization would be ideal. There is more research necessary because the level of lasting effect and best type of exercise is unknown (Kendrick, et al., 2014). Looking at specific exercises to compare whether a certain type could

increase efficacy would be greatly beneficial in also discovering whether exercise in general or intervening with specific exercises could be an alternative for older adults. The exercises in question are tai chi, water aerobics, and resistance training.

A cross sectional study of tai chi, water aerobics, and resistance training would be beneficial for looking at the relationship between falls, exercise, and fall efficacy (Hasson, 2014). Tai chi is beneficial due to the focus on balancing that directly correlates with falling. Through doing tai chi, there is an increase in balance and decrease in falling (Saravanakumar, Higgins, Van Der Riet, Marquez & Sibbritt, 2014.). Women who participate in water aerobics find an improvement in quality of life and balance compared to woman who do not participate. There is also a notable improvement in gait performance in water aerobic participants. However, the Modified Fear Efficacy Scale shows a less significant improvement between women who do and do not participate in water aerobics (Devereux, Robertson & Briffa, 2005). Another direction is through strength training. The loss of strength in older adults can be associated with a loss of function and balance and increased falls, which is why resistance training focused on muscle strengthening could be beneficial (Orr, Raymond & Singh, 2008). All three exercises present have qualities that could potentially increase fall efficacy, but it is uncertain the level to which each one would benefit older adult populations.

While it is beneficial to know that the fear of falling is a major risk factor for older adults, there needs to be a solution. The goal of this project was to compare these three exercise groups to see if there was a specific type of exercise that could increase fall efficacy. We already know there is a correlation between fall efficacy and falls, so looking at specific exercises to increase fall efficacy could greatly benefit older adults quality of life.

Literature Review

Roughly 30% of older adults over the age of 65 fall at least once a year. Falls take place due to decreased balance, muscle strength, and a slowed reaction rate (Liu-Ambrose et al., 2004; Wu, 2002). Many of these falls result in serious injuries such as head trauma, fractures, and potentially death (Wu, 2002). Due to the serious health issues associated with falls, there has been a consistent influx of research done to find a way to decrease the chance of falling. Older adults decrease their movements so as to try and prevent falling, but through this they slowly lose muscular strength that could decrease their risk of falling (Simmons & Hansen, 1996). Comparing different modes of exercise that would increase muscle strength or balance could lead to a more efficient preventative method for falling and a way to increase fall efficacy in older adult populations. EBSCO, Google Scholar, and the University of Arkansas interlibrary loan were heavily searched for literature regarding fear of falling, falls and exercise, water aerobics, tai chi, and resistance training. The searches were done in regards to older adult populations, so as to be applicable to my research. The findings are categorized below.

Fear of Falling

In the early 1980s, the phobia of standing or walking found commonly after an older adult fell was classified (Legters, 2002). After this discovery, there has been an influx of research on the fear of falling (FOF). Fear of falling can be outlined as avoiding daily activities due to an apprehension of falling (Tinetti & Powell, 1993). Originally the fear of falling was assumed to only be present in people who had previously fallen, however, it has become prevalent in people who have not fallen as well. Due to this, it is necessary to discover what interventions could prevent FOF as well as what causes FOF. It has been found 29-92% of older adults who have fallen have a FOF and 12-65% of older adults who have not fallen experience

FOF (Legters, 2002). Previous falls indicate a higher level of fear of falling when compared to someone who has not experienced falling. However, an ambulatory individual with no history of falls will still report FOF 58% of the time (Legters, 2002). One of the largest setbacks associated with the fear of falling is the inability to complete daily tasks and activities that are necessary for a higher quality of life. Many of these setbacks exclude an older adult from social interactions leading to isolation, depression, and a high level of anxiety (Legters, 2002). It has been found that as many as 26% of fallers and 13% of non-fallers admit to avoiding certain activities out of a fear of falling (Tinetti & Powell, 1993).

