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# EFFECTS OF COMBINED TAI CHI, RESISTANCE TRAINING AND DIET ON PERCENT BODY FAT IN OBESE OLDER WOMEN

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# EFFECTS OF COMBINED TAI CHI, RESISTANCE TRAINING AND DIET ON PERCENT BODY FAT IN OBESE OLDER WOMEN

BY

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## ABSTRACT

Obesity is a public health problem affecting approximately 35.4% of Americans 60 years of age or older and African-American women are considered at high-risk for obesity. Exercise and diet are effective at reducing the risk of chronic diseases. Resistance training (RT) has been reported to preserve or increase skeletal muscle mass, functional status, well-being, and improve memory. Tai Chi (TC), a form of martial art, is an exercise composed of slow deliberate movements that can result in improvements in cardiovascular disease risk factors including body composition, but no studies have combined diet, RT and TC in a community-based study in obese older women with a strong minority representation. **Purpose**: To examine the effects of combined TC, RT and diet on percent body fat (%BF) in obese older women in an urban setting. **Methods:** A 12-week intervention with 26 obese women (65% African-American), using a non-randomized design to a TC, RT, plus Diet group (EXD, n=19, age 65.1 ± 8.1 years, BMI = 38.8 ± 5.1 kg/m$^2$) or a control group (CON, n=9, age 65.5 ± 8.6 years, BMI = 36.5 ± 3.4 kg/m$^2$). Height and weight were assessed using standard techniques. Percent BF was assessed using a bioelectrical impedance analysis at baseline and at the end of the intervention in the morning in a fasted state. The EXD group participated in three, 45 min TC sessions, two, 45 min RT sessions and a one day, 45 min per week behaviorally-based dietary lesson using the Dietary Approaches to Stop Hypertension (DASH) diet. The CON group was asked to maintain their normal diet and daily routine. Between-group (EXD vs. CON) changes in the primary and exploratory outcome variables from baseline to post-testing were determined via analysis of covariance. **Results:** There were no significant within- or between-group differences in %BF (EXD: -0.33 ± 1.5, p = 0.39 vs. CON: 0.31 ± 3.2, p = 0.55; between-group p = 0.55). **Conclusion:** This combination of TC, RT, and dietary

modifications study did not have a substantial effect on lowering %BF in this urban population of obese women, but a larger, more comprehensive study may need to be done to verify these results.

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## PREFACE

This thesis is written to comply with the University of Rhode Island graduate school Manuscript Thesis Format. This thesis contains one manuscript: *Effects of Combined Tai Chi, Resistance Training, and Diet on Percent Body Fat in Obese Older Women.* This manuscript has been written in a form suitable for publication in *The Clinical Journal of Sport Medicine.*

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## Publication Status

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# INTRODUCTION

Approximately 35.4% of Americans 60 years of age or older are obese [1], that number is rapidly increasing and may be the single greatest cause of disability in older adults [2]. Obesity is defined as a body mass index (BMI) $\geq$ 30 kg/m$^2$ [3], and is more prevalent among women [4]. When predicting BMI values in older women, a linear correlation can be seen in body fat percentage (%BF) [68]. Also, women with a waist circumference of 88 cm (~35 in) or greater may be classified as being obese [3] which is associated with higher rates of disability [5]. Moreover, the prevalence of abdominal obesity in older women has increased by 35% and has doubled in the last decade. Minorities, especially African-American women are considered a high risk group as they tend to have the highest prevalence of obesity, with over half the women classified as being obese [3, 6]. Those who lose and maintain weight loss reduce the risk of chronic disease in this high risk population [6].

Dietary modification is a viable treatment for obesity, and the Dietary Approaches to Stop Hypertension (DASH) diet [7, 9-12] has been shown to be an effective intervention for improving a host of health outcomes including obesity reduction, although the original DASH diet was designed to treat hypertension [7, 12]. However, research indicates that obesity reduction via dietary modifications may exacerbate muscle loss which can worsen physical function that normally occurs with aging [6]. Previous findings also suggest adding endurance or resistance training to a diet program helps preserve fat-free mass during weight loss [13].

