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THE EFFECTS OF TAI CHI, RESISTANCE TRAINING, AND DIET ON PHYSICAL FUNCTION IN OBESE OLDER WOMEN

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THE EFFECTS OF TAI CHI, RESISTANCE TRAINING,
AND DIET ON PHYSICAL FUNCTION IN OBESE

OLDER WOMEN

BY

STEPHEN MARIS

A THESIS SUBMITTED IN PARTIAL FUFILLMENT OF THE REQUIREMENTS
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2014

MASTER OF SCIENCE THESIS
OF
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ABSTRACT

BACKGROUND: The increased prevalence of obesity and function limitations associated with aging are major public health problems in the U.S. The risk of developing obesity and functional limitations is higher in minority populations living in urban settings and previous research has shown that Tai Chi, resistance training, and diet individually result in increased levels of physical function and facilitate healthy weight loss. However, the combination of these specific interventions has yet to be examined in obese older women in an urban setting.

PURPOSE: The purpose of this study is to examine a combined resistance training (RT), Tai Chi, and a behaviorally-based dietary intervention on physical function.

METHODS: Using a non-randomized design, 28 obese women (65.2 ± 8.1 yr) completed a 12-week intervention; participants were assigned to an intervention group (EXD, BMI = 38.83 ± 5.06) or a control group (CON, BMI = 36.57 ± 3.39). The EXD group (n = 19) participated in Tai Chi three times per week for 45 minutes, RT twice per week for 45 minutes (2-3 sets, 10-15 reps), and a dietary session using a modified Dietary Approaches to Stop Hypertension Diet once per week for 45 minutes. The CON group (n = 9) was asked to continue their normal lifestyle. Outcomes measured were the short physical performance battery (SPPB), the timed up and go (TUG), chair-sit and reach to measure flexibility, and leg and grip strength. Analysis of covariance (ANCOVA) was used for between-group comparisons adjusted for baseline values. **RESULTS:** TUG time was significantly reduced by 0.64 ± 2.1 sec ($p = 0.04$) in the EXD group while the CON group saw a significant increase of 0.71 sec ($p = 0.051$). Flexibility measurements improved by 2.31 ± 5.4 cm in the EXD group (p

= 0.08), however, the CON group saw no significant changes from baseline (1.69 cm \pm 6.97; $p = 0.51$). **CONCLUSION:** Tai Chi, RT, and dietary changes helped improve performance on TUG time and flexibility, but there were no statistically significant increases in muscle strength measures or SPPB scores. Further research should be conducted using this combination of interventions with a larger sample size to verify these findings.

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PREFACE

This thesis is written to comply with the University of Rhode Island graduate school Manuscript Thesis Format. This thesis document contains one manuscript: *The Effects of Tai Chi, Resistance Training, and Diet on Physical Function in Obese Older Women*. This manuscript has been written in a form designed for publication in *Medicine and Science in Sports and Exercise*.

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INTRODUCTION

The prevalence of obesity, defined as a body mass index (BMI) greater than 30 kg/m², has doubled in the past 10 years in the general population and estimates indicate that 35% of adults over the age of 65 are obese in the U.S. (13). Obese individuals are at a much greater risk of developing health conditions including hypertension, cardiovascular disease, diabetes and some forms of cancer (27,2). Previous research (29) has shown that women have a higher prevalence rate of obesity compared to men, and the prevalence rates of obesity greatly differ across different racial groups. Over the age of 60 yrs, the prevalence rates of obesity for non-Hispanic white women, non-Hispanic Black women, Hispanic women, and non-Hispanic Asian women are 32.8%, 56.6%, 44.4%, and 11.4% respectively (13). In older women, obesity intensifies the decline of physical function that is associated with aging (3).

An exercise form effective in treating obesity is resistance training (RT), and RT has been shown to improve muscle strength, physical function, and can promote weight loss (22, 11, 28, 15). Resistance training can also be performed with little risk of injury to the subjects (28, 15). Resistance training programs in minority women have resulted in significant improvements in muscular strength, along with physical function (31, 28). However, RT is not considered an aerobic activity, Tai Chi exercise however, results in significant improvements in physical function in obese older adults and compares to aerobic activities (21). Previous Tai Chi interventions have resulted in significant improvements in physical function measures, and facilitates weight loss (1, 20, 22, 36, 37, 25). Tai Chi has also been found to have a very high adherence rate in the older adults due to its low risk of injury (23,37). Combining a dietary

intervention with an exercise program has been shown to significantly improve physical function in obese older women (9, 3, 39, 6).

Previous research has shown that the Dietary Approach to Stop Hypertension (DASH) diet improves total diet quality, blood pressure, and can result in moderate weight loss (4, 9, 10). The DASH diet has been shown to be an effective and reliable intervention tool in obese older adults, and significant improvements occur in physical function and muscle strength when the DASH diet is combined with an exercise program (9, 6, 34). Furthermore, previous research has shown that the modified DASH diet combined with exercise results in significant decreases in fat mass and results in significant weight loss (6, 21).

There have been numerous studies that show that combining exercise forms with a dietary intervention results in improved physical function and muscle strength (33, 3, 39, 6, 21). However, there is a lack of studies that examine Tai Chi and RT in combination with dietary changes in an urban setting. A study combining these individually demonstrated interventions has not been evaluated in obese older minority women. Thus the purpose of this study is to examine the effects of Tai Chi, diet, and RT in obese older women on measures of physical and muscle strength.

METHODS

Study Design

This study used a quasi-experimental, pre- and post-measures design to study changes in the primary and exploratory outcome measures. The intervention consisted of a 12 week design with a control group to examine changes and to be used as a comparison. The study took place at a senior center (St Martin De Porres Senior Center) in Providence, Rhode Island.. This study was approved by the Institutional Review Board at the University of Rhode Island on December 23, 2013 (HU1213-028).

Subjects

The women living in the surrounding communities (within 1 mile of the senior center) were recruited for this study. Flyers, press releases to local newspapers, and “word-of-mouth” at the local senior center were utilized as recruiting techniques. After the first contact from potential subjects, a brief medical and background history survey was completed over the telephone to establish eligibility for the study. After this initial telephone interview, all eligible subjects attended a short orientation session to learn more about the study, which served as another recruitment strategy. After the short orientation took place, the potential subjects who were interested and qualified for the study were invited to a baseline assessment session. The criteria for eligibility included: 1) women ages 50 – 80 years old, 2) BMI of 30.0 to 50.0 kg/m², 3) currently (within past 6 months) not involved in an exercise program, and 4) post menopausal via self report. The exclusionary criteria included: 1) failure to provide informed

consent, 2) significant or suspected cognitive impairment, 3) severe hearing loss, speech disorder, language barrier or visual impairment, 4) progressive, degenerative neurologic disease, 5) terminal illness with life expectancy of < 12 months as determined by physician, 6) severe pulmonary disease, uncontrolled diabetes, blood pressure or anemia, 7) medications not taken > 3 weeks, lipid lowering medications for >6 months, 8) major joint, vascular, abdominal, or thoracic injury within 6 months, 9) significant cardiovascular disease, and 10) inability to safely engage in exercise. A total of 33 subjects were initially recruited to be a part of the study. A total of six participants dropped out of the intervention group (one withdrew because of travel, one withdrew because sessions were too early in the day, one withdrew because of gallstones, one withdrew due to the exercise “being too easy”, and two subjects could not be contacted for post-testing). A total of one participant withdrew due to lack of follow-up in the control group. This resulted in a total of 26 participants as the analytical sample.

Outcome Measures

Physical Function: The primary measure physical function was the timed up and go (TUG) test. The timed up and go test requires the subject to start in a seated position, walk 8 feet, and then return to a seated position. The time (sec) it takes to accomplish this task was recorded, the better of two times were taken for analysis. The TUG test has been shown to be a valid predictor of falls and mobility of the older adult population (38). The TUG is a widely used measure of function, which makes the results generalizable, which is why the TUG was chosen as the primary variable.

Another measure of function was the short physical performance battery (SPPB). It includes a balance test, usual gait speed, and time chair stands. The balance test determines whether the subject can maintain a side by side stance, semi-tandem stance, and full tandem stance for 10 seconds each. The gait assessment test involves walking 4 meters at usual walking pace, which is repeated twice and the better (faster) of the two times (sec) taken. The timed chair stands test asks the subject to rise from a chair and sit from a chair 5 times as quick as they can with their arms crossed over their chest. Each test is scored from 0-4, with the best possible score being 4, and a maximum summary score of 12. The SPPB is a portable and reliable measure that has been shown to be a strong predictor of mortality and nursing home admissions (17).

Flexibility: The chair-sit-and-reach test is a measure of flexibility used in older adults (35). This test required the participant to sit on the edge of a chair with one knee bent and the other knee extended straight in front with the heel on the floor. While keeping the leg straight, the participant reached down their leg attempting to reach for their toes. Participants were given a demonstration before completing the test and there was a practice trial followed by two trials (the best score was used for data analysis). The score was the number of centimeters short of reaching the toes (negative number) or beyond the toes (positive number).

Muscle Function and Strength: Grip strength is a valid and reliable method and has been shown to be successful in measuring upper body strength in older adults (26). Grip strength was measured using a hand-grip dynamometer (Jaymar Hydraulic Dynamometer, J.A. Preston, Corp., Jackson, MS). The test was performed in subject's

non-dominated hand and the best of 3 scores was utilized for scoring. The hand dynamometer is considered to be a very reliable tool and can be done with little or no risk for the subjects (8).

Leg strength was determined by using a handheld manual muscle dynamometer (Nicholas Manual Muscle Tester – Lafayette Instrument Company). The manual muscle tester has been found to be a good method in determining strength and in all individuals (14). The device has been successful in determining strength in the older adult population and it is a portable, easy to use device (34). Knee extensor strength was measured as the peak amount of force that the examiner had to exert to break the isometric contraction. This break in the contraction is indicated by a small movement of the subject's dominant leg in the opposite direction of the movement exerted by the researcher. The value recorded was leg extensor torque (kg-m) in order to account for variations in leg length.

Anthropometrics: Height and weight were measured with a stadiometer (Webb City, MO, USA) to calculate BMI and were following a 12 hour fast. Waist and hip measures were determined by utilizing a standard tape measure with an attached tensometer. Body composition was measured using a simple foot-to-foot bioelectrical impedance device (Tanita BF-556). The device estimates fat mass and percent body fat using electrical currents. This test has been shown to be a valid and reliable measure of body composition while having few associated risks (30).

Other Measures: The subjects were asked to complete surveys about physical activity levels and dietary quality. The Yale Physical Activity Survey was used to estimate energy expenditure per week and time spent performing physical activity

(40). Dietary quality and patterns were measured using the Dietary Screening Tool (DST). The DST was created to assess general health and nutrition status through the quality and patterns of diets among older adults (7). Scores of the DST correspond to nutrition risk and were utilized in the diet education intervention.

Group Assignment

Since this project was a translational, community outreach program designed for benefiting the subjects, randomization of groups did not occur. After baseline testing was completed, subjects were placed into groups by the order in which they finished testing. Due to the limited space at the local senior center, there was a limit on how many subjects could be placed in the Intervention Group (EXD). Those subjects who wished to be involved in the study were asked to be in the waitlist control group (CON). The EXD group received all three aspects of the intervention, while the CON group was asked to maintain their normal lifestyle.

Intervention

DASH Dietary Education Intervention: A 45-minute behaviorally-based dietary education session was held once a week for the 12 week intervention period, and were led by a registered dietitian. A modified DASH-based diet was used as the diet plan and has been shown to have a high compliance rate with older adults (9,4). The goals of the diet include lowering intake of saturated fat ($\leq 7\%$ of caloric intake) and achieving a moderate intake of total fat ($\leq 35\%$ of caloric intake). We modified the intake of total fat from 27% to 35% to allow for increased intake of healthy

unsaturated fats. The diet also encourages high intake of fresh fruits, vegetables, and whole grains; consumption of low-fat dairy and meat products; moderate intake of sodium (3,000 mg or less/day), and subjects were encouraged to participate in the exercise program (180 minutes of activity a week) during this time. Dietary logs were used to evaluate subject compliance throughout the 12 weeks, and to provide feedback to the subjects.

Tai Chi Exercise Intervention: Subjects in the EXD group participated in Tai Chi exercise sessions 3 times per week for 12 weeks. The modified 24-movement Yang style form of Tai Chi was used since it has been shown to be an effective form of Tai Chi through previous research (21). The Tai Chi sessions lasted approximately 45 minutes and included; a 10-minute warm up, 35 minutes of practice and exercise, and was followed by a 5 minute cool down period. In order to aid and promote outside practice of Tai Chi, a DVD of the movements were given to the subjects to be used at home. During Tai Chi sessions, the subjects were supervised by study team members who were trained in Tai Chi to reduce variation from the protocol and to help ensure safety of the subjects. Due to the chance of having varying fitness levels in the sample, the exercise was progressive to each subject's ability and the intensity of the exercise was increased over time. This increase in intensity was achieved by modifying the movements of the Tai Chi by study staff such as slowing down the movements and by creating a wider base of support.

RT Exercise Intervention: Along with the Tai Chi and dietary sessions, the subjects engaged in a RT program that met twice a week. The program was based on ACSM RT guidelines (2). Each session included approximately 45 minutes using

elastic tubing that allows the body to move through uninhibited range of motion, which may help avoid musculoskeletal injuries (31). RT programs utilizing elastic tubing can be used as a practical and effect method of achieving strength gains in older adults (31). Seven total upper and lower body exercises for major muscles were done with 1-3 sets of 10-15 repetitions for each exercise. The goal was for the exercise intensity to be moderate, which has been demonstrated to have positive effects on physical functioning in older adults (34). Intensity was determined by the band color used by the subject and the Borg RPE scale. The Borg RPE scale is a subjective rating of perceived exertion scale that ranges from 6 – 20, the number 6 correlates to low difficulty and the number 20 is used to express maximal exertion.

Statistical Analysis

The EXD group sample number ($n = 25$) was chosen because of practical reasons, as the center only has room for 25 subjects to safely participate in the exercise program. Additionally, in order to determine our sample size requirement to achieve significant results, a sample size test was conducted. Estimating that subjects in the EXD group will gain improvements in the timed up and go (TUG) test by 1.5 (1.2) seconds and with no change in the control group, the required sample size for significance is 12 subjects in each group. This will result in a statistical power of .82 for the projected study findings with an alpha set at 0.05.

To assess our main hypothesis, the changes from baseline descriptive measures were analyzed to define differences between the groups (EXD group and CON group). First, an Independent Samples T-Test was used to test if the two samples were drawn

from the same population by comparing the two means on baseline measures. Next, the Shapiro Wilk test was used to determine if the data for the changes in the primary and exploratory outcome variables are normally distributed. The primary variable was the TUG test, and the exploratory variables were grip strength, leg strength, and flexibility. If the data were normally distributed a paired T-Test was run to examine within-group changes from baseline for the major outcome variables. If the data were not normally distributed a nonparametric equivalent was used, the signed rank test. Following that test, an analysis was conducted in the data to determine outliers in the primary outcome data, with outliers defined as a data point 3 deviations higher or lower than the mean. An analysis of covariance was utilized to examine the pre-post changes in the primary and exploratory outcome variables between the two groups, which was adjusted for the baseline values of the primary and exploratory variables, as well as potential confounders. After these analyses were completed, a separate analysis was run to compare changes in good attenders versus poor attenders in the EXD group; good attenders were defined as having an attendance greater than 60%, and the analysis of covariance was used to examine these changes.

RESULTS

Figure 1 depicts the flow of participants that took place throughout the study. The total analytic sample consisted of 26 participants, with 17 in the EXD group (BMI = 38.8 kg/m²) and 9 in the CON group (BMI = 36.6 kg/m²). There was only one significant difference between the subjects who dropped out of the study compared to those who completed, the dropouts had a smaller waist circumference when compared to the completers ($p = 0.036$).

Table 1 describes the baseline characteristics of the two groups. Although no randomization of group placement occurred, there were only two variables that demonstrated significant differences between each of the study groups. There were significant differences between groups in reported physical activity [7965.5 (SD = 5696.5) kcal/week in the EXD group vs. 3100.4 (SD = 3657.5) kcal/week in the CON group; $p = 0.038$], and average waist circumference [115.0 (SD = 8.9) cm in the EXD group vs. 106.8 (SD = 9.8) cm in the CON group; $p = 0.042$].

The average attendance for all aspects of the intervention sessions was 67.5%, and greater than 69% for the dietary sessions in the EXD group. The CON group experienced a decline in total diet quality of -6.1 (SD = 7.2), and the EXD group improved diet quality by 2.2 (SD = 10.7).

Table 2 shows the changes that occurred from baseline to 12 weeks in both groups. There were significant within-group changes in TUG time in both the EXD and CON groups, as the EXD group saw an improvement of 0.6 (SD = 2.1) sec after the 12-week intervention ($p = 0.04$) and the CON group saw a decline of 0.7 (SD = 0.9) seconds with the 12-week intervention ($p = 0.05$). Although both groups

experienced significant within-group changes, there were no significant between-group differences in TUG time change ($p = 0.104$).

Along with TUG time change, the EXD showed a tendency for an improvement in measures of flexibility with an improvement of 2.3 (SD = 5.4) cm with the 12-week intervention ($p = 0.07$), while the CON group did not significantly change ($p = 0.51$). There was not a significant between-group difference regarding flexibility change. There were no significant changes that occurred after baseline in SPPB scores, leg strength, or grip strength for either group.

Due to the variations in attendance percentage, a separate analysis was designed to examine post-intervention changes between good attenders ($n = 12$) and poor attenders ($n = 5$) within the EXD group to assess the efficacy of the intervention. Good attenders were defined as having an attendance $\geq 60\%$ to the intervention sessions. There was only one significant difference between the good attenders and the poor attenders at baseline; the poor attenders had a higher time measure for the chair stand test ($p = 0.054$). There were also significant within-group changes as the good attenders significantly improved TUG time by 0.8 (SD = 0.7) seconds ($p = 0.003$), but the poor attender group did not experience any significant changes ($p = 0.893$). There were no significant differences within or between-groups in flexibility, grip strength, knee extensor torque, or SPPB scores.

DISCUSSION

The major finding of the study, and in support of our hypothesis, was that with a 12-week intervention of combined of Tai Chi, RT, and diet resulted in significant improvements in selected measures of mobility and flexibility in obese older women in an urban setting. To our knowledge, the current study is the first to test the combined interventions of Tai Chi, RT, and diet in obese older minority women living in a community setting.