Self-efficacy is defined as how someone understands his or her own abilities to complete a specific activity or function at a certain level. By combining fear of falling and self-efficacy one is able to attain a more accurate reading of the fear associated with falling (Tinetti, Richman & Powell, 1990). The Fall Efficacy Scale was designed to give a variation of answer choices for the question “Are you afraid of falling?” Researchers discovered that the fear associated with falling was higher when individuals in question were able to rank their level of fear and ability (Legters, 2002). A 0 on the scale indicates the participant is ‘not confident at all’, a 5 is ‘fairly confident/ fairly sure’ and a 10 is ‘completely confident’. Tinetti et al. created the Fall Efficacy Test or FES in 1990. To create this test, physical therapists, occupation therapists, rehabilitation nurses, and physicians were consulted and asked which 10 activities would be the most essential for independent living. These activities needed to include some sort of position change or body movement that would ideally be safe and nonhazardous for the majority of older adults (Tinetti et al., 1990). To compare the lists, a second group of 10 were asked if they agreed with the original list. These 10 items were then compiled into 10 efficacy items; the test was scored 1-10 per item with a possible combined score of 10-100. A 0 on the scale indicates that you are ‘not

confident at all', a 5 is 'fairly confident/ fairly sure' and a 10 is 'completely confident'. To test the FES there were two pretests given. The first was to check if there was a test and retest reliability. The second pretest was to compare the self-reported fear of falling and the scores from the FES. The results supported the re-testability and that the test has validity in the scoring mechanism (Tinetti et al., 1990).

Tinetti et al. (1993), refers to a Mr. J.T. whom was seen after a fall and had a high level of fear associated with falling again. His treatment was a combination of addressing his fear of falls as well as a prescription of activity. It was found that in relation to falling, self-efficacy is both physical as well as mental. Due to this, an intervention that combines these two can increase efficacy and see a decrease in falls. A background of previous falls can be noted and a future physical activity prescription can be designed (Tinetti et al., 1993).

Tinetti et al. (1994) looked at risk factors and used the knowledge of risk factors to decrease falling. The following risk factors were examined: orthostatic hypotension; using four or more prescription medications; using sedatives; arm or leg strength or range of motion impairments, decrease in balance; inability to safely get from the bedroom to the bathroom. All of the participants were given the FES and a multitude of other health assessments given by a nurse practitioner and then a physical therapist. Once the risk factors were established, the subjects assigned to the intervention group were instructed on certain adjustments to make (Tinetti et al., 1994). There was a decrease in falls and risk factors for those who participated in the intervention group. The largest decrease was loss of balance. Unfortunately, there is not a quantitative way to determine if the decrease in risk factors was the sole reason for decrease in falls (Tinetti et al., 1994).

With the use of the FES and the Modified Fall Efficacy Scale or MFES, the fear of falling is a quantifiable value. The MFES has been used to predict the length of hospital stay of a patient of both fallers and non-fallers (Gettens & Fulbrook, 2015). Fear of falling, risk of falling, falling within a hospital, and the length of stay at a hospital were combined. During a 6-month period of time, the MFES was given to a patient before discharge and if a patient fell. At the end of the 6 months, it was found that a faller scored lower on admission to the hospital on the MFES compared to a non-faller (Gettens et al., 2015). In addition to this, there was significant increase of hospital length of stay if their MFES score was less than 5. For a non-faller it was found that the length of stay increased on average 11 days with a MFES score of less than 5. For a faller, the increase was as much as 18 days (Gettens et al., 2015). This collection of data showed a strong correlation with hospital stay and MFES score. This also suggests that using the MFES is beneficial in predicting falls and the level of risk associated with a patient.

Falls and Exercises

There are two main types of risk factors related to falling, intrinsic and extrinsic. An intrinsic risk factor is one that is focused on the actual person such as strength, flexibility, balance, and reaction time. Extrinsic is external factors that the individual may have less control over. Exercise could decrease the influence of intrinsic risk factors, but would not have an impact on extrinsic (Carter, Kannus, & Khan, 2001). Determining which risk factor plays a heavier role would be greatly beneficial in intervention of falling and the fear of falling. Currently, exercise can be categorized as helping with the intrinsic risk factors and be a key component for decreasing the fear of falling.

Roughly 13% of males and 12% of females 60-69 years old are categorized as highly active. By age 70-78, 16% of males and only 4% of females are highly active. Exercise is

necessary for older adults to continue daily activities without growing weary, as well as, allow for extra energy to enjoy activities. If sick, there is a greater ability to overcome illness and to decrease risks for future health problems (Daley & Spinks, 2000). Due to this, the low statistic of exercise activity is problematic. There have been claims that while age is causing the atrophy of the body, the sedentary lifestyle of the majority of aging adults is a large contributor. This disuse of muscles contributes to the decrease in strength along with aging. Many adults are not using their muscles out of fear of falling. The strongest contributor in falls is decreased balance, muscle weakness, and impairment in gait. Through exercise and training, all three of these factors can be improved (Daley et al., 2000). Physiologically, exercise causes your vertebrate tissues and organs to be in use and this use increases your health. This increase is in complete opposition to the affects of aging. The idea is that exercise can counter the affects of getting older. This increase in physical health can instill self-confidence that provides the opportunity for older adults to combat their fear of falling.