The major finding of this study was that TUG performance improved in the EXD group by 5.7%, while a CON group declined by 8.7%. These data support the original hypothesis that TUG time would significantly improve with the 12-week intervention. A major finding of this study that was not in support our hypothesis, is that measures of muscle strength did not significantly improve in the EXD group. This was an unexpected result because previous research has shown improvements in muscle strength after similar interventions in community settings (31,34). Additionally, the results indicate that the EXD group had a tendency to improve flexibility, as the subjects in the EXD group improved in flexibility measures by 24% after baseline. This improvement was also demonstrated in previous studies combining Tai Chi and diet modification (5,21).

The TUG is a valid predictor of fall risk and is a streamlined measure that can predict overall levels of physical function (38). These findings in TUG improvement confirm the results of the study conducted by Intarakamhang et al. (20). That Tai Chi intervention consisted of 14 older females and took place over 12 weeks. The results from that study demonstrated improvements in the TUG by 1.38 seconds ($p < 0.001$).

Tai Chi alone, and Tai Chi combined with other interventions has been shown to result in positive improvements in function (20,21,23). These changes in TUG time could be attributed to improved proprioception, and improved flexibility and strength of the muscles in the leg and trunk (9).

The findings of the current study in flexibility are similar in comparison to the findings from a previous study by Katkowski et al. (21). That previous study utilized Tai Chi combined with the DASH diet in obese older women, which resulted in significant within-group changes in flexibility (5.29 ± 2.16 cm; $p = 0.022$). That previous study took place over a 16-week period and the results of that study confirm that Tai Chi can improve flexibility measures in obese older women. Another study that demonstrated significant improvements in flexibility was performed by Audette et al. (5). That study took place over a 12 week time period and studied 19 older women and found a significant difference between the Tai Chi group and a walking group regarding improvements in flexibility (toe touch test improvements: 2.3 inches in the Tai Chi group vs. 0.6 in the walking group; $p = 0.02$). A mechanism that explains these results could be how Tai Chi involves the rotation of the head, trunk, and extremities while maintaining Tai Chi form, which can therefore, improve flexibility in the arm, trunk, and hip (19).

The lack of change in muscle strength was an unexpected finding because previous work by Straight et al. (34) observed improvements in muscle function and physical function in older women after combining resistance training and dietary modifications. That program took place over an 8-week period and combined resistance training with the DASH diet, and utilized free weights as a main form of

resistance. That study however, had a larger sample size and that intervention resulted in significant improvements in muscle strength along with improvements in physical function. Another resistance training program in older adults by Mikesky et al. (28) used a similar resistance training protocol when compared to the current study, and included 62 independent older adults over the age of 65. That study found significant results in muscle strength, as the subjects in the exercise group increased strength by an average of 12% for knee extension, and 10% for knee flexion ($p < 0.05$). Unlike these studies, our study did not observe significant changes from baseline in measures of muscle strength. This lack of change that occurred in our study could be attributed to the population cohort. It has been found that obese women have higher muscle strength measures when compared to lean women, which could have attributed to this lack of change (32).

After the data analysis based on attendance was performed, the significant change in TUG time that was observed in the good attenders (.80 seconds) was greater than previous studies with intervention groups incorporating the DASH diet with Tai Chi (21), and DASH diet with resistance training (34). The significant difference between groups at baseline in the chair stand test did not attribute to an overall difference in the SPPB total score. These data suggest that when participants attended the majority of combined intervention sessions, a significant improvement occurred in measures of physical function. It has been shown that it is difficult to promote consistent participation in community studies (24). However, community interventions ultimately need to be evaluated based on how all of the subjects improved as a group, not only through those who adhered to the program. Improving

adherence rates should be a major focus in future studies using this setting and population.

This study adds to current literature on the effects of combined exercise and dietary interventions. This is also, the first study to combine RT, Tai Chi, and dietary changes in obese older women. The findings from the current study confirm those findings in previous studies in obese older women regarding the TUG test and flexibility measures (21,33). However, the studies done in obese older women (33,21) did not incorporate minority women as a major part of their study population. A study done by Rogers et al. (31) included minority women and took place in a community setting over 4 weeks. The results of machine-based resistance training program showed improved lower body, and upper body strength by 20% and 24%, respectively ($p < 0.05$). However, that study did result in significant improvements in function that was in contrast to the improvements in function found in the current study. The current study fills the gap in current literature by incorporating this minority population and by combining multiple intervention strategies into one program.

There are several strengths of this study. First, a primary strength was the inclusion of minority women (84% non-white women). There is a lack of studies that have examined exercise and dietary interventions in older obese minority women. Those few studies (31,21,34) that included minority women did not use the current study's combined intervention strategies in this population or setting. Second, the current study also included a waitlist control group that was used as a comparison and to strengthen the study design. The waitlist control group allowed for an analysis to occur to effectively evaluate the impact of the intervention. Third, this study utilized

well-validated measures of physical function in older adults. The SPPB is a valid test that can evaluate function of the lower extremity and can predict disability in older adults (18,16). Moreover, an SPPB score below 9 is defined as functionally limited and sedentary (17) and this is significant as the baseline SPPB scores in the EXD group was 8.4 (SD = 2.5), and the average score for the CON at baseline was 8.9 (SD = 2.9). These values demonstrate that the groups in our study had a below average level of function and thus this population is ideal for conduction interventions to improve function.

Despite the strengths listed above, are some limitations to this study that need to be addressed. One limitation was that the final analytical sample was only 26 total participants. However, this sample size was adequate based on our a priori sample size calculation on TUG change, and because we were able to observe significant results in physical function in the EXD and CON group. Additionally, previous studies incorporating Tai Chi that found significant results in the TUG test (1.38 seconds: $p < 0.001$) over a 12-week period, had as few as 14 women in the intervention group (20). Second, the study groups were not randomized, which could have resulted in some bias with regard to the interpretation of the results. However, this study was primarily a translational research project with the main benefit of improving health of the participants, and therefore no randomization of group assignment occurred. Moreover, there were only minor baseline differences between groups that suggest that the groups were not substantially different and baseline values of primary and exploratory measures were used as covariates in the statistical analyses. Additionally, there were a total of 5 dropouts in the study, however, there

was only one significant difference between the subjects who dropped out of the study, and those who completed (dropouts had a smaller waist circumference compared to the completers; $p = 0.036$). Finally, whenever a combination of intervention strategies occurs, the results cannot be attributed to a singular intervention strategy. The results of this study cannot be attributed to Tai Chi, RT, or diet alone, but to the combination. However, previous studies (6,21,34) have shown that each of the interventions has been validated to improve obesity-related health outcomes and different combinations of the exercise interventions have resulted in significant changes in physical function and muscle strength.

In conclusion, the combination of Tai Chi, RT, and diet resulted in improved TUG times and results in improved measures of flexibility over 12-weeks in older obese minority women, but not in measures of muscle strength. This translational research study was able to positively influence the lives of subjects and the equipment used in the study was donated to the Senior Center in order for continuation of the program. This study was able to result in improved function of the subjects with a low cost and the program was not difficult to administer. Future studies should examine this combined intervention strategy with a larger sample size in this population in order to confirm these findings and to better evaluate the combined effects on muscle strength.

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Figure 1: Flow Chart of Subjects Throughout the Study.

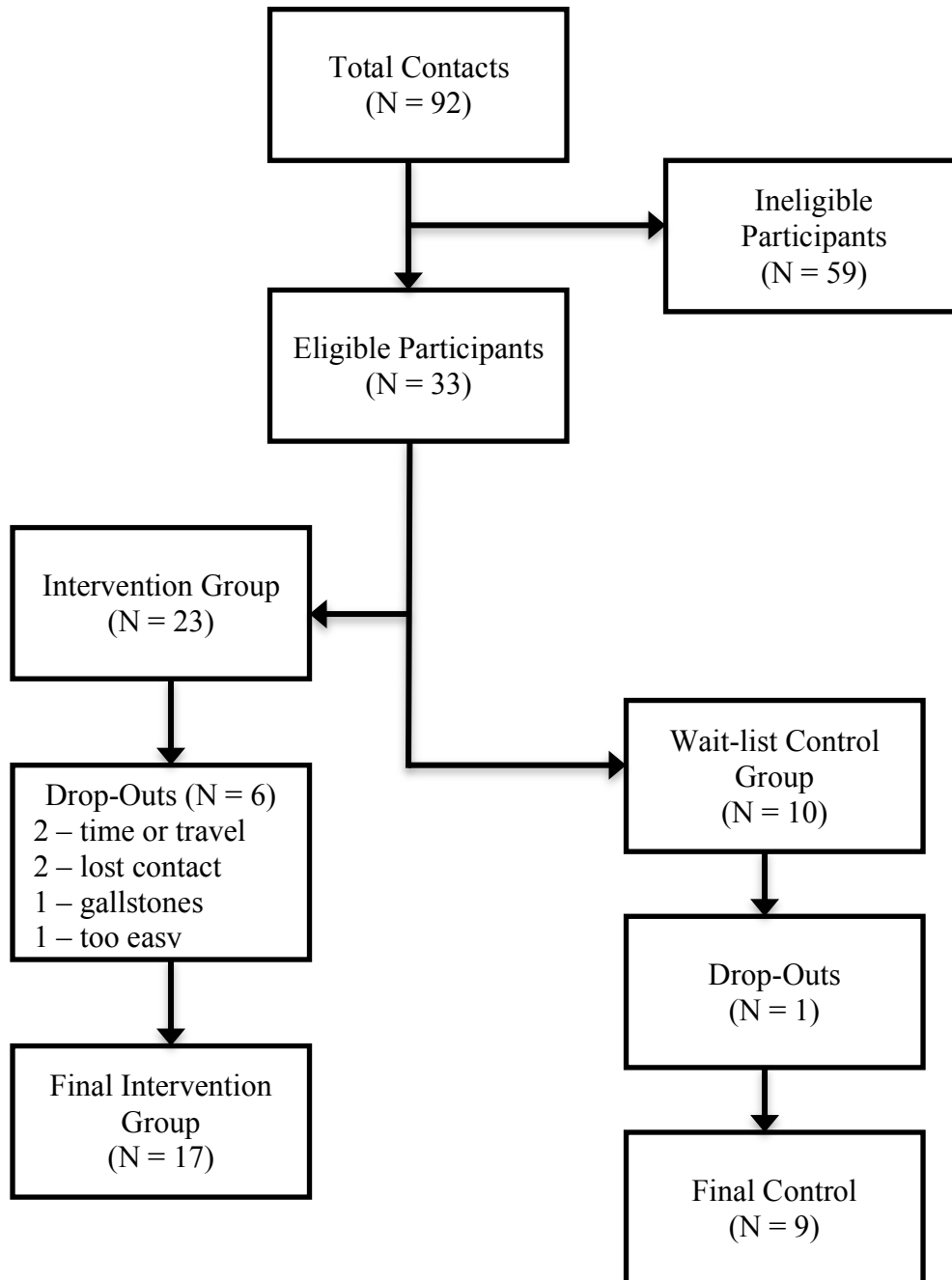


Table 1: Baseline Characteristics of the Experimental Group (EXD) and of the Control Group (CON).

Characteristic	EXD Group (n = 17)	CON Group (n = 9)	p value
Age (years) ¹	65.2 (8.1)	65.6 (8.6)	0.912
Education ²			0.132
High School, GED or Less * ³	10	5	
Associates/Some College * ³	6	1	
Bachelors or Higher * ³	1	3	
Weight (kg) ¹	97.9 (16.1)	94.5 (12.0)	0.578
Height (cm) ¹	158.3 (6.6)	159.8 (6.0)	0.593
BMI (kg/m ²) ¹	38.8 (5.1)	36.6 (3.4)	0.241
Waist Circumference (cm) ¹	115.0 (8.9)	106.8 (9.8)	0.042
Hip Circumference (cm) ¹	124.3 (11.1)	120.1 (6.2)	0.305
Waist to Hip Ratio ¹	0.93 (0.05)	0.89 (0.07)	0.167
Body Fat (%) ¹	49.8 (3.3)	49.6 (2.9)	0.888
Race/Ethnicity ¹			
Non White* ¹	13 (76)	9 (100)	0.263
White * ¹	4 (24)	0 (0)	
Physical Activity (kcal/week) ^{3,1}	7965.5 (5696.5)	3100.4 (3657.5)	0.038
Diet Quality Score ^{4, 1}	72.6 (21.4)	76.4 (27.6)	0.716
At Risk (<60)*	6 (40)	4 (44)	
Possible Risk (60 – 75)*	8 (47)	4 (44)	
Not at Risk (>75)*	2 (13)	1 (12)	

BMI – body mass index, % - percent

All data are expressed as means with (standard deviations)

¹ - Data analyzed using student t test, ² - Data analyzed using Fisher's Exact Test, ³ – measured by Yale Physical Activity Survey, ⁴ – measured by Dietary Screening Tool

** Data expressed as “n” and (percentage)*

Table 2: Baseline Data and Post Intervention Changes in Physical and Muscle Function in the EXD and CON Groups.

Variable	EXD Group (n = 17)	CON Group (n = 9)	p value between group
<i>TUG Score (seconds)</i>			
Baseline	10.5 (2.7)	10.3 (2.9)	0.863
Post Intervention	9.9 (3.2)	11.3 (3.4)	
Change	- 0.6 (2.1) *	0.7 (0.9)*	0.104
<i>Flexibility Score (cm)</i>			
Baseline	9.6 (10.4)	3.8 (3.9)	0.124
Post Intervention	6.4 (11.1)	2.0 (6.5)	
Change	- 2.3 (5.4)	- 1.7 (7.0)	0.930
<i>SPPB Score (0 – 12)</i>			
Baseline	8.4 (2.5)	8.9 (2.9)	0.628
Post Intervention	9.1 (2.9)	9.0 (2.6)	
Change	0.8 (2.4)	0.5 (1.9)	0.810
<i>4-m Gait Speed Time (s)</i>			
Baseline	5.41 (1.47)	5.17 (1.20)	0.681
Post Intervention	5.35 (1.67)	5.17 (1.26)	
Change	-0.06 (1.00)	- .16 (0.37)	0.781
<i>Five Chair Stand (s)</i>			
Baseline	10.75 (5.85)	14.24 (3.87)	0.122
Post Intervention	11.08 (6.35)	14.63 (5.18)	
Change	0.33 (6.24)	- 0.01 (2.98)	0.624
<i>Knee Ext. Torque (kg-m)</i>			
Baseline	6.74 (2.2)	6.65 (1.10)	0.907
Post Intervention	7.67 (5.68)	6.10 (2.21)	
Change	0.92 (5.51)	- .54 (2.54)	0.477
<i>Grip Strength (kg)</i>			
Baseline	19.38 (6.90)	18.93 (6.06)	0.871
Post Intervention	20.12 (6.57)	19.13 (5.14)	
Change	0.72 (4.09)	0.95 (3.31)	0.969

* - Signifies significant changes within groups ($p < 0.05$), Ext – extension
All data were analyzed using analysis of covariance adjusted for baseline values.
All data are expressed as least squared means (standard error)

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Appendix A: Review of Literature

Introduction

Obesity is a growing health problem and is associated with increased risk of coronary heart disease, type 2 diabetes, some cancers, hypertension, and sarcopenia [1,2,3,4]. The prevalence rate of obesity, defined as a body mass index (BMI) greater than 30 kg/m², is 35% in women older than 60 years of age [1,3]. Along with higher rates of obesity, older women are also at a greater risk of developing an age-related decline in muscle strength, also known as sarcopenia [1]. Both of these conditions result in significant disability in older adults, and leads to an impaired mobility. However, resistance training and Tai Chi have been found to increase strength, improve cardiovascular fitness, and result in moderate weight loss in older women on their own [4,5,6,7,8]. Changes in dietary quality have been associated with moderate weight loss and is considered an effective intervention tool for obese individuals [1,7,9].

The purpose of this literature review is to examine the consequences and treatments of obesity and how they are associated with physical and muscle function in older women. This literature review will also detail current research evidence regarding the use of diet, Tai Chi, and resistance training as intervention strategies, and when all of these interventions are combined.

Obesity in Older Adults

The prevalence of obesity has doubled in the past 10 years in the general population and estimates indicate that 37% of adults over the age of 65 are obese [1]. Recent research has shown that these obese individuals are at a much greater risk of

developing health conditions that include hypertension, cardiovascular disease, diabetes and forms of cancer [1,2,3,4]. Mathus-Vliegen et al. [1] discovered that morbidity and mortality associated with obesity and overweight individuals increases at a BMI greater than 30 kg/m². Consequently, these obese individuals should be targeted with treatment strategies in order to initiate weight loss. The majority of these obese individuals also have functional impairments, obesity-related diseases, and metabolic complications that are all significantly improved by weight loss.

Obesity is associated with greater risks of developing many chronic diseases and conditions. Must et al. [10] examined the association between being obese and the development of numerous diseases, using data from the Third National Health and Nutrition Examination Survey (NHANES III). Using these data, the researchers were able to develop prevalence ratios (PR) for the relationship between obesity and other diseases. The results show that obese individuals older than 55 years have an increased risk for developing type 2 diabetes mellitus, gall bladder disease, coronary heart disease, and high blood pressure ($p < 0.05$). The PR scores for each variable increased linearly in relation to BMI, with the exception of blood cholesterol. The PRs for developing type 2 diabetes were 5.76, and 2.98 for coronary heart disease, compared to the reference group ($p < 0.05$). These data show that along with obesity, there are many other comorbid conditions that are more likely to occur in obese individuals.

The prevalence rate of obesity has increased significantly over the last 10 years in the United States. The study done by Hedley et al [2] examined these obesity rates from the years 1999 – 2002. The study used data gathered from the NHANES survey

that resulted in a total of 4115 adults and 4018 children, and used BMI as the primary method of screening the individuals as obese or overweight. The obesity prevalence rates for individuals less than 20 years old, between 20-39 years, between 40–59 years, and greater than 60 years were 30.4%, 25.9%, 33.8%, and 32.9%, respectively ($p < 0.05$). The prevalence rates were higher depending on ethnicity and gender. For women between the ages of 40 – 59, the prevalence of obesity was 36.7%. Non-Hispanic white women, Non-Hispanic Black women, and Mexican American women had rates of 34.9%, 50.6%, and 47.7%, respectively ($p < 0.05$). These data demonstrates that certain populations are at a higher risk of developing obesity and it's comorbid conditions. According to this study, women are at a greater risk of developing obesity, however, this study was published in 2004, and more current research on obesity prevalence is required, as well as treatments.

More recent published research regarding the occurrence of obesity was described in the research data brief performed by Fakhouri et al [12]. The researchers examined the trends of obesity occurrence since the year 1999 and also examined the overall prevalence of obesity. The researchers confirmed that the rates of obesity are rising, and 34.6% of adults older than 65 are obese. When this number is compared to the data published from Hedley et al (2004), there was a slight increase in the prevalence of obesity. The highest recorded prevalence rate of obesity was recorded in Non-Hispanic Black women, with a percentage of 53.9% ($p < 0.05$). Non-Hispanic White women and Hispanic women also had high rates of obesity; 38.9% for White women, and 46.6% for Hispanic women. There was not a significant linear increase in obesity prevalence among older women; however, these rates did not decrease since

2002. These data is significant because by the year 2050, the number of adults older than 65 is expected to more than double, from 40.2 million to 88.5 million, which could result in higher overall rates of obesity. These data demonstrate that these minority older women are at a greater risk of developing obesity.

Obesity is one of the most influential risk factors for developing coronary heart disease. Approximately one third of adults in the U.S. are classified as being obese and are consequently at a greater risk for developing coronary heart disease. Clark et al. [7] examined how these rates of obesity are associated with the African-American population. The researchers found that obesity is twice as common in African-American women when compared to white women. From the year 2000, the age adjusted prevalence of obesity increased by 11.5% in black women. Along with this increase in body weight, black women saw an average waist circumference increase of 5.3 cm, compared to a 2.4cm increase in white women. This rise in obesity results in black women becoming more susceptible to metabolic syndrome and the development of coronary heart disease, which causes concern for health professionals.

In conclusion, the prevalence of obesity is significantly higher in older women and as a result, these older women are at a greater risk of developing the comorbid conditions of obesity. These obese older women are a high-risk population and possible intervention strategies should be examined. Along with older women at a higher risk, minority older women seem to have a significantly higher risk of developing obesity. The data gathered from these studies supports that older women and older minority women are at an increased need for intervention strategies that target obesity.

Obesity and Aging on Physical Function in Older Women

Along with higher risks for developing obesity and sarcopenia, the older adult population also can experience a decrease in overall physical function. This decline has the potential to vary depending on race or other factors. Thorpe et al. [13] researched the decline in physical function and how it's associated with race. The data were collected from 2,969 black and white subjects who were between the ages of 70 – 79 years old. This population was examined over a 5-year period and the data measures for physical function were the self-reported gait speed, the capacity to climb 10 steps, and walk a quarter mile. Of the 2,969 subjects, 37.1% (1,103) developed a form of mobility limitation within the 5-year period. This percentage varied by race; 53% percent of black women and 33% of black men developed a limitation, compared to 40% of white women, and 26% of white men ($p < 0.001$). This high rate of physical mobility limitations that are associated with age could greatly influence the quality of life of older adults. The study researchers suggested that more research should be focused on examining these effects of aging and methods to slow this decline in physical function.

A study done in Korea by Na et al [14] examined the effects of obesity on physical function, and the relationship between aging and obesity (utilizing anthropometric data). The study utilized data gathered from the 2005 Korean National Health and Nutrition Examination Survey (KNHANES) and there were a total of 5,462 subjects (2,325 were male, and 3,137 were female). Physical function and anthropometric measures were gathered using surveys that addressed activities of daily living, height, weight, BMI, and other functional abilities. The results of the

study demonstrated that BMI was associated with an increased waist circumference and hypertension in women who were older than the age of 70. Limitations in activities of daily living and BMI had a linear relationship with the greatest prevalence in women who were older than 70 years. This significant association demonstrates that more current research is needed to confirm these findings.

Current research that focused on the relationship between BMI and physical function was provided by Sirtori et al [15]. Physical function was evaluated using a survey that measured health related quality of life (HRQoL), and other measures that were included were gender, BMI, and age. The measures of HRQoL were gathered using a survey called the IWQoL-Lite, the higher a score on the IWQoL-Lite, signifies greater disability. There were a total of 117 subjects in the study (80 female) who reported a BMI greater than 30 kg/m². All of the data were collected via a subjective survey that was given to all of the subjects. The average BMI scores of the subjects in the study was 43.7 kg/m², which is classified as extreme obesity. Older age and higher BMI scores were significantly associated with increased disability and declines in HRQoL. Individuals who had a higher BMI (average of 47 [42.3–51.8]) were significantly associated with a higher score on the IWQoL-Lite (110 [104–117]). The higher score on the IWQoL-Lite demonstrates a lower level of function. These data show that having a higher BMI and being of older age, resulted in significant physical decline.

The changes that occur over time in performance measures of upper and lower extremity performance can represent physical function deterioration or improvement.

There are very limited data that represent the changes that occur in upper and lower extremity performance over time. Onder et al. [16] examined the prospective changes in physical function measures, and examined rates of decline in these measures according to age. The data for the study was gathered from the Women's Health and Aging Study. Lower extremity function was measured utilizing walking speed, balance, and chair stand tests. Upper extremity function was measured using the lock and key test, pegboard test, and grip strength. After 3 years, the subjects saw a decline of 16-27% in lower extremity performance scores and upper extremity performance declined as well (7 – 24%). As a result of the aging process, physical function in both, upper and lower extremities, decreases over time. Although no explanations were provided, lower extremity measures demonstrated a greater significant decline than upper extremity measures. This decline in physical function could also be linked to variations in individual's activity levels.

Physical function decline can also be a result of a sedentary lifestyle. Seguin and colleagues [17] examined the relationship between physical functioning and a sedentary lifestyle in older women. As part of the Women's Health Initiative, this study included women between the ages of 50 – 79 years old at baseline. Over 61,600 women completed a survey pertaining to physical function over a 3 year time period. The results of the study show that lower physical function scores are associated with a greater amount of sedentary time ($p < 0.001$). The greater amount of sedentary time was also significantly associated with a higher frequency of falls, and performance of activities of daily living ($p < 0.001$). The study also found that women who reported a high level of sedentary time, but reported higher levels of physical activity, were

shown to have greater physical function scores (correlation coefficient = -0.78, $p < 0.001$). Women who reported high levels of sedentary time were also associated with a significant increase in risk of chronic diseases. Overall, the study found that sedentary activities result in significant decreases in physical function and increases in chronic disease risk. Physical function could also decline be caused by the biological aging process.

There seems to be a relationship between overweight obesity with physical activity and physical function in the older adults. The goal of the study conducted by Riebe et al. [18] was to investigate this relationship and determine the association between age, gender, physical function, and physical activity. The study included a total of 821 subjects who participated in the Study of Exercise and Nutrition in Older Rhode Islanders (SENIORS) Project. The information was gathered via the timed up and go test, the Yale Physical Activity Scale, and the stage of change questionnaire. The study results demonstrated that obesity was significantly associated with lower levels of physical activity and physical function (timed up and go: 11.2 [± 0.6] seconds for obese group, and 9.5 [± 0.4] for overweight group: $p < 0.05$). Within the BMI groups (normal, overweight, obese), the individuals who were more physically active were significantly less likely to have irregular physical function scores when compared to those who were sedentary. Obese women had a lower level of physical function when compared to obese men, which places them at a higher risk of developing future disability. Aging was significantly associated with lower levels of physical activity and resulted in lower physical function. This study demonstrated the

importance of staying active to avoid obesity and to help slow down the loss of physical functioning that occurs in old age.

Obesity and Aging on Muscle Function in Older Women

Obesity is accompanied by another condition that is associated with aging and can lead to decreased mobility and increased fall risk. There is a loss of muscle mass that occurs as a result of the aging process, and is called sarcopenia. This is caused because skeletal muscle is very adaptable and changes over time due to aging, inactivity, or exercise level. As shown in a review by Thompson [19], muscle mass decreases by approximately 25 – 35% from peak values observed at younger ages (25 – 35 years old) when an individual reaches old age. Decreases in muscle fiber number, size, and muscle fiber recruitment contribute to this loss of muscle mass. Inactivity results in atrophy of postural muscles that are not utilized on a regular basis (i.e. anti-gravity muscles). The inactive older adult has increased risks for muscle atrophy and decreased function or disability. This portrays the importance of physical activity for older adults in order to prevent this loss of muscle mass. Overall more studies are needed to define the relationship between age and muscle loss to determine the best prevention and rehabilitation strategy.

The loss of muscle mass associated with aging can also cause pain in joints such as the knee or ankle, which corresponds to a decreased level of physical function in the elderly. Goodpaster et al. [20] examined the associations between loss of muscle mass and knee pain in older adults. There were 858 subjects who were between the ages of 70 – 79 that were recruited from the Health, Aging, and Body Composition Study. Muscle quality and mass was measured by using computed

tomography (CT) and dual-energy X-ray absorptiometry (DEXA) scans and the strength of the quadriceps was measured isokinetically by using a handheld manual muscle tester. The subjects were placed into two different groups, individuals who were experiencing pain in one group, and pain free individuals were placed into group two. The average BMI of the subjects was 27.9 ± 4.8 kg/m². Subjects who were experiencing knee pain had significantly lower muscle torque ($p < 0.001$), indicating a lower muscle quality than the individuals not experience pain. Muscle quality was found to be significantly lower in subjects who had osteoarthritis and/or pain when compared to healthy older adults. This pain associated sarcopenia influences muscle strength and muscle quality in the older adult population.

Comparing muscle across different age groups can examine the decline of muscle, which was the goal of the study conducted by Hiroshi et al. [21]. The study had a total of 164 subjects who were placed into 5 different groups according to their ages. The age groups were 20 – 39 yrs, 40s, 50s, 60s, and 70s. The methods in which the study examined strength were isokinetic knee extensor and flexor peak torque, and the cross sectional area (CSA) of the quadriceps femoris muscle. The results of the study show that over time, peak torque was inversely related to age in both women and men. The speed of contraction also decreased from .799 - .756 seconds for men, and .639 - .530 in women ($p < 0.001$). A significant correlation was found between the CSA of the quadriceps and peak torque values in both men and women. The correlation was .827 in men ($p < 0.001$) and .657 in women ($p < 0.001$). This demonstrates that muscle function and strength decline with age; however, muscle mass also decreases over time. This loss of muscle mass can be an influencing factor

in the loss of muscle strength. The results of this study demonstrate that muscle strength losses can be due to the loss of muscle mass associated with aging. The decline in muscle function can also be related to the speed of contraction and recruitment of muscle fibers. Muscle mass and function decline as a result of the aging process, however, there is a relationship between obesity and muscle strength.

The association between obesity and handgrip strength was measured in the study conducted by Stenholm et al. [22]. The study was designed to discover the relationship between history of obesity and muscle strength. The study included 2,021 men and women who were 55 years or older and were part of the Health 2000 Survey in Finland. Obesity history was recorded as the recalled weights from ages 20, 30, 40, and 50 years. The results of the study show that the early onset of obesity was associated with a significantly lower handgrip strength ($p < 0.001$). The earlier the onset of obesity resulted in a lower handgrip strength score in all subjects. A lower handgrip strength score was seen with individuals who are currently obese, when compared to never obese individuals ($P < 0.05$). The results of this study describe the relationship between duration of obesity and physical performance measures. There were no significant differences between genders, however, only 51.9% of women reported that they have never been obese (regarding obesity history). Being obese is significantly related to lower physical performance scores, however, the significance of this relationship varies depending on obesity history.

The association between muscle strength and BMI can also be used to predict major mobility disability in the older adult population. Obesity and muscle decline are two significant threats that are currently influencing the lives of the growing, older

adult population. Marsh and colleagues [23] studied whether or not muscle weakness and obesity can predict failure in a functional performance measure. This performance measure was the short physical performance battery (SPPB). The study included 406 subjects who were between the ages of 70 – 89 years of age. The results of the study show that lower grip strength was associated an increased risk of developing significant mobility disability ($p < 0.01$). Grip strength and BMI were positively related and grip strength was significantly correlated to a higher gait speed ($P < 0.001$). Muscle strength and gait speed was highly correlated, however, there were no significant results found when comparing BMI to gait speed.

Obesity and aging have significant effects on physical function and muscle function in the older adult population. These significant effects result in impaired mobility, increased fall risk, and decreases the independence of the older adult population. Obesity is also a major risk factor in numerous chronic diseases and conditions, which can include hypertension, diabetes, coronary heart disease, and some cancers. The number of older adults is expected to increase and the prevalence rates of obesity are not declining. Obesity is a major health problem and possible treatment methods should be explored and established.

Treatments of Obesity

Obesity is a major health problem and the prevalence of obesity is increasing. Obesity is a risk factor for numerous diseases and conditions that include coronary heart disease, hypertension, and some cancers [1,2,3,4]. As individuals age, their risk of developing obesity increases and this can lead to declines in overall health. These include decreases in physical functioning and muscle strength. The primary

treatments of obesity include a low calorie diet, increased levels of physical activity, behavior therapy, pharmacological therapy, and surgery options [3]. Increased levels of physical activity and diet modifications can result in significant weight loss. A 5 – 10 % reduction in weight can improve blood pressure, cholesterol, glycemic control, and reduce obesity. Diet and exercise seem the most plausible actions due to their low risk of complications, the associated improvements in health, and the low cost of adopting an exercise and diet program.

Diet and Older adults

Obesity causes many serious medical complications and diseases that can result in impaired quality of life in the older adult population. The paper by Villareal et al. [24] discussed the importance of weight loss therapy in older adults. Current data gathered from research studies supports that weight loss therapy results in significant improvements in weight management, physical function, quality of life, and in risk factors associated with cardiovascular disease. Diet is a widely used method to result in weight loss and improve overall health. After reviewing many articles, the data showed that a low-calorie diet that reduces intake by 500-1000 calories per day results in weight loss of .4 -.9 kg per week. Dietary interventions can result in significant weight loss; however, weight loss therapy should also focus on minimizing loss of muscle mass in older adults.

Throughout the weight loss process, the intake of nutrients should be significantly evaluated. The goal of the study by Miller [25] was to examine the nutrient intake in older obese adults throughout a weight loss study. The study included a total of 71 subjects who were an average age of 69.5 years (± 5.8). The

weight loss occurred for 6 months and utilized partial meal replacements, and the goal was to reduce 10% of starting weight. The results of the study showed that subjects in the weight loss group decreased body weight by an average of 8.8% (± 0.4). The daily average caloric intake was significantly lower in the weight loss group; 1396 (± 64) kcals, when compared to the control groups 1817 (± 71) kcals. The study also recorded that key micronutrients (calcium, vitamin D, iron, vitamin C, vitamin E) were higher in the weight loss group. Weight loss was accompanied by an improvement in consumption of important nutrients vital to overall health. This study was able to result in moderate weight loss, however, there were no measures of muscle quality or mass.

Weight loss and diet can result in significant weight loss, however, the effect of weight loss on muscle mass and quality can be negative. The goal of the study conducted by Sasntanasto et al. [26] evaluated the effects of weight loss on muscle area and muscle mass. The study included 36 overweight and obese older adults that were placed in physical activity plus weight loss group, or a physical activity plus overall health education group. The majority of measurements were gathered using the SPPB and the DEXA. After the 6 month time period the physical activity and weight loss group lost greater thigh fat and muscle area when compared to the physical activity and education group. The weight loss group lost a total of 12.4% strength and resulted in decreased muscle fat. Total score on the SPPB was inversely correlated with change in fat mass. The physical activity plus weight loss group improved in measures of function along with a decreased total body weight.

Comparing the effects of dietary interventions, exercise interventions, and the combination of the two can discover which intervention strategy is the most effective. The research study done by Villareal et al. [27] used this idea to create their intervention to compare dietary and exercise interventions, and the combination of the two. The randomized controlled trial consisted of 107 older obese adults who were 65 years of age or older. The subjects were randomly assigned to a control group, dietary group, exercise group, or a diet-plus-exercise group. The dietary sessions met on a weekly basis and consisted of dietary education and diet deficit between 500 – 750 calories per day. The main outcomes of measure for the study were physical performance and body weight. After the 52 week intervention, the diet-plus-exercise group improved their physical performance scores by an average of 5.4 points (± 2.4) and the control group improved by .2 (± 1.8) points ($p < 0.001$). The diet plus exercise group saw a reduction of 8.6 kg (± 3.8) in their overall body weight ($p < 0.001$). This study showed that when diet is combined with exercise, physical function performance measures were improved. This study examined physical function parameters, but did not measure muscle quality or lean body mass.

Dietary interventions in older adults can result in significant weight loss, which reduces the negative effects of obesity. However, as previously stated, weight loss can also result in loss of lean mass (muscle mass). This results in a condition known as sarcopenia obesity, or a loss of muscle mass that occurs as a result of obesity and because of natural aging. The study done by Avila et al. [28] examined the effects of diet alone on lean mass, and also included a diet plus resistance training group to be used as a comparison group to the diet alone group. The study consisted of 27 older

obese adults with an average age of 67 (± 4) years. Body composition was measured using an air displacement measuring device and CT scans were taken of mid thigh muscle composition. The results of the study showed that the diet alone group saw a significant decrease of 1.7 (± 0.9) kg in weight ($p = 0.044$). However, the diet alone group also resulted in a significant decrease of 1.4 (± 0.4) kg in lean mass ($p = 0.001$). The diet and resistance training group saw decrease in weight of 3.3 (± 0.8) kg ($p < 0.001$), and saw an increase in lean mass of 0.8 (± 0.04) kg ($p = 0.077$). Combining diet and an exercise form resulted in greater results in body weight and in lean mass measures. Combining the two intervention strategies may result in significant effects on measures of body composition and muscle quality. This idea of combined interventions will be discussed later.

There are many forms of dietary interventions that result in weight loss and improve measures of function through weight loss. One of the most used diets in the older adult population is the Dietary Approach to Stop Hypertension (DASH) diet [29]. The DASH diet is a diet that is mainly used to influence total diet quality and is used to result in weight loss and improved blood pressure. The goals of the diet include lowering intake of saturated fat ($\leq 7\%$ of caloric intake) and achieving a moderate intake of total fat ($\leq 35\%$ of caloric intake) [30]. The diet also encourages high intake of fresh fruits, vegetables, and whole grains; consumption of low-fat dairy and meat products; and a moderate intake of sodium (3,000 mg or less/day) [30]. The DASH diet has been shown to be an effective intervention tool when working with the older adult population [29,30,31]. This modified DASH diet is designed to alter the intake of total fat from 27% to 35% to allow for intake of healthy unsaturated fats.

DASH Diet and Older Adults

Obesity can result in hypertension, or chronic high blood pressure.