Ageing shows a decrease in muscle mass, an increase in fat and a higher risk for broken bones that, in turn, lead to more serious health issues. With an increase in exercise and physical activities, older adults can see a 40-60% decrease in the risk of hip fractures. Hip fractures are typically caused by falls and result in serious health issues. Due to the correlation found with physical activity it becomes vital to find which specific type of exercise could even further decrease the deterioration of physical fitness (Devereux, Robertson & Briffa, 2005).

General exercise will improve balance, strength, and reaction time. Studies consistently have shown that exercise can successfully decrease fall risk factors as well as falls, but the full implications and effects are unknown. When tai chi with strength and balance training is practiced at home or tai chi alone is practiced there is a reduction in falls (Liu-Ambrose et al.,

2004; Zijlstra et al., 2007). A planned physical activity class such as balance training, strength and resistance training, tai chi or dance, all decrease the fear of falling (Kendrick, D., et al., 2014). Any exercise involving endurance, strength training and balance can reduce the risk of falling (Daley, M., et al., 2000). While all of this has been found, there is a sizable amount of discrepancy on the specific type of exercise prescription needed for preventing falls in older adults. (Carter, Kannus & Khan, 2001). So far there has not been a study done to differentiate between the different exercise forms to truly compare which has a greater effect on falls and fall efficacy in older adult populations. Tai chi, water aerobics, and resistance training have been suggested for more research for older adults (Hasson, 2014). More articles have been specifically reviewed on tai chi, water aerobics and resistance training.

Tai Chi

The ancient Chinese martial art, tai chi has become a source of interest for health professionals. This type of exercise consists of slow and continuous movements that engage the entire body. Older adults seem to favor the slow non-exhausting movement of tai chi (Wu, 2002). Through engaging every part of the body it incorporates, strength, balance, posture and focus, all of which can benefit decreasing falls. Tai chi also focuses on deep breaths and mental focus (Saravanakumar, Higgins, Van Der Riet, Marquez & Sibbritt, 2014). In 2002, Ge Wu completed a review of past research on tai chi; at the time of the review, it was concluded that there was not enough conclusive evidence to know the exact implications tai chi has on falls and postural balance. This is due, in part, to the wide variation of studies and populations tested. One of the studies Wu discussed was a longitudinal study conducted to look directly at the effect of tai chi on reducing falls (Wu, 2003; Li et al., 2005). All of the participants were independent and able to move. Of those participating in the tai chi group, 42% had fallen in the last year and 31%-

34% of the non-tai chi group had fallen in the past year. Individuals participating in the tai chi group had a reduction of falls by 48%. The other groups did not see a significant reduction. Fear of falling has been tested in two other studies and there was a report of a decrease in the fear of falling after participating in tai chi (Wu, 2002).

Tai chi has been compared to a stretching and balance group, focusing on individuals who were previously at a greater risk of falls (Li et al., 2005). After 6 months of participating in tai chi or the stretching and balance control group, it was found that falls or the risk of falling was reduced by 55% within the tai chi group participants. Some of the possible sources of this reduction are that tai chi increases the control one has over their body, increased strength of muscles, and stabilization in posture (Li et al. 2005). Similar to other studies, there was a large decrease in the fear of falling after participating in tai chi for those 6 months (Wu, 2003; Li et al., 2005).

Tai chi and yoga have been compared to see which is more beneficial for decreasing falls. The tai chi and yoga were offered to participants twice a week for 14 weeks. At the end of the trail, balance was measured with the Berg Balance Scale consisting of 14 static and dynamic balance activities, which are then scored 0-4. Falls were recorded the 6 months before intervention, 6 months during and the 6 months after. The results showed a slight increase in balance in the yoga group, but the difference between the groups did not have a statistical significance high enough to differentiate. Falls did not show a significant change in either group. The study suggested a need for more data collection on a larger scale (Saravanakumar et al, 2014).

Most studies have been conducted under the regiment of tai chi twice per week with a specific type of instructor. One study conducted required the attendance of tai chi only once a

week (Voukelatos, Cumming, Lord & Rissel, 2007). This specific study looked at Tai Chi only and measured the balance of participants at the beginning and end of the study, 16 weeks later. The tai chi group did score better on 5 of the 6 balance tests, showing there was a significant improvement in balance. The biggest difference came in the number of falls post intervention. There was just enough of a percent difference to be statistically significant, and about a 50% reduction in falls. There was enough data to conclude that this study supported previous studies that tai chi does decrease falls in older adults.

Water Aerobics

Water is a possible location of aerobic activity for older adults because there is not a risk of falling; this would be classified as an exercise environment with low risk (Devereux, Robertson & Briffa, 2005). Through using water aerobics there is ability for older adults to exercise independently with the removal of the fear of falling, but still the enhancement of physical strength and aerobic abilities. This physical enhancement is what could play a role in a decrease in falls and fear of falling. The water also provides a weight free environment that removes pressure on joints. The ability an older adult has to practice movement in a weight free, injury free way allows them to learn from their errors and, with muscle memory, be less likely to fall outside of the water (Simmons & Hansen, 1996).

There is a vicious cycle with the relationship of physical movement, falling, and resulting in the fear of falling. When comparing four different types of exercisers: water exercisers, land exercisers, water sitters, and land sitters, water exercisers showed more improvement in the functional reach test (Simmons et al., 1996). The functional reach test measures how far someone can reach without losing his or her balance. The increase in ability was partially due to the confidence gained by correcting movement errors in the water (Simmons et al., 1996). The

fear of falling was completely removed from the equation, which in turn allowed physical improvements. It is possible that the buoyancy of water could have also played a large part in the practice of losing one's balance and having to compensate, but in a way that allows your body to correct itself without truly falling.

Water exercise's effect on balance, fear of falling, and proficiency of movement in women 65 and older presenting with osteopenia or osteoporosis has previously been examined (Devereux et al., 2005). The intervention group underwent water-based exercises for 10 weeks combined with a self-management program. A step test, and two baseline self-reported tests were given to the participants to gauge their progress. The Modified Falls Efficacy Scale (MFES) was used to determine fall efficacy, at the end of the experience the results showed no difference between control and tested group from beginning to end of the experiment. While there was no change in the MFES scale, there were significant improvements in the step test. One of the suggested recommendations for future research was to compare water to land-based aerobic exercising as well as increase balance testing to further understand improvements (Devereux et al., 2005).

Resistance Training

In addition to water exercises, resistance training has also been used as a method to decrease falls. Older adults who fall have less strength in their legs than those who do not fall (Orr, Raymond & Singh 2008). Weak leg strength contributes to lower performance in older adults and could be a possible risk factor for falls. Increasing muscle mass and muscle strength could stop the loss of balance and the fall that proceeds. Progressive resistance training, or PRT, has been accepted to be a method of increasing strength and improving balance (Orr, 2008). The majority of testing done is a combination of PRT with another form of exercise and has not

looked exclusively at resistance training. Due to this, there is a lot of inclusive data collected in relation to the effect of resistance training alone. There is a positive relationship between decreased falls and resistance training, but there is a need for more evidence to conclude that resistance training alone can do this (Latham, Bennett, Stretton & Anderson, 2004; Orr et al., 2008).

Previous research evaluated the effectiveness of resistance training and agility training with older adult women living in a community (Liu-Ambrose et al., 2004). Exercises measuring these values were assessed and compared to baseline values. An assigned exercise class was required for the participant twice per week. The resistance-training group aimed to see an increase in muscle strength in arms, legs and trunk. The agility-training group was focused on coordination and balance. One problem that was discovered was musculoskeletal complaints in roughly 10 women. However, overall, there was a progression of improvement in fall risks through the implementation of resistance and agility training (Liu-Ambrose et al., 2004). At the end of the program, the conclusion was drawn in support of implementing resistance training, as well as agility training to decrease the risk of falling. It was uncertain if the decrease in falls was due to the resistance or the agility training.