Hypertension can lead to cardiovascular disease and is most effectively prevented and treated through diet and exercise. The DASH diet is a diet plan that can be used to result in weight loss and improve blood pressure. The study done by Appel et al. [29] utilized a clinical trial in order to determine the DASH diet's effect on blood pressure. The study included 459 adults who had a systolic blood pressure less than 160 mm Hg, and a diastolic blood pressure of 80 – 95 mm Hg. After the 11 week time period, the subjects improved their systolic blood pressure by 5.5 mm Hg, and their diastolic blood pressure by 3 mm Hg ($p < 0.001$). The subjects who were hypertensive before the study took place had a larger decrease in blood pressure after the study. The 133 subjects with hypertension reduced systolic blood pressure by 16.9 mm Hg, and diastolic by 8.5 mm Hg ($p < 0.001$). This DASH diet can be used as a dietary tool to lower blood pressure.

The DASH diet has been shown to result in positive effects on blood pressure with individuals who have hypertension, however, studies have yet to been done with individuals who have normal blood pressure. The main objective of the study conducted by Sacks et al. [30] was to examine the effects of the DASH diet on blood pressure measures in both hypertensive and normotensive individuals. The study included a total of 412 subjects who were randomly assigned to eat a control diet, or the DASH diet. Along with the DASH diet, subjects were told to reduce their sodium intake. The systolic blood pressure improved by 1.3 mm Hg after the 30 day time period ($p < 0.03$). After reducing the intake of sodium in the DASH diet group, the

systolic blood pressure was improved by 1.7 mm Hg ($p < 0.01$). When compared to the diet control, subjects in the DASH diet group without hypertension had a lower average systolic blood pressure of 7.1 mm Hg. However, this average was 11.5 mm Hg lower in subjects who had hypertension. The short term effects of the DASH diet on blood pressure were significant and the data showed that the DASH diet was more effective than a traditional diet. This study measured the DASH diet on blood pressure scores but did not measure insulin sensitivity and lipids.

The DASH diet is well established as a diet that significantly improves blood pressure and can result in weight loss. The DASH diet may also influence other biological markers such as insulin sensitivity and lipids. The study performed by Blumenthal et al. [31] examined the effects of the DASH diet on markers of insulin sensitivity and lipids. They combined the DASH diet with an exercise program in a study that included a total of 144 overweight men and women who had high blood pressure. High blood pressure was defined as having blood pressure readings between 130 to 159 mm Hg for systolic, and 85 to 99 mm Hg for diastolic blood pressure. The 144 subjects were randomized into a DASH diet alone group, DASH diet combined with exercise, and a usual diet control group for the 4 month time period. Insulin sensitivity was estimated based on glucose and insulin levels taken at a fasting state. Individuals in the DASH diet plus exercise condition lost an average weight of 8.7 kg (95% CI: 2.0 – 9.7 kg) while the other groups maintained weight. The DASH diet alone did not show any significant differences when compared to the usual diet control. However, when the DASH diet was combined with an exercise program, the results were improved insulin sensitivity and lower total cholesterol ($p < 0.001$).

Combining the DASH diet with an exercise program resulted in significant weight loss and improvements in insulin sensitivity and lipids. This study only focused on overweight men and women, and did not study individuals regarding physical function or the effects of the DASH diet on those with chronic disease.

The DASH diet has been shown to result in weight loss and reduce hypertension, however, these results have not been shown in individuals who have chronic conditions such as metabolic syndrome [32]. Metabolic syndrome is a collection of metabolic risk factors for cardiovascular disease and type 2 diabetes [32]. The goal of the study done by Shenoy and colleagues [32] was to evaluate the effects of the DASH diet with a vegetable juice supplement on weight loss and the ability to reach vegetable intake recommendations. The 12-week prospective study consisted of 81 men and women. Vegetable juice was given as 8 or 16 ounces given daily (depending on group placement). The control group did not receive any vegetable juice, one group received 8 ounces daily, and the other received 16 ounces daily. The subjects in the groups consuming vegetable juice demonstrated greater weight loss, consumed more vitamin C, potassium, and dietary vegetables than those in the control group. The DASH diet plus 8 ounce supplementation group lost an average of 2.25 kg (± 2.72) after the 12-week time period ($p < 0.05$). The addition of a vegetable juice supplement to the DASH diet resulted in significant weight loss and improved consumption of vegetables and key vitamins.

Although the DASH diet has demonstrated positive effects on blood pressure over short term studies, it has not been shown to lower blood pressure over a long period of time nor has it been shown to influence cardiovascular biomarkers. The goal

of the study performed by Blumenthal et al. [33] was to examine the DASH diet over a 4 month period, and to evaluate its effects on blood pressure and cardiovascular measures. The study included 144 overweight or obese subjects with pre-hypertension. The subjects were separated into a diet control, DASH diet alone, and DASH diet plus weight management. The results of that study showed that clinic measured blood pressure was reduced by 16.1 mm Hg for systolic and 9.9 mmHg for diastolic blood pressure ($p < 0.05$). There was also a significant improvement in pulse wave velocity, left ventricular mass, and baroreflex sensitivity. The addition of an exercise program combined with the DASH diet resulted in significant improvements in blood pressure and measures of cardiovascular function.

There not an adequate amount information about what adherence rate is necessary in order to elicit improvements associated with the DASH diet. The study conducted by Epstein et al. [34] examined the influence of adherence on measures of blood pressure with a DASH diet group, DASH diet plus weight loss, and a usual diet control. The study included 144 sedentary obese adults with high blood pressure and took place over a 16-week period. After the 16-week intervention, the subjects in the DASH diet plus weight loss improved systolic blood pressure by 19.2 mm Hg and diastolic blood pressure by 9.9 mm Hg (95% CI). The DASH alone group improved systolic blood pressure by 11.2 mm Hg and 7.5 mm Hg in diastolic blood pressure (95% CI). Only ethnicity differences estimated adherence to the diet, African Americans were less adherent to the diet when compared to whites (95% CI). Greater adherence to the DASH diet resulted in larger deductions in blood pressure markers in both systolic, and diastolic blood pressure ($p < 0.01$). The greater adherence rate to

the DASH diet resulted in improvements in blood pressure. However, this study did not measure physical function or muscle strength of the subjects.

Weight management is the primary method of treating obesity, however it is important during weight loss to minimize the loss of lean mass. The study by Newman et al. [35] was conducted to evaluate the relation between weight loss or weight gain with changes in lean mass in older adults. The study included 2,163 men and women between the ages of 70-79 yrs, and the data were collected over a 4-year period and was taken from the Health, Aging, and Body Composition Study. The study results showed that in older men and women, there was a significant loss of lean mass that occurred with weight loss. These results were even more significant when subjects were involved with a hospital stay. This study portrays the importance to maintain lean mass when promoting weight loss, especially in older adults. Weight loss therapy should be designed to minimize muscle loss, and to maximize weight loss. Diet alone results in weight loss, improved physical function, and the DASH diet also significantly improves blood pressure measures. Previous studies [31,32,33] have shown that diet combined with exercise actually yields the greatest results in physical function, blood pressure, and can also influence weight loss [26,28]. Exercise and diet combined can result in weight loss and minimize loss of lean muscle, as well as improving physical function.

Exercise and Older Women

Physical activity and exercise have been shown to improve physical function [1], however, little is known about community based physical activity interventions. The study conducted by Fitzpatrick et al. [36] examined the effects of a physical

activity intervention in community centers in Georgia. There were a total of 418 older adults (83% female) included in the study, and the study spanned over a 4-month period. The physical activity program included chair exercise, and the promotion of walking outside the program (measured using pedometers), and function was measured by the SPPB. After the intervention was completed, the subjects improved physical function by 8.8% ($p < 0.001$) and increased physical activity minutes by 26% ($p < 0.001$). Increased levels of physical activity were significantly associated with improved physical function scores.

Exercise is one the primary methods for weight management, and also has positive effects on physical function and muscle function. The American College of Sports Medicine (ACSM) submitted a position stand stating that evidence has shown that regular exercise can minimize and reduce the physiological effects of a sedentary lifestyle. Exercise prescription for older adults, and older women should include aerobic exercise, muscle strengthening, balance, and flexibility exercises. Aerobic exercise forms can include walking, running, or Tai Chi. Aerobic exercise is a well studied exercise mode and results in generally positive effects in physical function [1]. Muscle strengthening exercise methods include resistance training or body weight exercises. Balance and flexibility exercises include stretching, body weight exercises, or Tai Chi. Resistance Training and Tai Chi exercise can be an easy and effective way to felicitate the benefits of exercise. These two forms of exercise are favored by older adult because of the low impact, and low risk of injury to the subjects [37,38].

Resistance Training and Older Adults

Resistance training is an exercise mode that results in significant improvements in muscular strength and endurance and could have greater effects in older adults. The goal of the study conducted by Krist et al. [37] was to examine the effects of resistance training on mobility and muscular strength. The resistance training program was designed to be progressive, or with increasing intensity over time. There were a total of ten subjects (6 women) who were all over the age of 77 years old and they were recruited from local nursing homes in Germany. Since the subjects were recruited from a nursing home it is assumed that they had impaired mobility. The exercise program spanned 8 weeks and resistance training exercises were completed twice a week. The exercises were completed using six different gym machines that were performed for 3 sets of 8 repetitions using the major muscle groups. The mobility of the subjects was assessed with the Elderly Mobility Scale (zero = lowest, 20 = highest). Muscle strength was determined by the 8-repetition maximum of each participant. Mobility scores improved from 14.1 (\pm 3.2) to 17.5 (\pm 3.6) after the 8 week training program ($p < 0.005$). There were improvements in muscle strength of 62% (at the chest press) and 108% (at the leg extension machine). These numbers are quite large for increases in muscle strength but that can be due to the subjects starting at a very low level of function, and that the testing devices were used by the subjects during the training sessions (familiarity with the equipment could influence the results). This resistance training program significantly improved mobility and muscle strength in all of the subjects, and demonstrates that resistance training can be utilized in older adults. However, there are variations and multiple options when choosing the most effective method of resistance training.

There are many different forms and methods of resistance training that can be used by exercise professionals. One of the most common and easily transported is the use of elastic tubing or bands. These bands can allow full range of motion movements with resistance that can theoretically lower injury risk. The goal of the study performed by Mikesky et al. [38] was to evaluate the efficacy and adherence to a 12 week progressive resistance training program using elastic tubing. The study included a total of 55 (34 women) adults with an average age of 71.2 years old. The subjects were randomly assigned to an exercise group or a non-exercise control group. The exercises consisted of 3 sets of 10-12 repetitions that incorporated both upper and lower muscle groups. At the end of the study, 80.6% of the original subjects completed the program. Of these 80.6% however, adherence to the training session was an average of 90%. There were no significant changes between the two groups, however the exercise group significantly improved. Subjects in the exercise group increased strength by an average of 12% for knee extension, and 10% for knee flexion ($p < 0.05$). This study showed that elastic tubing resulted in significant strength gains and is a practical exercise tool for older adults. However, this study was not completed in an inner-city setting, nor did it include minority populations.

Due to the practicality of elastic tubing, they can be used as an inexpensive exercise program for inner-city minority populations. The goal of the study conducted by Rogers et al. [39] was to determine the effects of elastic tubing on physical function in older inner-city women. The study included 22 African-American women between the ages of 62 – 94 yrs. The subjects were separated into an exercise group ($n = 16$) and a control group ($n = 6$). The training program was composed of chair-based

exercises that were performed using elastic resistance bands and dumbbells. The training targeted both upper and lower muscle groups. The results of the study show that lower body function improved by an average of 20% in the exercise group using the 30 second chair stand test ($p < 0.05$). The exercise group also saw an improvement in upper body strength by 24% using the 30-second dumbbell curl test ($p < 0.05$). Along with improvements in overall upper body strength, the exercise group increased grip strength by an average of 5%. Elastic tubing with dumbbell strength training resulted in significant improvements in strength measures of the upper and lower body. Even though there were significant improvements in muscle strength, this study did not measure physical function.

Resistance training has been shown to significantly influence individual measures of physical function. However, the goal of Bouchard et al. [40] was to examine the effects of resistance training on an overall measure of physical function, physical capacity. The study included a total of 48 obese women who were between the ages of 55 to 75 years old. Physical capacity was measured with 11 different performance tests and scores ranged from 0 – 44. Body composition was also measured through use of DEXA scans. The 48 obese women were randomly assigned to 4 groups, one with resistance training alone, resistance training combined with caloric restriction, caloric restriction alone, or a control group. The results of the study showed that body weight, fat mass, and BMI all significantly decreased in the caloric restriction, and the resistance training plus caloric restriction groups ($p < 0.01$). However, the caloric restriction group saw a significant decrease in lean body mass after the 3 month time period ($p < 0.05$). The global physical capacity scored

improved by an average of 10% (± 8.8) in the resistance training group compared to the control group ($p < 0.01$). The 3-month training program had a significant effect on physical capacity and when incorporated with caloric restriction diet, the subjects lost a significant amount of body weight. This study time frame spanned across three months, and consequently, future studies should examine the long term benefits of resistance training.

Resistance training has been shown to result in significant effects in short term studies, however, there has not been a long-term study that evaluated the effects of resistance training. The study performed by Flansbjerg et al. [41] was designed to evaluate the long term effects of resistance training. The study included 18 men and women with an average age of 66 (± 4) years who were all chronic stroke patients. The training group participated in resistance training sessions for the lower body muscle groups twice a week for 10 weeks. One of the primary measures was the timed-up-and-go (TUG) test. After the 10 week time period, the subjects did not experience any significant between group differences. However, the resistance training group improved their TUG time by 4.4 seconds ($p < 0.05$). Even though the subjects of this study included chronic stroke patients, and not healthy overweight adults, the results are still significant. Resistance training alone accounted for the drastic change in TUG time after the 10 week intervention. After the 4 year follow up, all of the subjects maintained their benefits of the program and their TUG times decreased another 0.6 seconds ($p < 0.001$). Resistance training significantly improved physical function and these improvements appeared to span the 4 year time period.

Resistance training is a form of exercise that is believed to require a lot of expenditure and can be quite difficult for some individuals [42]. However the study performed by Brochu et al. [41] examined if disabled women with heart disease could perform resistance training at the required intensity to receive benefits. The study spanned 6 months and included 30 older women with coronary heart disease and were an average age of 70.6 (\pm 4.5) years old. The physical function measure was recorded via self report and consisted of 15 practical activities, and the resistance training program was performed using dumbbells and universal weights. After the intervention was complete, the resistance training improved their physical function score by 24%, on the contrary, the control group only improved by 3% ($P = 0.007$). The resistance training group also significantly improved in measures of upper body and lower body strength (18 vs. 6%, and 29 vs. -2%, respectively). This study demonstrated that disabled older women can effectively participate in resistance training in order to result in significant gains of physical and muscle function.

Resistance training has been shown to increase muscle strength and help delay the onset of sarcopenia and other physical limitations. As shown from previous studies [36,37,38,39,40] resistance training increases muscle strength from external measurements, such as; bench press test, or isometric leg strength. The next study examined these variables as well as DXA scans to determine lean body mass. Botero et al. [43] researched this effect of resistance training on muscle strength and body composition with 23 post-menopausal women who were an average age of 60.02 years (\pm 4.42). The training program was administered for 12 months and consisted of periodization based resistance training that occurred twice a week. This exercise

program consisted of 6-14 repetitions for 3 sets. The researchers found a significant increase in muscle strength and lean body mass, and also found decreases in body mass, body fat percentage and fat mass after the 12 month intervention period. Resistance training can alter the effects of aging and decreases body fat in elderly women, however resistance training does not consistently result in improved balance, flexibility, and certain performance measures of function.

As stated above, the ACSM recommends that the exercise prescription for older adults should be multifaceted and should include different forms of exercise. Resistance training is a form of exercise that is anaerobic and focuses primarily on strength and some physical function improvements. This creates the need for alternative exercises that focus on improving balance, flexibility, and physical function.

Tai Chi and Older Adults

A physical activity that focuses on these aspects is the Chinese martial art Tai Chi. Tai Chi is an exercise form that focuses on fluid motion and slow movements of the body that requires body control and balance. Tai Chi has a very high adherence rate in the older adult population due to its low impact of exercise and there is a low risk of injury for the subjects. Tai Chi is increasing in popularity and there have been recent studies that have demonstrated its effects in the older adult population. Tai Chi originated from China and is a martial art form that has been practiced for over 1200 years. The review performed by Adler et al. [44] described Tai Chi and the physiological benefits of the exercise form. Tai Chi is very practical and can be performed anywhere where there is substantial space and limited equipment is

necessary to perform the exercise. Studies have shown that Tai Chi results in reduced lipid profiles, improvements in insulin resistance in diabetic patients, and a reduced body fat percentage. Tai Chi also has significant effects on measures of cardiovascular performance. Blood pressure (systolic and diastolic), pulmonary function, and aerobic capacity have all improved as a result of Tai Chi. Other improvements have been found in aerobic capacity, peak VO₂ consumption, and cardiac output. Tai Chi has also been found to improve musculoskeletal measures such as flexibility, endurance, and muscular strength. All of these improvements can be verified by examining the current research investigating Tai Chi and its effects on the elderly population.

Tai Chi is increasing in popularity due to its low impact style of exercise and low risk to the subjects. However, little is known about the effects of Tai Chi on physiological variables, and how Tai Chi compares to walking. Walking is one of the most popular aerobic exercise forms. Audette et al. [45] conducted a study in order to examine the effects of Tai Chi versus brisk walking on measures of cardiorespiratory fitness, strength, and physical function. There were a total of 19 subjects that were included in the study and all were sedentary women with an average age of 71.4 (\pm 4.5) years old. The primary outcome variables were aerobic capacity, strength, flexibility, balance, and quality of life measures. A significant improvement was seen in estimated VO₂max scores with the Tai Chi group improving by 4.2 (\pm 3.03) ml/kg/min. The brisk walking group and control group had a change of 0.2 (\pm 2.63) ml/kg/min, and -4.4 (\pm 2.63) ml/kg/min, respectively ($p = 0.003, 0.08$). The Tai Chi group also saw significant gains in non-dominant knee extensor strength, along with the single-

leg stance test ($p < 0.05$). Tai Chi can be an effective way to improve many different functional fitness measures in elderly women. Tai Chi was also found to have elucidated greater results on these measures than the walking group. However, the main limitation of this study was that there was a lack of a true control group.