This led to further research that solely looked at resistance training and how it affects frail and non-frail older adults (Yamada et al., 2011). The participants were divided based on frailty, which was determined by the timed up and go (TUG). If a participant took greater than 13.5s they were defined as frail. After categorization was completed, all participants took part in resistance training twice a week for 50 weeks. At the conclusion, the participants were re-tested and the conclusion was drawn that there was a relationship between fragility and resistance training effectiveness. Resistance training decreased the fear of falling and improved physical

performance, but only in the frail group (Yamada et al., 2011). This was the first test to compare level of physical wellbeing to resistance training results.

Through the literature reviewed, there is enough research completed to suggest that all three forms of exercise decrease falling. There is also enough research previously done that connects the fear of falling to future falls.

Methodology

This was a cross sectional study looking at the effects of different exercise classes on fall efficacy in older adult populations, specifically living in a retirement facility. The exercise classes were provided by the facility. A health history questionnaire was given to the residents. Based on their responses they were sorted into three categories: water aerobics, tai chi, and resistance training. The desired group was around 15 participants male or female over the age of 60 for each exercise. Within each category, the levels of participation were also documented as having a high or low involvement level. For water aerobics, resistance training and tai chi, 2 or more times per week for 3 or more months was high involvement. Low involvement was 1 time per week for less than 3 months.

The Fall Efficacy Scale- International (FES-I) consists of a 16 questions that are ranked from 1-4. 1 “not at all concerned,” 2 “somewhat concerned,” 3 “fairly concerned,” 4 “very concerned.” This test determined the concern of falling an individual is experiencing when completing daily tasks (Yardley et al., 2005). The lower the score, the less fear of falling the individual feels. The lowest FES-I score possible was a 16, the highest being 64. The second test was the Tinetti test. It was given to all participants, ranking the balance ability and gait of the participant (Tinetti, Williams & Mayewski, 1986). The scoring is 0, 1 or 2 for each activity. All

the scores are added together. The higher the score combination the lower the risk of falls and the lower the scores the higher risk the participant has of falling. The highest score possible for the Tinetti is a 28. A higher Tinetti score indicated a higher level of balance and gait and a low risk for falls. Scores ≤ 18 indicated a high risk for falls, a score of 19-23 indicated a moderate risk and scores ≥ 24 indicate a low risk for falls. This study was designed to survey the level of activity and the type of activity and then compare the results of the survey with the results from the Tinetti test and Fall Efficacy Scale- International (FES-1).

Data Analysis Procedures

The data were compared with a one-way analysis of variance. FES-I test results were compared between the three exercise groups. The same was done for the Tinetti test. A one-way Analysis of Variance (ANOVA) was used to discover if there was difference between the test results for the exercises groups. Statistical significance was set at .05. Additionally, a post hoc test was run to compare each individual exercise groups. The dependent values were the Tinetti and FES-I scores and the independent values were the exercise groups.

Results

Participants were recruited from the resistance training, water aerobics, and tai chi classes taught at Butterfield Trail Village. Forty-one people were recruited and chose to participate in the study. Out of the forty-one people, 9 were classified as water aerobics (Group 1), 8 were resistance training (Group 2), 8 were tai chi (Group 3), and another 15 were an unforeseen combination of the three different exercises and this group was classified as combination category (Group 4). Classification was determined by previous participation in a specific

exercise class, which was documented on the health history questionnaire. If they only participated in one class they were put into that category, but if they participated in more than one they were placed in the combination category. Through the survey, it was discovered that the majority of the participants were all high participation (95%). High participation was defined as attending class 2 or more times per week for 3 or more months. Low involvement was 1 time per week for less than 3 months. The average age, weight, height, BMI and gender are shown in Table 2.

Table 1: Participants per exercise group.

Water Aerobics	Tai Chi	Resistance Training	Combo
<i>n</i> = 9	<i>n</i> = 8	<i>n</i> = 8	<i>n</i> = 15

Table 2: Average age, weight, height, BMI, and percent gender.

Mean Age	Mean Weight	Mean Height	Mean BMI	Percent Men	Percent Women
80	69kg	152cm	29.9	12%	88%

Fear of falling was ranked using the Falls Efficacy Scale- International (FES-I), while balance and gait were measured using the Tinetti test. All of the Tinetti mean scores were within one number of each other. The scores from these two tests were averaged for all four groups and the standard deviation for each group was calculated as seen in Table 3 and represented by Figure 1. The lowest score was water aerobics, averaging 26.11, and the highest score was the combination group, scoring 27.38. The FES-I scores have a slightly larger mean difference between groups. The highest score was 23.67 for water aerobics and the lowest, 21.13, was for tai chi.