Tai Chi is becoming a favored exercise choice by researchers when they are working with older adults. The reasons for this are described in the review article written by Kuramoto [46]. Tai Chi is favored by researchers due to its low injury risk and it is equivalent to moderate or light intensity exercise. After examining the majority of Tai Chi studies from 1996 – 2004 the researcher combined the conclusions from each study. Tai Chi has been found to reduce pain in patients with arthritis and osteoarthritis, and has been demonstrated to improve balance and reduce fall risk. Improved aerobic capacity in all populations and blood pressure reductions were seen in myocardial infarction patients. Strength increases in the lower legs is also associated with Tai Chi participation. There is also qualitative data on the effects of Tai Chi that include improved quality of life, improved sleep quality, and stress reduction. Overall, Tai Chi is an effective exercise tool for older adults and can be used to improve aspects of health with low cost and low risk to the subjects.

Tai Chi is form of exercise that can be very progressive and imposes a very low injury risk of the subjects. It is a mind-body exercise type that is becoming more popular in the U.S and can be utilized as an effective and safe exercise form with elderly women. The research study done by Wayne et al. [47] researched the effects of Tai Chi with 86 post-menopausal women for 9 months of Tai Chi training. The study was focused around osteopenic measures but there was a sub-study which

examined bio-motion, or balance of the subjects. A total of 16 subjects entered this sub-study where the tests were tandem walking, quiet standing, and repeated chair rise. The Tai Chi group saw an improvement in the sway range during balance testing of 3.19 mm ($p < 0.014$), and average sway velocity improved by .24 points from baseline ($p < 0.027$). There was improvement in function tests; however, the findings were not statistically significant. The Tai Chi group experienced improvements in bone mineral density and functional measures that predict fall risk. The researchers concluded by stating that a disadvantage to their study was that they did not incorporate trained study staff that could have lead the Tai Chi classes, and this method could have improved their adherence rates.

Due to Tai Chi incorporating slow nature movements, older adults can perform basic Tai Chi movements as a form of exercise with little fall or injury risk. Intarakamhang et al. [48] performed a study that focused on the effects of Tai Chi on overall quality of life (determined by a questionnaire) and balance measures. The intervention consisted of 14 females who were an average age of 64.1 (± 4.2 years). The subjects were all placed in the one intervention group with no control group. After the 12-week intervention, balance scores in the right and left single leg stance test improved by 8.59 seconds and 5.85 seconds, respectfully ($p < 0.001$). There were also improvements in the timed up and go test, the subjects improved by 1.38 seconds ($p < 0.001$). Tai Chi also significantly influenced overall quality of life by 7.64 points ($p < 0.001$). This study demonstrated that Tai Chi has positive effects on quantitative and qualitative measures of physical function and reported measures of overall quality of life.

The effects of Tai Chi can be seen on overall healthy adults, obese adults, and can also be seen in patients with chronic disease. Osteopenia is a chronic disease that is characterized by loss of bone mass due to the aging process. Osteopenia is a primary health concern for the elderly because individuals with osteopenia can break major bones from one minor fall. These major bones are the hip, spine, femur, and even the bones of the arm (when bracing a fall). Tai Chi causes significant changes in measures of physical function, however, little is known on the effects of Tai Chi in women with osteopenia. The goal of the study performed by Chyu et al. [49] was to evaluate the effects of Tai Chi on measures of fall risk in the elderly with osteopenia. The study was a randomized controlled trial that included 61 elderly females who were 65 years and older. The subjects were randomized into a Tai Chi group that met three times per week, or a control group for the 24-week program. After the 24-week program individuals in the Tai Chi group showed an increase in stride width ($p = 0.05$), improvement in overall health ($p = 0.008$), and self reported pain measures ($p = 0.03$) when compared to the control group. There were no significant changes in the timed-up-and-go test, five chair sit-stand test, or the other balance parameters. Although there were no improvements in physical function measures, this study demonstrated that Tai Chi resulted in significant improvements in measures of fall risk in elderly osteopenic patients.

Tai Chi has been found to elicit positive changes on physical function among older persons and older adults with chronic disease. However the majority of the interventions incorporating Tai Chi generally took place across a 10 – 12 week time period. The study performed by Li et al. [50] studied the effects of Tai Chi over a 6-

month time period. The study included a total of 94 subjects between the ages of 65 to 96. The subjects were randomly assigned to either the 6-month Tai Chi exercise group or a waitlist control group. Physical function was measured by a 6-item self report scale given to subjects. The exercise group saw a significant improvement of 65% across all of the function measures ranging from walking and lifting to vigorous exercise ($p < 0.05$). The results of the study show that over the 6 month time period, physical function significantly improved in the exercise group. The effects of Tai Chi can be utilized to improve overall health in short term and long term research studies.

Tai Chi has been found to result in improved performance measures of physical function in the older populations. However, little is known about the effects of Tai Chi on cognitive and physical function in older adults. The goal of the study by Piliae et al. [51] was to examine the effects of Tai Chi on physical and cognitive function in older adults. The study included a total of 132 subjects who were randomized into three different groups. There was a Tai Chi group, a western exercise group, and an attention-control group. The western exercise program included resistance and endurance training that took place at a local YMCA and the Tai Chi exercise was instructed by a Tai Chi Grand Master that met. Measures of physical function were balance, strength, flexibility, and cardiorespiratory endurance. Measures of cognitive function that were included were the semantic fluency and digit-span tests. The results of the study showed that Tai Chi resulted in greater improvements in balance ($F = 3.36, p = 0.04$) and showed a significant improvement in cognitive measures ($F = 7.75, P < 0.001$) when compared to the control group and western exercise group. The Tai Chi exercise program led to an improvement in

cognitive measures and flexibility measures that were maintained throughout the 12-month period.

Previous studies have shown that both Tai Chi and resistance training can significantly improve physical function and muscle strength [35 – 42]. However, these previous studies do not combined the two intervention strategies and they do not include a dietary component. Tai Chi can be considered as an aerobic activity, due to its similarity to walking [43] and how it results in significant improves in measures of cardiovascular health. Resistance training is considered an anaerobic activity due to its significant effects on muscle strength, physical function, and its effects on cardiovascular markers. Combining exercise interventions may be a plausible way to illicit significant effects on numerous measures of overall health. There have been numerous current research studies that have examined the theory of combining an aerobic and an anaerobic exercise program, however very few have combined Tai Chi, resistance training, and the DASH diet.

Exercise Combinations in Older Adults

The combination of a strength training and endurance exercise program could have greater effects than just strength training or endurance training alone. The exercise intervention used by Gudlaugsson et al. [52] incorporated strength training twice a week and daily endurance exercise. The endurance portion consisted of daily walking that took place on an outdoor track and the time spent walking was increased over time. The average walking time was 34 minutes per day. Strength training took place at a local fitness center using circuit series strength machines from Life Fitness, and this intervention took place over a 6 moth time period. The study had a total of

117 subjects who were 71 – 91 years old and were randomized into an intervention group or a control group. The physical function measures were the SPPB, 8-foot up-and-go test, and strength performance. Scores on the SPPB increased by a mean difference of .6 (95% CI) and the scores on the 8-foot up-and-go test improved by a mean of 1.0 seconds (95% CI). Strength performance (knee extension) improved and the control group declined with a mean difference of 55.0 N (95% CI). Regular exercise can be used to improve functional fitness in older adults increasing their independence. This population sample was a narrow range of subjects (71-91 years old), which make these results difficult to generalize.

The ACSM created numerous position stands that were reviewing the most current research in order to create lifestyle guidelines. The position stand for the ACSM created by Chodzko-Zajko et al. [53] examined the topic of exercise and physical activity for the older adult population. The biological aging process can result in the decline of physical function and lead to impaired mobility for older adults. Although the biological aging process that occurs normally cannot be reversed, regular exercise can minimize the effects of a sedentary lifestyle and increases life expectancy. Life expectancy increases as a result of exercise and its positive effects of the progression and developing of chronic disease and other disabling conditions. Ideally, the exercise prescription for older adults should include a combination of aerobic exercise, muscle strengthening exercises, and flexibility exercises. All older adults should be involve in an exercise program that encompasses all of these exercises in order to receive the maximum benefits

Comparing the effects of dietary interventions, exercise interventions, and the combination of the two is a method to aid in discovering the appropriate treatment for obesity. The research study done by Villareal et al. [27] used this idea to create their intervention to compare dietary exercise interventions to determine which had the greatest influence on weight and physical function. The randomized controlled trial consisted of 107 older obese adults who were 65 years of age or older. The subjects were randomly assigned to a control group, dietary group, exercise group, or a diet-plus-exercise group. The dietary sessions met on a weekly basis and consisted of dietary education and diet deficit between 500 – 750 calories per day. The exercise sessions met three times per week and each was approximately 90 minutes. The exercise sessions consisted of walking, cycling, and stair climbing as aerobic forms of activity, and nine upper and lower extremity exercises were performed as progressive resistance training. The subjects were instructed to perform 8 -12 repetitions for 1 - 2 sets. The main outcomes of measure for the study were physical performance and body weight. After the 52 week intervention, the diet-plus-exercise group improved their physical performance scores by an average of 5.4 points (± 2.4) and the control group improved by .2 (± 1.8) points ($p < 0.001$). The diet plus exercise group saw a reduction of 8.6 kg (± 3.8) in their overall body weight ($p < 0.001$). The results of this study show that the combination of diet and exercise provides a greater improvement in physical function, and demonstrates a greater reduction in body weight. This study was a long-term intervention, which could have greatly influenced the results of the study.

Combining exercise modes into one intervention strategy can result in significant effects on measures of physical and muscle function. However this combination does not significantly influence weight loss when compared to diet interventions. The previous studies did not include a dietary intervention with their combined exercise programs. Weight management is an important factor in reducing the effects of obesity and its comorbid conditions. One of the newest intervention strategies is to combine aerobic exercise and strength training exercise with a lifestyle change in diet. This combination of three interventions may result in greater significant changes in weight loss, physical function, and muscle strength.

Combined Interventions (Diet, Aerobic Exercise, and Resistance Training) on Older Adults

The guidelines of the National Heart, Lung, and Blood Institute encourages of a loss of reduction in weight of 10% for those individuals who are obese. Donnelly and colleagues [54] wrote a position stand for the ACSM describing the intervention strategies for weight loss in adults. The authors described that regular physical activity (150 – 300 min) may result in long-term weight loss for the obese adult. Activity level and weight loss have a linear relationship, greater weight loss occurs as one becomes more active throughout the week. However, if there is a dietary intervention involved, the less amount of physical activity time is required to result in moderate weight loss. Resistance training does not enhance weight loss, but has been shown to increase loss of fat mass and increase fat free mass. Combining resistance training, regular physical activity, and diet could yield to the greatest results in weight

loss. Physical activity and resistance training alone may not result in weight loss, so therefore, it is important to incorporate a form of diet or caloric restriction.

The combination of lifestyle based weight loss programs and both aerobic, and resistance training, was the intervention method of choice for the study done by Anton et al. [55]. There were a total of 34 subjects that took place in the research study who were obese, older (between the ages of 55 – 79 years old) women with mild to moderate functional limitations. The study design was single blinded and the study staff responsible for testing were unaware of the subjects random group assignments. The intervention contained a dietary component and an exercise component that met on a weekly basis and three times per week, respectively. The dietary component consisted of a group session lead by the staff and the exercise portion incorporated aerobic, strength training, and flexibility exercises. The main mode of aerobic activity was walking, and strength training consisted of five lower body exercises that were performed for two sets of 10 repetitions. The main outcomes of the study were knee extension isokinetic strength and the SPPB. After the 24-week intervention SPPB scores improved in the intervention group by 1.82 ($p < 0.001$). However, knee extension strength did not significantly change from baseline. The combination of aerobic and strength training exercises plus a diet education program can yield significant loss of weight, improve physical function, and help maintain muscular strength. This study only took measures of SPPB to evaluate function and the exercise program consisted of only five different exercises that were only performed on the lower body muscle groups which could have influenced the results.

Data from longitudinal and cross-sectional studies have demonstrated that a convincing link between increasing body mass index (BMI) and decreasing physical function exists. This increasing BMI is strongly associated with a decrease in the ability to perform activities of daily living (ADLs), and decreases in physical performance and mobility (through self report). If weight loss were to be combined with an increase in exercise and physical activity, obesity rates should decline and physical function could increase. Villareal et al. [56] examined the effects of a combined intervention on body weight in 27 obese older men and women. The intervention spanned six months and included weekly behavioral therapy to facilitate weight loss and exercise training 3 times per week. Each of the exercise sessions was supervised by a physical therapist and the main goals were to improve flexibility, endurance, strength, and balance. The exercise lasted 90 minutes and began with a 15 minute warm up of flexibility exercises, followed by 30 minutes of endurance exercise and 30 minutes of strength training, and the last 15 minutes consisted of balance exercises. Physical function was measured by strength, gait, and balance tests, and body composition was evaluated through dual energy x-ray absorptiometry. The results of the study show that subjects in the treatment group lost 8.4% (\pm 5.6%) of their body weight and the control group did not see any positive nor negative effects ($0.5\% \pm 2.8\%$) in their body weight at the end of the study ($p < 0.001$). The intervention group improved by 2.6 (\pm 1.6) points on their physical performance test score ($p < 0.001$). These results suggest that a weight loss and exercise intervention has strong influences on body weight management and physical function. This study

was not able to observe significant between group differences regarding physical function improvements nor was it completed in a community setting.

The combination of resistance training and weight loss could cause significant improvements in body composition and in physical performance measures. The goal of the study conducted by Avila et al. [57] was to evaluate the changes in body composition and physical performance measures as a result of a resistance training plus weight loss combination. The DASH diet was used as the dietary component and RT machines were utilized for resistance training. The primary outcomes of measure were body composition, mid-thigh composition, and muscle and physical function. The results of the study show that there were no differences between the two groups regarding weight loss. The DASH diet plus resistance training group had a greater reduction in body fat than the diet alone group (4.1 ± 0.9 vs. 0.2 ± 1 kg; $p = 0.005$). The resistance training group also so significant changes in strength (60 ± 18 vs -5 ± 9 N; $p = 0.008$) than the DASH diet alone group, along with larger increases in lean mass (0.8 ± 0.4 vs. -1.4 ± 0.4 ; $p = 0.002$). Both of the groups experienced significant decreases in 400 meter walk times with no differences between the groups. The combination of resistance training and the DASH diet resulted in significant improvements in physical function, muscle function, and positive changes in body composition. A limitation of this study was how there was a lack of a true control group in order to make comparisons.

Community-based interventions in obese older adults have yet to incorporate resistance training and dietary changes. The purpose of the next study done by Straight et al. [58] was to examine the effects of a community-based intervention that

incorporates resistance training and DASH diet on physical function and body composition in obese older adults. The study included a total of 95 overweight and obese older adults between the ages of 55 – 80 years old. The subjects were involved in an 8 week intervention that included resistance training sessions that met twice a week using elastic tubing and dumbbells, and a weekly dietary session on a modified DASH Diet. The primary outcome measures were body composition and physical function. The results of the study show that there were significant improvements in knee extensor torque (1.2 ± 1.8 kg: $p < 0.001$), handgrip strength (1.2 ± 2.5 kg: $p < 0.001$), and the 8-foot-timed-up-and-go test (0.56 ± 0.89 seconds: $p < 0.001$). The results of the study demonstrate that resistance training and dietary changes resulted in improved physical functioning and improved muscle strength in a community setting. This study combines resistance training and the DASH diet in older adults, however, this study did not incorporate an aerobic activity such as Tai Chi. However, this study also only took place over a short term of time (8 week time period).

Physical function decline is greatly associated with high rates of obesity. However, a weight loss program combined with moderate exercise could result in improved physical function and weight loss. Maintaining muscle strength is also an important factor as to reduce the chances of sarcopenic obesity occurring. The goal of the study by Anton et al. [54] was to evaluate a combination of exercise and weight management on physical function in older adults. The study included a total of 34 obese older (55 – 79 years of age) adults that were randomly assigned to two different groups for the 24-week period. There was a weight loss plus exercise group, and an educational control group. The weight loss plus exercise group was involved in group

based weight management sessions that met once a week, and an exercise program that met three times per week incorporating walking and lower body resistance training. The four major outcomes of the study were body weight, walking speed, knee extension strength, and the SPPB test. Scores on the SPPB improved in both exercise groups, and there were significant differences between groups ($p = 0.02$). The exercise plus weight loss group lost significantly more weight when compared to the educational control group (5.95 kg [$\pm .99$] vs. .23 kg [$\pm .99$]; $p < 0.01$). There were no significant changes in muscle strength in either group throughout the study. The results demonstrate that a weight loss program plus exercise can result in weight loss, improve physical function, and maintain muscle strength in the process. This study did not take place in a community setting nor did it have a racially diverse analytical sample.

Alone, Tai Chi results in improved physical function and fall risk reduction in older adults. However, Tai Chi has not yet been combined with a dietary weight loss program in older women. The study conducted by Katkowski et al. [59] examined the effects of Tai Chi in addition to a weight loss program on body composition and physical function in older women. The study included a total of 27 obese older women who were randomized into a Tai Chi plus weight loss group, or a weight loss only group. The dietary program met once a week using the DASH diet and the Tai Chi sessions met three times per week over the 16 week period. The results of the study showed that both of the groups lost a significant amount of body mass (Tai Chi: 2.2 kg \pm 0.9, Weight loss: 3.7 kg \pm .9; $p < 0.05$). There were tendencies for significant results between groups for leg strength ($p = 0.062$), grip strength ($p = 0.070$), timed up

and go test ($p = 0.069$), and fat free mass ($p = 0.056$). This study shows that Tai Chi results in significant weight loss when combined with a weight loss program. There are also trends that support that Tai Chi may have improved leg strength, grip strength, timed up and go test, and fat free mass. The results of this study showed trends of significant changes but the only statistically significant findings were weight loss and flexibility.

When weight loss occurs, there is a high risk of observing a decline in lean mass and muscle strength. This decline in lean body mass is referred to as sarcopenia and can cause impaired mobility in older adults. This portrays the importance of maintaining lean mass throughout weight loss. The review article by Delmonico et al. [60] depicted the importance of resistance training during a weight loss intervention. Although weight loss is recommended for overweight and obese adults to reduce risk of disease, exercise is a valuable addition to weight loss than can result in greater loss of weight and conservation of lean body mass. Resistance training is a well-known exercise modality that improves muscle strength and physical function. When combined with weight loss, resistance training has shown to be an effective method for the retention of lean body mass, improved physical function, and weight loss. The combination of intervention modalities elicits significant results, although, the long-term health benefits of resistance training and weight loss combined are unknown.

Conclusion

Obesity is a growing health problem and is a risk factor for numerous conditions and diseases that can lead to impaired mobility, decreased physical function, and decreased muscle strength. Older minority women have the greatest

prevalence of obesity and are consequently, at greater risk of developing the diseases and conditions associated with obesity. The primary method to reduce the effects of obesity is to initiate weight loss through different modalities. However, throughout weight loss there can be negative effects on physical function and muscle strength. Physical function and muscle strength are two key indicators of physical performance and are associated with overall quality of life. Changes in diet can result in significant weight loss; however, diet alone can result in a loss of lean mass as well. Resistance training is an exercise modality that can be used to increase physical function, and aid in the conservation of lean body mass. Tai Chi is another exercise mode that is considered aerobic and has the same beneficial results when compared to walking. There have been very limited studies that have combined diet, resistance training, and Tai Chi as an intervention method. The studies that have looked at combined interventions have shown to illicit significant improvements in function and muscle strength. However, this combination has yet to be examined in older women, older minority women, and has yet to be done in a community setting.

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Appendix B: Consent Form for Research

Initial ____ Date ____ Page 1 of 6

The University of Rhode Island
Department of Kinesiology
25 West Independence Way, Suite P, Kingston, RI 02881
Department of Nutrition & Food Sciences
106 Ranger Hall, Kingston, RI 02881

Department of Communicative Disorders
201 Fernwood Building, Kingston, RI 02881

CONSENT FORM FOR RESEARCH

Title of Project: A community-based exercise and dietary intervention program in obese women at an urban Rhode Island senior center

Purpose of the Consent:

You are invited to take part in the research project described below. The researchers will explain the project to you in detail. You should feel free to ask questions. If you have more questions later, Drs. Matthew Delmonico (401-874-5440), Ingrid Lofgren (401-874-5706), Furong Xu (401-874-2412), and Leslie Mahler (401-874-2490) from the Departments of Kinesiology, Nutrition and Food Sciences, and Communicative Disorders at the University of Rhode Island, the persons mainly responsible for this study, will discuss them with you. Individuals may be able to participate if they have/are 1) female, 2) age 50-80 years, 3) a body mass index (BMI) of 30-50 kg/m², 4) no recent medication changes, 5) post-menopausal, and 6) free of diseases or conditions that would prevent safe changes in diet and/or participation in an exercise program.

Description of the project:

This is a research project designed to assess the role that a 12-week Tai Chi and resistance exercise training program plays in improving physical functioning, muscle mass, fat mass, and improving heart disease risk factors when combined with a dietary intervention to improve dietary intakes. Tai Chi, a form of martial arts that is a slow and low-impact exercise, and resistance training (RT) have been shown to be effective for improving health outcomes in older women, including physical functioning. Another purpose of the study will be to assess the influence of intentional dietary changes with Tai Chi and resistance exercise training on changes in cognitive function, sleep quality, blood pressure, blood fats and sugar metabolism, muscle function, and other important health-related measures. Your participation will vary depending on which group you are assigned to. However, the study may require your participation of about 4 hours per week. All of the testing and intervention sessions will take place at the St. Martin de Porres Center. You are responsible for your own transportation to all of the testing and intervention sessions.

What will be done:

You understand that if you choose to participate, the study requires your involvement in three phases.

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PHASE 1: During the first phase, you will undergo preliminary testing (two visits, 1-2 hours per visit). At the first testing visit, your blood pressure, height, weight, waist and hip girths, body composition, muscle strength, and ability to complete selected tasks similar to common activities of daily living will be assessed during this first phase. These activities of daily living tasks include rising from a chair, standing balance tests, and short (4-meter) brisk walks. Any risk of injury during the completion of these tasks will be minimized by having all sessions supervised by an exercise physiologist qualified to direct this type of testing. In addition, you will be asked to complete several questionnaires that will take only 30-40 minutes. These include a dietary screening tool, a physical activity survey, a social support survey, a sleep quality questionnaire, balance questionnaires, life and body satisfaction surveys, and resiliency surveys. You will also complete one finger stick that will be used to analyze blood sugar, fats, and cholesterol. Analysis of blood will be conducted using a portable Cholestech machine. For the 12 hours prior to the finger sticks, you will be asked to refrain from eating and/or drinking anything, unless it is plain water. For example, if your finger sticks are scheduled for 8:00 am on a Wednesday, you are asked to not eat and/or drink anything besides plain water after 8:00 pm on Tuesday evening. We do encourage you to drink as much plain water as you would like. The total amount of blood drawn for these tests over the course of the study will be equivalent to less than one teaspoon.

At testing visit 2, a brief cognitive screening test will be administered that will take 30 minutes. The screening tasks include list learning, naming, short-term recall, figure drawing, and coding.

You understand that trained personnel, using universal precautions and established methods, will conduct these finger sticks. You understand that the finger stick requires a very small amount of blood. You understand that there is a risk of bruising, pain, and in rare cases, infection or fainting as a result of blood sampling. However, these risks to you will be minimized by allowing only trained people to draw your blood.

You understand that strength assessments will be performed using portable devices that measure how much force you can exert force through a typical knee extension motion and your grip strength. You understand that you may experience some temporary muscle soreness as a result of the muscle testing. There is also a risk of muscle soreness or skeletal injury from strength testing as well as from exercise training. The investigators of this study will use procedures designed to minimize this risk. The flexibility of your leg muscles will also be tested by using a simple test that requires you to attempt to touch your toes while seated.

Your percent body fat will be performed using a battery-powered, portable device that uses a very low electrical current (~ 50 kHz) in order to estimate fat mass and percentage body fat. This test only takes about 20 seconds to complete but is a valid and reliable measure of body composition with very few risks. Even though the risk is low, as a precaution, individuals with a pacemaker will not be tested on the device.

At the end of the first phase (testing), you will be assigned to either the exercise (Tai Chi and resistance training) plus dietary group or to a waitlist control group based on group availability.

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PHASE 2: INTERVENTION

Dietary Sessions (Exercise plus Healthy Diet Group)

For those assigned to this intervention, you will be asked to participate in a dietary intervention designed to improve your diet. You will be instructed on how to change your diet to increase fruit, vegetable, whole grain, and monounsaturated fat intakes with reductions in saturated/trans fats, refined carbohydrates, and sodium by the end of 12-week protocol as measured by the dietary questionnaires. At the senior center, you will meet in a group (~15-25 other participants) with an expert in nutrition once per week (~45 minutes per session) for 12 weeks who will give you instructions and expert advice on food selection, preparation, and other dietary changes. Body weight will be monitored periodically, and you will be instructed to keep careful records of your food intake.

Exercise Sessions (Exercise plus Healthy Diet Group)

Tai Chi. If you are assigned to the diet plus exercise group, you will also be asked to participate in three (3) supervised exercise sessions per week (~40 minutes per visit) for the 12-week intervention in your local senior center. Tai Chi is considered a soft form of Chinese martial arts (not for self-defense) that incorporates slow and low-impact exercise movements while you are standing on your feet. You will be asked to come to an assigned room at the senior center. During these sessions, you will receive instructions from trained exercise staff and will undergo Tai Chi exercise training using a modified Tai Chi protocol specifically designed for older adults. Your progress will be monitored and you will always be instructed by an exercise specialist regarding the proper form for Tai Chi techniques. No special clothing is required. You will also be instructed to stop exercising immediately if you experience chest pain, muscle injuries, or any other unexpected symptoms. Although you will always have supervision when doing Tai Chi and other exercise training during this study, if you ever experience chest pain while exercising at other times, you should immediately call 911 to seek emergency care and notify your primary care physician. If you have any problems or injuries, you should also notify a member of the study team. Study team members and their phone numbers are noted on the first page of this consent form.

During each Tai Chi exercise training session you will be asked to exercise for approximately 40 minutes per session. All sessions will start with a brief warm-up. The first several Tai Chi training sessions will begin with lighter intensities focusing on learning different Tai Chi movements. The difficulty will be gradually increased based on individual progress. The difficulty of the Tai Chi exercise will be adjusted so that you are exercising at an effort level that is judged to be appropriate to improve your fitness level. Your blood pressure will also be measured at the start of each training session. You will be able to provide feedback using standardized pain and discomfort rating scales. Your overall progress will be monitored by an exercise specialist so that you are able to tolerate the exercise. Each session will end with a final blood pressure measurement and 5-10 minutes of stretching. You will be given printed diagrams and a DVD of the Tai Chi exercises so that you may practice the movements on your own between exercise sessions if you choose. Once you have mastered several of the movements, we will encourage you to practice Tai

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Chi on your own, and we will have you keep a journal of any extra Tai Chi practice that you perform.

Resistance Training. On two of the days that you participate in Tai Chi, you will be asked to do some additional exercises using basic resistance exercise training equipment (for example, rubber bands), which offers resistance against extending and flexing your arms, legs, and trunk region for approximately 20 minutes. All sessions will start with a brief warm-up that will be achieved by doing the Tai Chi exercise. The first several resistance training sessions will begin with lighter resistances to get you used to the resistance training program. Your overall progress will be monitored by an exercise specialist so that you are able to tolerate the exercise.

Control Group

If there is no space available in the exercise plus diet group, you understand that you may be assigned to the “waitlist control” group. If you are assigned to this group, we will ask you to participate in the baseline (phase 1) and follow-up (phase 3) testing phases, but you will not be participating in the 12-week intervention (phase 2). However, by serving as a control participant you will receive the results of your health-related testing and the other participation incentives that the intervention group will receive. Additionally, as another incentive once the follow-up testing is complete, we will offer you the dietary materials, six supervised Tai Chi exercise sessions, and four resistance training sessions at the St. Martin de Porres Center along with the Tai Chi DVD so that you may continue to practice Tai Chi. These Tai Chi sessions will be very similar to the sessions conducted as part of the Tai Chi plus healthy diet group and are intended to give all participants the opportunity to learn Tai Chi. You understand that participation in these sessions is not part of the research investigation and is optional.

PHASE 3: The third and final phase will be a repeat of all previously taken measures from Phase 1 after the completion of the 12 week intervention. All data will be coded with a study number and stored only at the University of Rhode Island without any personal identifiers (including initials or birth dates) to ensure confidentiality. You will receive a copy of your results 2-3 months after the study is complete, although some of the results will be available immediately.

Risks or discomfort:

You understand that it is possible that heart, blood vessel, or other health problems could arise during your participation in the testing or training involved in this study. Although highly unusual, it is possible that these problems could lead to a heart attack or even death. Therefore, prior evaluation and written clearance with a signature from your personal physician is strongly recommended, but not required, to participate in this study. The St. Martin de Porres center may also require that you sign their liability waiver prior to participation. You also understand that it is possible that these risks will not be eliminated completely, even with a medical evaluation prior to participation in the study. However, the investigators believe the risk of harm from study participation is small and that the benefits of the study will likely outweigh any potential risks. Additionally, you understand that with the

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testing described above, Tai Chi, resistance training, and exercise in general there is a risk of muscle soreness or other muscle injury as well as skeletal injury. Because Tai Chi does require some degree of balance, there is also a risk of falling associated with this type of exercise. However, the investigators will take precautions in order to reduce the likelihood that these adverse events will occur.

In case there is any injury to the participant:

In the event of physical injury resulting from participation in this study, upon your consent, emergency treatment will be available at the nearest local hospital with the understanding that any injury that required medical attention becomes your financial responsibility. You understand that the University of Rhode Island at Kingston will not provide any medical or hospitalization insurance coverage for participants in this research study, nor will they provide compensation for any injury sustained as a result of this research study, except as required by law.

You understand that if you are injured while participating in this research project as a result of negligence of state employees who are involved in this research project, you may be able to be compensated for your injuries in accordance with the requirements of the Federal Tort Claims Act. If you are a federal employee acting within the scope of your employment, you may be entitled to benefits in accordance with the Federal Employees Compensation Act.

Confidentiality:

All information collected in this study is confidential, and your name will not be identified and linked to any study data at any time to anyone other than the principal investigators of the study. Your data will be coded with an ID number only, which will be linked back to you only by the principal investigators of the study. All study data, including this consent form, will be locked in a file cabinet and also stored in a study computer with a password secured in our study office (Independence Square building, room 120). Study records are retained securely for ten years after the study ends.

Benefits of this study:

You understand that although this study may help you personally, it may also help the investigators better understand which interventions are the most effective in helping obese older women improve their physical function, body composition, and heart disease risk factors. However, because of what is already known regarding the individual effects of a healthy diet and exercise training, it is likely that you will notice some benefits. These potential benefits include increased understanding of nutrition, a reduction in overall weight and body fat, and improved mobility.

For your participation in the study and after the study is completed, you will receive, free of charge, information about your blood pressure, blood test results, body composition, muscle strength, and physical function.

Compensation:

You will receive a \$20 supermarket gift card and a study t-shirt for your participation at the end of the study.

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Decision to quit at any time:

You understand that it is your decision and your decision alone whether or not you consent to participate in this study. You are free to ask questions about this study before you decide whether or not to consent to participate. Also, if you consent to participate in the study you are free to withdraw from participation at any time without penalty or coercion, or without any requirement that you provide an explanation to anyone of your decision to withdraw. If you wish to quit, simply inform one of the principal investigators listed in the next section of this consent.

Rights and Complaints:

If you are not satisfied with the way this study is performed, you may discuss your complaints with the principal investigators, Drs. Matthew Delmonico at (401) 874-5440, Ingrid Lofgren at (401) 874-5869, Furong Xu (401) 874-2412, or Leslie Mahler (401) 874-2490 (anonymously, if you choose). In addition, if this study causes you any injury or if you have questions about your rights as a research participant you may contact the office of the Vice President of Research, 70 Lower College Road, Suite 2, University of Rhode Island, Kingston, Rhode Island; telephone: (401) 874-4328.

Alternatives to study participation: You understand that you might achieve similar results by another method i.e., another healthy diet plan and other exercise programs, which may be discussed with your physician. If you choose not to participate in this study, you are encouraged to discuss with your physician about healthy diet and exercise strategies.

You have read and understand the above information in the Consent Form and have been given adequate opportunity to ask the investigators any questions you have about the study. Your questions, if any, have been answered by the investigators to your satisfaction. Your signature on this form means that you understand the information and you agree to voluntarily participate in this study.

Signature of Participant

Signature of Researcher

Typed/printed Name

Typed/printed name

Date

Date

Please sign both consent forms, keeping one for you.

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Appendix C: Phone Screening

Subject Name: _____ Eligible to Participate: ___ Yes ___ No
Date of Interview: _____ _____ Need More Information or Review

THE UNIVERSITY OF RHODE ISLAND DIETARY EDUCATION AND ACTIVE LIFESTYLE (UR-IDEAL) STUDY – PHASE 6

Data Sheet for Detailed Subject Telephone Interview

- Brief Explanation of Study
 Permission to Conduct Interview? ___ Yes ___ No

Comment: _____

Contact Information

Name: Dr./Ms./Mrs. _____

Address: _____

Phone #: _____

E-Mail: _____

Best Way and Time to Contact: _____

• Time Commitment – Available

___ Yes ___ No Wants to be contacted after _____ (Date) Comment: _____

• Proximity to St. Martin de Porres Senior Center

Length of commute: _____ miles or _____ minutes

Mode of Transportation: _____

If Bus: Do you have a bus pass? _____ How many buses does it take to get to the center? _____

Is this a financial burden? _____

• Age

Age: _____ yrs Date of Birth: _____ / _____ / _____
MM DD YY

Approximate Height: _____ Approximate Weight: _____

Calculated BMI: _____

• Race

- ___ American Indian or Alaskan Native
___ Asian or Pacific Islander
___ Black, not of Hispanic origin
___ Hispanic
___ White, not of Hispanic origin
___ Other/Unknown

Name: _____

2

• **Highest level of education completed**

- Less than high school
- High school or GED
- Some college
- Two-year college degree (e.g. Associates)
- Four-year college degree (e.g. B.S., B.A.)
- Masters degree
- Doctoral degree
- Professional degree (e.g. M.D., J.D.)
- Other (please specify) _____

• **Smoking**

Always Non-Smoker _____ Non-Smoker for _____ Smoker _____

• **Physical Activity**

Participates in regular (>1x/wk for past 3 months) exercise? Yes No

If yes, describe in detail (e.g. frequency, intensity, duration, mode)

Describe other non-structure physical activity (e.g. leisure time, gardening, occupational, or other)

• **Cardiovascular (heart, blood, or blood vessel) conditions?**

No Yes (Record on Medical History/Treatment Form)

Comments: _____

• **Respiratory Conditions?**

No Yes (Record on Medical History/Treatment Form)

Comments: _____

• **Osteoarthritis/Degenerative Arthritis**

No Yes

If yes, how long and what was the severity _____

• **High Blood Pressure**

No _____

Yes _____ Controlled (Record High BP and Treatment on Medical History/Treatment Form)

Yes _____ Uncontrolled

Comments: _____

Name: _____

3

• **Lower Back Pain or other orthopedic conditions (knee, neck, or other back pain)**

No Yes

If yes, describe including severity

• **Frailty**

Fractures (wrist, hip, spine) as adult? Yes No

If yes, describe: _____

≥ 2 Falls in One Year? Yes No

If yes, describe: _____

• **Diabetes**

No

Yes – Type 2. If type 2, taking insulin now? _____

Yes – Type 1 (Insulin Dependent)

Comments: _____

• **Orthopedic Conditions? (knee, neck, or back pain)**

No

Yes (Record on Medical History/Treatment Form)

Comments: _____

• **Major surgeries as an adult?**

No Yes

If yes, what type (e.g. surgeries of the joints, heart surgeries, angioplasty, bypass surgery, pacemakers, etc.) and date(s)

• **Other Medical Conditions (especially those that would make exercise difficult or unsafe)**

No

Yes (Record on Medical History/Treatment Form)

Comments: _____

• **Medication Info – See last page**

No

Yes (Record on Medical History/Treatment Form)

Comments: _____

Name: _____

4

• **Personal Physician Info**

Name of Physician: _____

Specialty of Physician: _____

Phone Number: _____

Fax Number: _____

Address (if phone and fax unknown): _____

• **Summary**

Interviewer Printed Name: _____

Interviewer Signature: _____

Questions/ Comments: _____

Reviewer Initials: _____

____ Appears to Qualify

____ Needs Drs. Delmonico, Xu, or Lofgren to review

____ Need More Information

____ Not Qualified

Questions/ Comments: _____

Appendix D: Medical History

MEDICAL HISTORY The University of Rhode Island Dietary Education and Active Lifestyle (UR-IDEAL) Study

Name: _____ Initials: ___ ___ ___ ID#: _____

Name of Interviewer: _____ Date: _____

Emergency contact name and address & phone: _____

DIRECTIONS: Read the following questions out loud to each prospective volunteer and check "yes" or "no". Any answers that require qualification should be written in the space below the question or on the back of the sheet.