Table 3. Mean scores for each exercise group with standard deviation. Water aerobics (1), resistance training (2), tai chi (3), and combination (4).

Exercise Group	<i>n</i>	Tinetti Mean	Standard Deviation	FES-I Mean	Standard Deviation
1	9	26.11	2.62	23.67	7.86
2	8	27.00	1.20	23.00	5.18
3	8	27.25	1.04	21.13	3.27
4	15	27.38	1.15	21.94	5.30

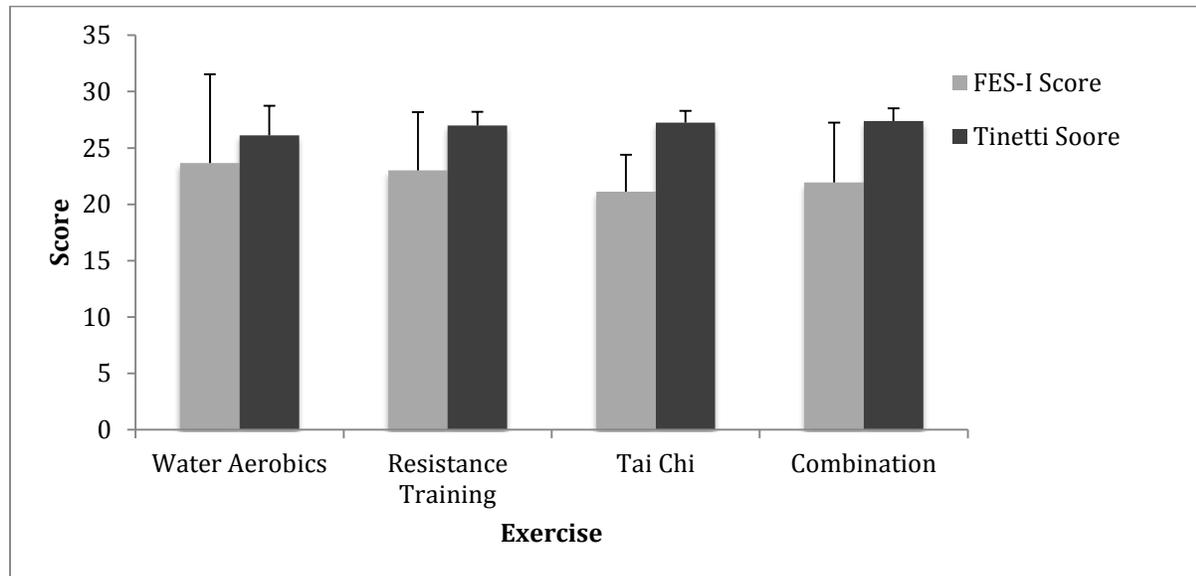


Figure 1. Mean values for water aerobics, resistance training, tai chi and combination. Error bars attached at the end of each column represent standard deviation.

After the exercise means were calculated, one-way ANOVA was used to compare the statistical significance between the four exercise groups. Statistical significance was determined by $p \leq .05$. Each exercise group was compared to the other three, for the Tinetti test. The mean difference and significant difference between the averages of each exercise group's Tinetti results are shown in Table 4.

Table 4. Post-hoc comparison for Tinetti between water aerobics (1), resistance training (2), tai chi (3), and combination (4). Mean difference and significant difference is noted between each group.

Exercise	Exercise Compared	Mean Difference	Significant Difference
1	2	-.89	1.00
	3	-1.14	.88
	4	-1.26	.37
2	1	.89	1.00
	3	-.25	1.00
	4	-.38	1.00
3	1	1.14	.88
	2	-.13	1.00
	4	.68	1.00
4	1	1.26	.37
	2	.38	1.00
	3	.13	1.00

When comparing the four exercise groups with each other, there was no significant difference found between any of the group's Tinetti score results. The largest mean difference was between water aerobics and combination of 1.26, but this difference has a $p = .37$.

One-way ANOVA was run for the FES-I. Table 5 reports the mean differences and statistical significant differences. Statistical significance was set at $p \leq .05$.

Table 5. Post-hoc comparison for FES-I between water aerobics (1), resistance training (2), tai chi (3), and combination (4). Mean difference and significant difference is noted between each group. Statistical significance was set at $p \leq .05$.