YES NO

SECTION A

Musculoskeletal system:

Have you ever been told by your doctor that you have any of the following?

- | | | |
|---|-------|-------|
| a. Osteoarthritis or degenerative arthritis | _____ | _____ |
| b. Rheumatoid arthritis | _____ | _____ |
| c. Osteoporosis | _____ | _____ |
| d. Ankylosing Spondylitis | _____ | _____ |
| e. Unknown or other type of arthritis | _____ | _____ |
| f. Any other disease of joint or muscle: | _____ | _____ |

Comments: _____

SECTION B

Cardiovascular system:	YES	NO
1. Has any family member had a heart attack prior to the age of 55? If so, how are they related to you?	_____	_____
2. Have you ever had frequent cramping in your legs while resting? If yes, is it a current problem?	_____	_____
3. Have you ever had pain or cramping in your legs while walking? If yes, is it a current problem?	_____	_____
4. If yes, is this pain relieved by rest or by discontinuing walking?	_____	_____
5. Have you ever been told that you have high blood pressure If yes, a. What was the date of onset? Diagnosis _____ b. Were you given any medications?	_____	_____
6. Did a doctor ever tell you that you had a heart problem? If yes: a. What was the date of onset? Diagnosis _____ b. What did the doctor call it? Angina, heart failure, heart attack, rhythm disturbances, heart murmurs, enlarged heart, diseases of heart valves, others. Were you given any medications? Abbreviation, another name? _____	_____	_____

10. Have you ever had any chest pain or discomfort other than breast pain **YES** **NO**
 or pain and discomfort due to a respiratory or digestive problem? _____

If yes,

a. What was the month and year of the first occurrence? _____

b. What was the month and year of the most recent occurrence? _____

c. How would you describe the pain or discomfort? Pressure, burning,
 squeezing, piercing, stabbing, shooting or sticking. _____

d. How many minutes did it last? _____

e. Does the pain or discomfort move? If yes, to where? _____

If yes, to where? _____

Does the pain or discomfort tend to occur:

After meals- _____

At night- _____

When Exercising- _____

When walking in cold windy weather- _____

When upset, excited or nervous- _____

Other- _____

f. Is this pain relieved by

A change in posture- _____

Rest- _____

Physical activity- _____

Bicarbonate of soda, Tums or antacids- _____

Prescribed medications- _____

YES **NO**

g. Did you ever consult a doctor for this pain or discomfort? _____

If yes,

What was the diagnosis?

Were you given any medications?

11. Do you have any history of high cholesterol in your blood as evident by
previous blood lipid tests? _____

Comments: _____

SECTION C

Respiratory System:

1. Have you ever had attacks of wheezing? _____

If yes,

a. Is it seasonal/periodic? _____

b. Have you ever-required hospitalization to treat an acute attack? _____

2. Has your doctor ever told you that you have any respiratory or lung disease? _____

a. If yes, please describe

Comments: _____

SECTION D

YES NO

Endocrine system:

Have you ever had any of the following symptoms?

- a. Thyroid problems? _____
- b. Adrenal problems? _____
- c. Diabetes mellitus? _____

If yes, which type? Type 1 or Type 2 _____

Date of onset- _____

Were you on any medication, diet controlled? _____

SECTION E

Reproductive system:

Menstrual History

- a. Have you attained menopause? _____

If so, move on to question b & c, then to section F. If no, proceed to section F.

- b. Are you on Hormone Replacement Therapy? _____

- c. Approximate date of last menstrual period? _____

Comments: _____

SECTION F

YES NO

Neurological system:

- | | | |
|--|-------|-------|
| 1. Do you have any significant problems with your memory? | _____ | _____ |
| a. When answering the telephone, do you recall
what you were doing before it rang? | _____ | _____ |
| b. Can you give the directions to your house/apartment? | _____ | _____ |
| c. Can you keep appointments without a reminder? | _____ | _____ |
| d. Can you remember what clothes you wore yesterday? | _____ | _____ |
| 2. Any problems with vision other than corrective lens changes? | _____ | _____ |
| If yes, which of the following conditions- Blindness, temporary loss
of vision, double vision, glaucoma, cataract, macular degeneration
or others. | | |

Do you have:

- | | | |
|---|-------|-------|
| 3. Ringing in your ears? | _____ | _____ |
| 4. Faintness (other than feeling faint when changing posture) | _____ | _____ |
| 5. Vertigo (a feeling of spinning, or unsteadiness) | _____ | _____ |
| 6. Fainting Spells (black outs)? | _____ | _____ |
| 7. Seizure or convulsions? | _____ | _____ |
| 8. Migraine or severe headaches? | _____ | _____ |
| 9. Paralysis of arm or leg? | _____ | _____ |
| 10. A head injury with loss of consciousness? | _____ | _____ |
| 11. Pain, numbness or tingling in your arm or hand? | _____ | _____ |
| 12. Pain in your lower back? | _____ | _____ |

	YES	NO
13. Kidney stones?	_____	_____
14. Ruptured vertebral disc in neck or back?	_____	_____
15. Do you have pain in any part of body including headaches while exercising?	_____	_____
16. Numbness or pain in your legs?	_____	_____
17. Have you been told that you have a peripheral neuropathy?	_____	_____
18. Tremors?	_____	_____
19. Problems with walking? If yes,	_____	_____
a. Do you fall frequently?	_____	_____
b. Is your walking problem related to pain, weakness or loss of balance?	_____	_____
20. Parkinson's disease?	_____	_____
21. Stroke?	_____	_____
22. Epilepsy?	_____	_____
23. Have you ever had an operation on skull or brain?	_____	_____
24. Do you have multiple sclerosis?	_____	_____
25. Have you ever had meningitis or Brain fever?	_____	_____
26. Any history of neurological consultation?	_____	_____

Comments: _____

SECTION H

Hematology/Immunology/Oncology:

YES NO

- | | | |
|---|-------|-------|
| 1. Have you ever been told by your physician that you had a problem with anemia or any disease of the red blood cells or the white blood cells? | _____ | _____ |
| 2. Any family history of this problem? | _____ | _____ |
| 3. Do you have any history of bleeding disorders? | _____ | _____ |
| 4. Have you ever been diagnosed as having cancer?
If yes, what type, which site, date of onset? _____ | _____ | _____ |
| 5. Were you given any medications, radiation or undergone any surgery? | _____ | _____ |

Comments: _____

SECTION I

Surgical History:

- | | | |
|--|-------|-------|
| Have you undergone any surgeries as an adult?
If yes, | _____ | _____ |
| a. Where and for what purpose? | | |
| b. Date of Surgery? | | |
| c. Length of stay in hospital | | |
| d. Any complications of Surgery? | | |

Comments: _____

	YES	NO
Have you ever been diagnosed with an abdominal aneurysm?	_____	_____
Do you have a: History of severe pain in the abdomen? If yes, Please specify	_____	_____
Do you have a history of severe headache?	_____	_____
If Yes, What was the date of onset? _____		
Was it associated with neurological signs like blurred vision, nausea/vomiting, seizures, drowsiness, memory impairment, sensory or motor loss(weakness)?		
Was it a new or different type of headache other than tension, migraine etc?		
Was it the worst ever experienced?	_____	_____
Did it occur after exertion, coughing or straining?	_____	_____

SECTION J

Do you have any other health problems not covered in this questionnaire? _____

If yes, please do specify.

Comments: _____

Appendix E: Medical Clearance

_____ has volunteered to participate in a healthy diet plus exercise study entitled "A community-based Tai Chi and weight loss study in obese women at Rhode Island senior centers." It is strongly recommended that volunteers have the clearance of her physician to participate in this study.

The aim of this study is to evaluate the impact of a 12-week Tai Chi and resistance training exercise program when combined with a healthy diet intervention (Dietary Approaches to Stop Hypertension-based diet) in obese (BMI: 30.0-50.0 kg/m²) older women aged 50-80 years.

Exclusionary criteria for eligibility (Please check any that apply):

- Significant or suspected cognitive impairment
- Significant cardiovascular disease
- Severe hearing loss, speech disorder, language barrier or visual impairment
- Progressive, degenerative neurologic disease
- Terminal illness with life expectancy of < 12 months, as determined by a physician
- Severe pulmonary disease, uncontrolled diabetes, blood pressure, or anemia
- Inability to safely engage in mild to moderate exercise with muscular exertion
- Not within age range for study (50-80 years)
- Medications not taken for > 3 weeks, lipid lowering medications for > 6 months
- Major joint, vascular, abdominal, or thoracic surgery within six months

Although we are unaware of any cardiac complications that have resulted from Tai Chi, resistance training, strength or physical functioning testing, there is only a limited amount of data available in older adults.

Please check one of the following:

- Clearance granted
- Clearance not granted
- Please send me the following information about the study:

Volunteers will either participate (at the St. Martin de Porres Senior Center) in 1) a 12-week dietary program plus Tai Chi (a low-impact martial art) and resistance exercise training or 2) a waitlist control group. Both groups will be under the supervision of exercise specialists trained specifically for this study under the direction of the Principal Investigators, Matthew J. Delmonico, PhD, MPH, Department of Kinesiology, University of Rhode Island, Ph: (401) 874-5440, Ingrid E. Lofgren, PhD, MPH, RD, Department of Nutrition and Food Sciences, University of Rhode Island, Ph: (401) 874-5706, Furong Xu, PhD, Department of Kinesiology, Room 215, University of Rhode Island, Ph: (401) 874-2412, and Leslie Mahler, PhD, CCC-SLP, Ph: (401) 874-2490.

Physician's name: _____

Physician's signature: _____

Date _____

Appendix F: Yale Physical Activity Scale

YALE PHYSICAL ACTIVITY SCALE

Interviewer: I will ask you about some common types of physical activities. Please tell me if you did them during a **typical week in the last month**. Our interest is learning about the types of physical activities that are a part of your regular work and leisure routines.
For each activity you did, please tell me how many **hours** you spent doing the activity **during a typical week**.

Work: (Number of hours per week)

1. ____ Shopping (e.g., grocery, clothes)
2. ____ Stair climbing while carrying a load
3. ____ Laundry (time loading, unloading, hanging, folding only)
4. ____ Light housework: tidying, dusting, sweeping; collecting trash in home; polishing; indoor gardening; ironing
1. ____ Heavy housework: vacuuming, mopping; scrubbing floors and walls; moving furniture, boxes, or garbage cans
6. ____ Food preparation (10+ minutes in duration): chopping, stirring, moving about to get food items, pans
7. ____ Food service (10+ minutes in duration): setting table; carrying food; serving food
8. ____ Dish washing (10+ minutes in duration): clearing table; washing/drying dishes, putting dishes away
9. ____ Light home repair: small appliance repair; light home maintenance/repair
10. ____ Heavy home repair: painting, carpentry, washing/polishing car
11. ____ Other: _____

Yard work: (Number of hours per week)

12. ____ Gardening: planting, weeding, digging, hoeing
13. ____ Lawn mowing (walking only)
14. ____ Clearing walks/driveway: sweeping, shoveling, raking
15. ____ Other: _____

Caretaking: (Number of hours per week)

16. ____ Older or disabled person (lifting, pushing wheelchair)
17. ____ Childcare (lifting, carrying, pushing stroller)

Exercise: (Number of hours per week)

18. ____ Brisk walking (10+ minutes in duration)
19. ____ Pool exercise, stretching, yoga
20. ____ Vigorous calisthenics, aerobics
21. ____ Cycling, exercycle
22. ____ Swimming (laps only)
23. ____ Other: _____

Recreational Activities: (Number of hours per week)

24. ____ Leisurely walking (10+ minutes in duration)
25. ____ Needlework: knitting, sewing, needlepoint, etc.
26. ____ Dancing (mod/fast): line, ballroom, tap, square, etc.
27. ____ Bowling, boccie
28. ____ Golf (walking to each hole only)
29. ____ Racquet sports: tennis, racquetball
30. ____ Billiards
31. ____ Other: _____

5.6.08

YALE PART 2

Now I would like to ask about certain types of activities that you have done *during the past month*. I will ask you about how much vigorous activity, leisurely walking, sitting, standing, and other things that you usually do.

32. About how many times during the month did you participate in vigorous activities that lasted at least 10 minutes and caused large increases in breathing, heart rate, or leg fatigue or caused you to sweat?

Not at all (go to Q34)	1-3 Times Per Month	1-2 Times Per Week	3-4 Times Per Week	5 or more Times Per Week
---------------------------	------------------------	-----------------------	-----------------------	-----------------------------

33. About how long do you do this vigorous activity each time?

Not applicable	10-30 minutes	31-60 minutes	60 or more minutes
----------------	------------------	------------------	-----------------------

34. Think about the walks you have taken during the past month. About how many times per month did you walk for at least 10 minutes or more without stopping which was not strenuous enough to cause large increases in breathing, heart rate, or leg fatigue or cause you to sweat?

Not at all (go to Q36)	1-3 Times Per Month	1-2 Times Per Week	3-4 Times Per Week	5 or more Times Per Week
---------------------------	------------------------	-----------------------	-----------------------	-----------------------------

35. When you did this walking, for how many minutes did you do it?

Not applicable	10-30 minutes	31-60 minutes	60 or more minutes
----------------	------------------	------------------	-----------------------

36. About how many hours a day do you spend moving around on your feet while doing things? Please report only the time that you are *actually moving*.

Not at all	Less than 1 hr per day	1 to less than 3 hrs per day	3 to less than 5 hrs per day	5 to less than 7 hrs per day	7 + hrs per day
------------	------------------------------	------------------------------------	------------------------------------	---------------------------------	--------------------

37. Think about how much time you spend standing or moving around on your feet on an average day during the past month. About how many hours per day do you *stand*?

Not at all	Less than 1 hr per day	1 to less than 3 hrs per day	3 to less than 5 hrs per day	5 to less than 7 hrs per day	7 + hrs per day
------------	------------------------------	------------------------------------	---------------------------------	------------------------------------	--------------------

5.6.08

38. About how many hours did you spend sitting on an average day during the past month?

Not at all	Less than 3hrs	3 hrs to less than 6 hrs	6hrs to less than 8 hrs	8 + hrs
------------	----------------	--------------------------	-------------------------	---------

39. About how many flights of stairs do you climb up each day?
(Let 10 steps = 1 flight) _____

40. Please compare the amount of physical activity that you do during other seasons of the year with the amount of activity you just reported for a typical week in the past month. For example, in the summer, do you do more or less activity than what you reported doing in the past month?
(Interviewer – mark the right category for each season)

	Lot more	Little more	Same	Little less	Lot less
Spring	1.3	1.15	0	.85	.7
Summer	1.3	1.15	0	.85	.7
Fall	1.3	1.15	0	.85	.7
Winter	1.3	1.15	0	.85	.7

5.6.08

Appendix G: Dietary Screening Tool

Dietary Screening Tool

DIRECTIONS: Please check one response to each question that best describes how you eat.

How often do you usually eat fruit as a snack?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you usually eat whole grain breads?

- Never or less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you usually eat whole grain cereals?

- Never or less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you usually eat candy or chocolate?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat crackers, pretzels, chips, or popcorn?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat cakes or pies?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat cookies?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat ice cream?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat cold cuts, hot dogs, lunchmeats or deli meats?

- Never or less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat bacon or sausage?

- Never or less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat carrots, sweet potatoes, broccoli, or spinach?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 or more times a week

How often do you eat fruit (not including juice)? Please include fresh, canned or frozen fruit.

- Never or Less than once a week
- 1 or 2 times a week
- 3 to 5 times a week
- Every day or almost every day

How often do you eat hot or cold breakfast cereal?

- Never
- Less than once a week
- 1 or 2 times a week
- 3 to 5 times a week
- Every day or almost every day

How often do you drink some kind of juice at breakfast?

- Never or Less than once a week
- 1 or 2 times a week
- 3 to 5 times a week
- Every day or almost every day

How often do you eat chicken or turkey?

- Never or less than once a week
- 1 or 2 times a week
- More than 3 times a week

How often do you drink a glass of milk?

- Never or Less than once a week
- 1 or 2 times a week
- 3 to 5 times a week
- Every day or almost every day
- More than once every day

Do you usually add butter or margarine to foods like bread, rolls, or biscuits?

- Yes
- No

Do you usually add fat (butter, margarine or oil) to potatoes and other vegetables?

- Yes
- No

Do you use gravy (when available) at meals?

- Yes
- No

Do you usually add sugar or honey to sweeten your coffee or tea?

- Yes
- No

Do you usually drink wine, beer or other alcoholic beverages?

- Yes
- No

How often do you eat fish or seafood that IS NOT fried?

- Never
- Less than once a week
- Once a week
- More than once a week

How many servings of milk, cheese, or yogurt do you usually have each DAY?

- None
- One
- Two or more

How many different vegetable servings do you usually have at your main meal of the day?

- None
- One
- Two
- Three or more

Which of the following best describes your nutritional supplement use.

- I don't use supplements
- I use supplements other than vitamins and mineral
- I use a multivitamin/mineral preparation (e.g. Centrum)

Appendix H: Data Collection Sheet

SPPB

BALANCE SCORING:

- **A. Side-by-side-stand**
 - Held for 10 sec 1 point
 - Not held for 10 sec 0 points
 - Number of seconds held if less than 10 sec: ____sec
 - Not attempted 0 points
 - If participant did not attempt test or failed, check why:
 - Participant could not walk unassisted
 - Not attempted, you felt unsafe
 - Not attempted, participant felt unsafe
 - Participant unable to understand instructions
 - Other (Specify)
 - Participant refused
 - **If 0 points, end Balance Tests**

- **B. Semi-Tandem Stand**
 - Held for 10 sec 1 point
 - Not held for 10 sec 0 points
 - Number of seconds held if less than 10 sec: ____sec
 - Not attempted 0 points
 - If participant did not attempt test or failed, check why:
 - Participant could not walk unassisted
 - Not attempted, you felt unsafe
 - Not attempted, participant felt unsafe
 - Participant unable to understand instructions
 - Other (Specify)
 - Participant refused
 - **If 0 points, end Balance Tests**

- **C. Tandem Stand**
 - Held for 10 sec 2 points
 - Held for 3 to 9.99 sec 1 point
 - Held for < than 3 sec 0 points
 - Not attempted 0 points
 - If participant did not attempt test or failed, check why:
 - Participant could not walk unassisted
 - Not attempted, you felt unsafe
 - Not attempted, participant felt unsafe
 - Participant unable to understand instructions

- Other (Specify)
- Participant refused
- **D. Total Balance Tests score _____(sum points)**
- Comments:

GAIT SPEED TEST SCORING:

- Length of walk test course: Four meters
- **A. Time for First Gait Speed Test (sec)**
 - Time for 4 meters ____sec
 - If participant did not attempt test or failed, check why:
 - Tried but unable
 - Participant could not walk unassisted
 - Not attempted, you felt unsafe
 - Not attempted, participant felt unsafe
 - Participant unable to understand instructions
 - Other (Specify)
 - Participant refused
 - Aids for first walk.....None Cane Other
- **B. Time for Second Gait Speed Test**
 - 1. Time for 4 meters ____sec
 - 2. If participant did not attempt test or failed, check why:
 - Tried but unable
 - Participant could not walk unassisted
 - Not attempted, you felt unsafe
 - Not attempted, participant felt unsafe
 - Participant unable to understand instructions
 - Other (Specify)
 - Participant refused
 - Aids for second walk..... None Cane Other
 - What is the time for the faster of the two walks? _____sec.
 - If the participant was unable to do the walk: **0 points**
- **For 4-Meter Walk:**
 - If time is more than 8.70 sec: **1 point**
 - If time is 6.21 to 8.70 sec: **2 points**
 - If time is 4.82 to 6.20 sec: **3 points**
 - If time is less than 4.82 sec: **4 points**

CHAIR SCORING:

- **Single Chair Stand Test:**
 - Safe to stand without help YES NO
 - Participant stood without using arms YES NO → If yes go to repeated stand
 - Participant used arms to stand YES NO → If yes end test; score as 0 points
 - Test not completed → End test; score as 0 points
 - If participant did not attempt test or failed, check why:
 - Tried but unable
 - Participant could not walk unassisted
 - Not attempted, you felt unsafe
 - Not attempted, participant felt unsafe
 - Participant unable to understand instructions
 - Other (Specify)
 - Participant refused

- **Repeated Chair Stand Test**
 - Safe to stand five times Yes No → If five stands completed record time
 - Time to complete five stands ___ sec
 - If participant did not attempt test or failed, circle why:
 - Tried but unable
 - Participant could not walk unassisted
 - Not attempted, you felt unsafe
 - Not attempted, participant felt unsafe
 - Participant unable to understand instructions
 - Other (Specify)
 - Participant refused

- **Scoring the Repeated Chair Test**
 - Participant unable to complete 5 chair stands or completes stands in >60 sec: 0 points
 - If chair stand time is 16.70 sec or more: 1 points
 - If chair stand time is 13.70 to 16.69 sec: 2 points
 - If chair stand time is 11.20 to 13.69 sec: 3 points
 - If chair stand time is 11.19 sec or less: 4 points

- **Scoring for Complete Short Physical Performance Battery**
- **Total Balance Test score _____ points**

- **Gait Speed Test score _____ points**
- **Chair Stand Test score _____ points**
- **Total Score _____ points (sum of points above)**

Timed Up and Go

A. Time for first TUG test (sec)

Time: _____ sec

If participant did not attempt test or failed, check why:

Tried but unable _____

Participant could not walk unassisted _____

Not attempted, you felt unsafe _____

Not attempted, participant felt unsafe _____

Participant unable to understand instructions _____

Other (specify) _____

Participant refused _____

Aids for first walk.....None _____ Cane _____ Other _____

B. Time for second TUG test (sec)

Time: _____ sec

If participant did not attempt test or failed, check why:

Tried but unable _____

Participant could not walk unassisted _____

Not attempted, you felt unsafe _____

Not attempted, participant felt unsafe _____

Participant unable to understand instructions _____

Other (specify) _____

Participant refused _____

Aids for second walk.....None _____ Cane _____ Other _____

Chair Sit and Reach Test

Practice	cm
Trial 1	cm
Trial 2	cm

Comments:

Grip Strength: Arm: L / R

Trial 1	kg
Trial 2	kg
Trial 3	kg

Comments:

Leg Strength: Leg: L / R

Trial	Kilograms	Pain/ Discomfort
Practice		
1		
2		

Comments:

Appendix I: DASH Education Session Outline

URIDEAL VI Nutrition *Snack and Give-aways*

1. Intro/common food beliefs (Feb 6th):
 - a. Snack: Granola bars
 - b. Give-away: nutrition binder (in lipid lab)
2. Food label reading (Feb 13th):
 - a. Snack: Valentines – Chocolate and vanilla animal crackers ("URIDEAL is wild about you, Valentine") (will need heart/valentine baggies)
 - b. Give-away: the Valentines will also count as a give-away
3. MyPlate and serving size (Feb 20th):
 - a. Snack: cereals (but no milk) (will need cups or bowls)
 - b. Give-away: Fiber one cereal samples (from Bell Institute – ordered 1/25, should arrive in time)
4. DASH (Feb 27th):
 - a. Snacks: dark chocolates
 - b. Give-away: Dark Chocolates
5. Fats (March 6th):
 - a. Snacks: nuts (will need napkins)
 - b. Giveaway: Tablespoon/teaspoon (in Ranger 404)
6. Fruits and vegetables (March 13th):
 - a. Snacks: fruit salad (will need bowls and forks)
 - b. Give-away: chip/veggie clip (in Ingrid's office)
7. Grains (March 20th):
 - a. Snack: brown rice chips.
 - b. Give-away: whole grain pens, whole grain pins , whole grain stickers (in lipid lab)
8. Protein (March 27th):
 - a. Snacks: almond butter and crackers (or sunbutter and/or peanut butter and/or cashew butter) (will need napkins)
 - b. Give-away: Mrs. Dash packets (in Ranger 404)
 - i. Also try “Have an undergrad contact the different nut boards – like the Peanut Board <http://www.nationalpeanutboard.org/> - and see if they have anything that could be used as a give away – sticky pads, pens, etc. Or contact the companies that do sunbutter, cashew butter and see if they have small samples that

they would provide – you know those small peanut butter containers you get with a bagel?”

ii. Try almond council (the almond tins?)

9. Dairy (April 3rd):

a. Snack: soy milk and almond milk (will need cups)

b. Give-away: Cabot recipes (in Ranger 404)

i. Also try: Contact dairy institute, Silk, Almond milk or soy milk companies, etc for give aways. Anything you can think of!

10. Cutting calories and healthy substitutions (April 10th):

a. Snacks: reduced fat smart food (will need napkins)

b. Give-away: flax seed packets (in Ranger 404)

11. Healthy beverages (April 17th):

a. Snack: Sparkling water and crystal light (will need cups)

b. Give-away: crystal light packets

12. Wrap up (April 24th):

a. Snack: Ppt can request a healthy snack

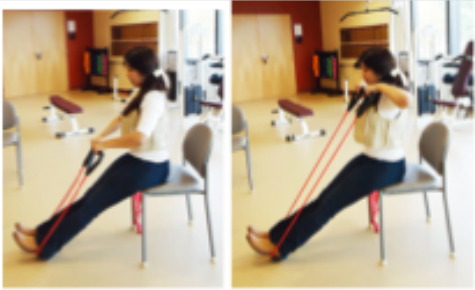

b. Give-away: URIDEAL pens (in lipid lab)

Key:

- Indicates need to find.
- Indicates need to purchase

Appendix J: Resistance Training Session Outline

Resistance Training Exercises:

<p>Seated Low Row:</p> <ul style="list-style-type: none">• Sit up straight in a chair. Pull belly button to spine• Start with resistance tube wrapped underneath the arch of both feet• Level 1: Feet close together• Level 2: Feet shoulder width apart• Hold one end of the band in each hand• Extend legs out straight with heels on the floor• Extend arms out straight in line with your legs, hands to your knees• Pull arms straight back to your armpits, bending the elbows• Squeeze shoulder blades together in the back (exhale) about 1 second• Slowly return to the starting position (inhale) about 2 seconds• Repeat 10-15 times for 2 sets	
<p>Lat Pull Down:</p> <ul style="list-style-type: none">• Sit up straight in a chair. Pull belly button to spine• Hold the band in each hand• Extend the arms above your head, shoulder width apart• When arms are above head, thumbs should be touching.• Slowly pull the tubing down to the chest and separate the arms so they are shoulder width apart (exhale) about 1 second• Squeeze shoulder blades together in the back• Slowly push the tubing back up above your head to the starting position (inhale) about 2 seconds• Repeat 10-15 times for 2 sets	

Resistance Training Exercises:

Seated Leg Press:

- Sit up straight in a chair. Pull belly button to spine
- Hold one end of the band in each hand
- Loop tube underneath the arch of one foot
- Pull tube up with both arms so hands are at shoulder height. Press elbows back so tubing is now behind the arms
- Bend knee, lifting foot off the floor (bottom of your shoe should be facing the wall opposite you)
- Level 1: Extend leg straight down to the floor with toes to the ceiling, but keep a small bend in the knee.
- Level 2: Extend leg straight out in front with toes to the ceiling (exhale) about 1 second
- Slowly return to starting position where knee is bent and bottom of foot is facing the wall (inhale) about 2 seconds
- Switch sides
- Repeat 10-15 times for 2 sets



Level 1:



Level 2:

Bicep Curls:

- Level 1: Step one foot on the middle of the resistance tube.
- Level 2: Place both feet on the middle of the resistance tube
- Hold one end of the band in each hand
- Stand up straight and tall.
- Relax arms to the side
- Palms facing each other
- Keep elbow in at side throughout exercise
- Curl arm up (exhale) while on the way up, rotate palms to face the ceiling. About 1 second
- Slowly return to starting position (inhale) about 2 seconds
- Repeat 10-15 times for 2 sets



Level 1:

Resistance Training Exercises:

Bicep Curls Level 2 Continued:



Seated/Standing Shoulder Press:

- Place both feet on the middle of the resistance tube
- Level 1: Sit nice and tall. Flat back no arching, keep breathing
- Level 2: Stand up straight. Flat back no arching, keep breathing
- Both levels: Hold one end of the band in each hand
- Both levels: Place arms in the "field goal" position
- Both levels: Extend arms straight up to the sky (exhale) about 1 second
- Both levels: Slowly lower arms to starting position (inhale) about 2 seconds
- Repeat 10-15 times for 2 sets



Level 2:



Resistance Training Exercises:

Chest Press:

- Performed sitting in chair
- Loop exercise band around your back
- Grasp one end of band in each hand as shown
- Press forward until arms are straight. About 1 second
- Keeping wrists straight
- SLOWLY return arms to starting position. About 2 seconds
- Level 1: Arms make a diagonal
- Level 2: Arms are straight in front of body shoulder width apart.
- Level 3: Arms come forward and fists touch
- Repeat 10-15 times for 2 sets
- 30 second rest interval between sets



Level 1:



Level 2:



Level 3:

Resistance Training Exercises:

Triceps Extensions:

Stand straight with feet shoulder width apart.

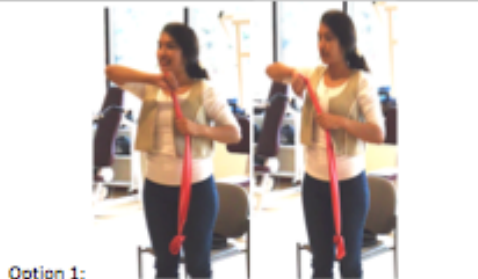
- Grab one end of the resistance band with your right hand.

Option 1:

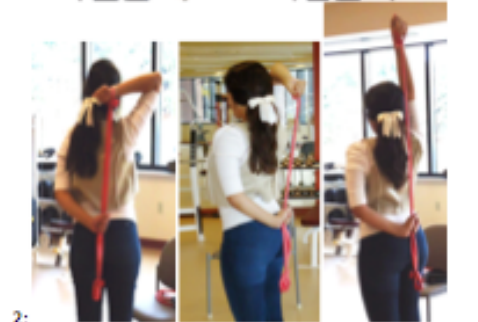
- Hold the other end of the band in Left hand.
- Raise right hand chest level with the back of your hand facing your chest.
- Without rotating the hand, straighten your arm out to the side shoulder height. About 1 second
- When as straight as possible, pause at the end and then slowly return to starting position. About 2 seconds
- Do 10-15 repetitions times total on each arm, and 2 sets on each arm

Option 2:

- Raise your right hand above your head until your arm is vertical and elbow is by your ear. Bend your arm at the elbow until it is behind your neck or back.
- Make sure the resistance band is hanging behind your back.
- Grab the other end of the resistance band in the small of your back with your left hand. This is your starting position.
- Raise your arm up to the ceiling until it is completely straight. Focus on keeping your upper arm vertical and close to the side of your head. About 1 second
- Pause at the top and then slowly lower your forearm to the starting position. You have completed one repetition. About 2 seconds
- Do 10-15 repetitions times total on each arm, and 2 sets on each arm



Option 1:



2:

Appendix J: Intervention Training Log

	<u>Week 1:</u>			<u>Week 2:</u>		
Date:						
BP Before Exercise						
BP After Exercise						
Any Medication Changes?						
How are you feeling today? (Any unusual pain or discomfort)						
Did you Practice Tai Chi at home?						
What was your RPE during Tai Chi today?						
Seated Low Row Level: Band Color:						
Seated Low Row RPE:						
Lat Pull Down Level: Band Color:						
Lat Pull Down RPE:						
Seated Leg Press Level: Band Color:						
Seated Leg Press RPE:						
Bicep Curls Level: Band Color:						
Bicep Curls RPE:						
Seated/Standing Shoulder Press Level: Band Color:						
Seated/Standing Shoulder Press RPE:						
Chest Press Level: Band Color:						
Chest Press RPE:						
Tricep Extensions Level: Band Color:						
Tricep Extensions RPE:						

Week 1: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Week 2: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

	<u>Week 3:</u>			<u>Week 4:</u>		
Date:						
BP Before Exercise						
BP <u>After</u> Exercise						
Any Medication Changes?						
How are you feeling today? (Any unusual pain or discomfort)						
Did you Practice Tai Chi at home?						
What was your RPE during Tai Chi today?						
Seated Low Row Level: Band Color:						
Seated Low Row RPE:						
Lat Pull Down Level: Band Color:						
Lat Pull Down RPE:						
Seated Leg Press Level: Band Color:						
Seated Leg Press RPE:						
Bicep Curls Level: Band Color:						
Bicep Curls RPE:						
Seated/Standing Shoulder Press Level: Band Color:						
Seated/Standing Shoulder Press RPE:						
Chest Press Level: Band Color:						
Chest Press RPE:						
Tricep Extensions Level: Band Color:						
Tricep Extensions RPE:						

Week 3: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Week 4: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

	<u>Week 5:</u>			<u>Week 6:</u>		
Date:						
BP Before Exercise						
BP <u>After</u> Exercise						
Any Medication Changes?						
How are you feeling today? (Any unusual pain or discomfort)						
Did you Practice Tai Chi at home?						
What was your RPE during Tai Chi today?						
Seated Low Row Level: Band Color:						
Seated Low Row RPE:						
Lat Pull Down Level: Band Color:						
Lat Pull Down RPE:						
Seated Leg Press Level: Band Color:						
Seated Leg Press RPE:						
Bicep Curls Level: Band Color:						
Bicep Curls RPE:						
Seated/Standing Shoulder Press Level: Band Color:						
Seated/Standing Shoulder Press RPE:						
Chest Press Level: Band Color:						
Chest Press RPE:						
Tricep Extensions Level: Band Color:						
Tricep Extensions RPE:						

Week 5: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Week 6: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

	<u>Week 7:</u>			<u>Week 8:</u>		
Date:						
BP Before Exercise						
BP After Exercise						
Any Medication Changes?						
How are you feeling today? (Any unusual pain or discomfort)						
Did you Practice Tai Chi at home?						
What was your RPE during Tai Chi today?						
Seated Low Row Level: Band Color:						
Seated Low Row RPE:						
Lat Pull Down Level: Band Color:						
Lat Pull Down RPE:						
Seated Leg Press Level: Band Color:						
Seated Leg Press RPE:						
Bicep Curls Level: Band Color:						
Bicep Curls RPE:						
Seated/Standing Shoulder Press Level: Band Color:						
Seated/Standing Shoulder Press RPE:						
Chest Press Level: Band Color:						
Chest Press RPE:						
Tricep Extensions Level: Band Color:						
Tricep Extensions RPE:						

Week 7:

Weight:

Date: _____

Notes: _____

Date: _____

Notes: _____

Date: _____

Notes: _____

Week 8:

Weight:

Date: _____

Notes: _____

Date: _____

Notes: _____

Date: _____

Notes: _____

	<u>Week 9:</u>			<u>Week 10:</u>		
Date:						
BP Before Exercise						
BP After Exercise						
Any Medication Changes?						
How are you feeling today? (Any unusual pain or discomfort)						
Did you Practice Tai Chi at home?						
What was your RPE during Tai Chi today?						
Seated Low Row Level: Band Color:						
Seated Low Row RPE:						
Lat Pull Down Level: Band Color:						
Lat Pull Down RPE:						
Seated Leg Press Level: Band Color:						
Seated Leg Press RPE:						
Bicep Curls Level: Band Color:						
Bicep Curls RPE:						
Seated/Standing Shoulder Press Level: Band Color:						
Seated/Standing Shoulder Press RPE:						
Chest Press Level: Band Color:						
Chest Press RPE:						
Tricep Extensions Level: Band Color:						
Tricep Extensions RPE:						

Week 9: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Week 10: _____ **Weight:** _____

Date: _____
Notes: _____

Date: _____
Notes: _____

Date: _____
Notes: _____

	<u>Week 11:</u>			<u>Week 12:</u>		
Date:						
BP Before Exercise						
BP <u>After</u> Exercise						
Any Medication Changes?						
How are you feeling today? (Any unusual pain or discomfort)						
Did you Practice Tai Chi at home?						
What was your RPE during Tai Chi today?						
Seated Low Row Level: Band Color:						
Seated Low Row RPE:						
Lat Pull Down Level: Band Color:						
Lat Pull Down RPE:						
Seated Leg Press Level: Band Color:						
Seated Leg Press RPE:						
Bicep Curls Level: Band Color:						
Bicep Curls RPE:						
Seated/Standing Shoulder Press Level: Band Color:						
Seated/Standing Shoulder Press RPE:						
Chest Press Level: Band Color:						
Chest Press RPE:						
Tricep Extensions Level: Band Color:						
Tricep Extensions RPE:						

Week 11:

Weight:

Date: _____

Notes: _____

Date: _____

Notes: _____

Date: _____

Notes: _____

Week 12:

Weight:

Date: _____

Notes: _____

Date: _____

Notes: _____

Date: _____

Notes: _____