Exercise	Exercise Compared	Mean Difference	Significant Difference
1	2	.67	1.00
	3	2.54	1.00
	4	1.73	1.00
2	1	-.67	1.00
	3	1.88	1.00
	4	1.06	1.00
3	1	-2.54	1.00
	2	-1.88	1.00
	4	-.81	1.00
4	1	-1.73	1.00
	2	-1.06	1.00
	3	.81	1.00

The FES-I score results showed no statistical significance between any of the exercise groups ($p = 1.00$). The largest mean difference was between water aerobics and tai chi, 2.54 but the difference was not statistically significant ($p = 1.00$). Both the FES-I and the Tinetti showed no statistically significant differences between any of the exercise groups in relation to the FES-I for the fear of falling or the Tinetti test for balance and gait.

Conclusion

Past research has shown that exercise participation has a positive relationship with a decrease in the fear of falling (Halvarsson et al., 2015; Kendrick et al., 2014). The goal of this study was to compare individual exercises in hopes to find a specific exercise that was more beneficial than the rest. However, after comparing each group using the FES-I and the Tinetti test, there was not a statistically significant difference found between any exercise group: water aerobics, resistance training, tai chi, or the combination group.

Previous literature has supported water aerobics as a safe exercise to perform for individuals with poor balance. The water creates an environment that eliminates the risk of falls. This allows the participant to increase cardiovascular strength, muscle strength and improve balance all without the fear of falling and sustaining a major injury (Simmons et al., 1996). During the present investigation, individuals who were strictly participating in water aerobics consistently scored lower on the Tinetti test and higher on the FES-I, averaging scores of 26.11 and 23.67, respectively. This indicated a lower balance and gait and a higher fear of falling compared to other exercise groups. Consistent with these results is a previous study where water aerobic participants had a better gait test score than non-water aerobic participants, but did not consistently have better fear of falling scores (Devereux et al., 2005). Devereux et al.'s previous study combined with this current study suggests that water aerobics does not decrease the fear of falling as efficiently as other exercises. However, neither study can prove this with a statistical difference.

There is a direct link between a decrease in muscle mass in older adults and an increase risk for falls (Orr, 2008). Resistance training increases muscle mass, strength, and decreases risk of falls among older adults (Yamada et al, 2011). However, previous research has typically been resistance training coupled with a different form of exercise and more research has been necessary to fully support that resistance training alone can reduce the risk of falls (Latham, Bennett, Stretton & Anderson, 2004; Orr, 2008). During this study, 8 participants were strictly partaking in resistance training. These 8 scored an average of 27.00 for Tinetti and 23.00 for FES-I. These were the second lowest scores in the study, but as stated previously, there is no statistical significance in the difference in scores. These lower scores could indicate that

resistance training is more effective when it is coupled with a different exercise form, but more research would be necessary to conclude this.

Tai chi focuses on controlling muscles, increasing strength and having controlled breathing (Li et al. 2005). This direct focus on balance could be what correlates strongly to the FES-I and the Tinetti test. In this study, Tai chi scores were the second highest scores in Tinetti (27.25) and the lowest score for FES-I (21.13). These scores could indicate that tai chi's balance focus is slightly more beneficial than some of the other exercises. However, when compared to other exercises, the scores were not statistically significant enough to draw that conclusion. Previous studies have consistently seen that tai chi participants do have a decrease in falls and increased falls efficacy (Saravanakumar et al, 2014; Wu, 2003; Li et al., 2005). In addition, tai chi requires different movements that increase self-confidence of the participant that could correlate with a decrease in the fear of falling.

This study was not originally designed with a combination group, however, it was found that a large number of active older adults (36%) chose to participate in multiple forms of exercise. This group was unique as the participants had attributes from each exercise group. The mean scores for this group's Tinetti tests scored the highest at 27.38 and the mean scores for the FES-I were the second lowest mean scores at 21.94. However, while there was no statistically significant difference found between these scores, it could be speculated that the attributes gained from different exercises can each be beneficial for older adults. Water aerobics allows for older adults to have the freedom to move in the water without joint pain, fear of falling, ability to increase muscle mass and participate in aerobic activity. Tai chi focuses completely on balance and improving the balance of the participant. Resistance training focuses on building muscle mass, which allows for participants to be stronger and less likely to become injured. Each of

these exercises bring with them individual attributes that have allowed the combination group to be successful. Since there was no statistical significance found during the study the numbers can indicate that any type of exercise is going to have a positive affect on the individual.

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