Resistance training (RT) has been reported to preserve or increase skeletal muscle mass [14]. Thus, RT may be a powerful intervention strategy for improvements in body composition [15] especially in minority women [16, 17].

Resistance training helps to prevent or reverse increases in body fat, as well as assist in weight control in older adults in as little as 10 weeks [18-20]. Although, older individuals tend to have an increase in the proportion of visceral and abdominal fat [21] studies have reported a reduction in visceral fat in response to RT in older women [22-24]. Therefore, the addition of RT to a diet intervention may effectively improve body composition in overweight and obese older adults [25]. Adding an aerobic exercise such as Tai Chi to a resistance training intervention may yield beneficial results in body composition and allow for a greater variety of exercise modes to be used for obesity reduction.

Tai Chi, a traditional Chinese martial art, shows potential as an alternative form of aerobic exercise for improving body composition such as decreased body fat in older adults, and shows positive effects on physical function, balance, flexibility, and mental well-being [10, 14, 26, 27]. Studies have shown Tai Chi to be a rhythmic exercise [28, 29] at an intensity of ~60% of maximum heart rate [28] that is comparable to walking and has been shown to be well-tolerated in older populations [30, 31]. Observational data show that Tai Chi practice has been associated with lower body mass [32] and intervention studies demonstrated improved body composition in combination with a DASH diet [10], but no data exists on its efficacy in minority women.

Therefore, the purpose of this intervention was to assess the changes in body fat percentage in response to Tai Chi, RT and a behaviorally-based dietary intervention (EXD) in obese older women compared to a control (CON) group. Also, it was hypothesized that the EXD intervention group would have a decrease in body fat percentage that would be significantly different than the CON group. Exploratory

aims included an examination in the changes in other anthropometric variables including waist circumference (WC), waist to hip ratio, and BMI.

## Methods

### Study Design:

This study employed a non-randomized experimental design with pre- and post-measures in obese older women consisting of baseline testing, a 12-week intervention and post-intervention testing. The study used a combined exercise intervention strategy of Tai Chi plus RT, cool down, and a dietary intervention (EXD). There was also a wait-list control (CON) group to strengthen the design. Assessments of all outcomes were collected on all participants at baseline and at the end of the intervention. Participants in the intervention group practiced Tai Chi for three non-consecutive days (MWF) per week, RT was practiced on two of those days, and the dietary sessions were held once per week. This intervention took place at the St. Martin de Porres Senior Center in Providence, Rhode Island. The study was approved by the Institutional Review Board at the University of Rhode Island (#HU1213-08).

### Participants:

Each potential participant completed a brief medical survey over the phone or in person to assess initial eligibility. Prior to starting the study, all apparently eligible participants attended an orientation session, completed a detailed medical history form, read and signed the informed consent. The inclusion criteria were women between the ages 50–80 years, a BMI of 30.0 to 50.0 $kg/m^2$, not engaged in a regular exercise program within the last six months, and post-menopausal by self-report. The exclusion criteria included, failure to provide informed consent, have significant or suspected cognitive impairment, severe hearing loss, speech disorder, language barrier or visual

impairment, progressive, degenerative neurologic disease, a terminal illness with life expectancy of < 12 months (as determined by a physician), severe pulmonary disease, uncontrolled diabetes, blood pressure, or anemia, medications not taken for > 3 weeks (lipid lowering medications for > 6 months), major joint, vascular, abdominal, or thoracic surgery within three months, significant cardiovascular disease, or the inability to safely engage in mild to moderate exercise with muscular exertion.

Participants were recruited from the Providence area, within a one mile radius of the Senior Center through advertisements placed in monthly newsletters, an announcement made at the Senior Center, word of mouth, internet announcements on social media sites such as Facebook, and flyers were mailed to women between the ages of 50 and 80 years. To assess eligibility of potential participants, a study coordinator measured their height, weight, and BMI. If a participant appeared to qualify, she was asked to attend an orientation session to read and sign an informed consent and complete a more detailed medical history. After completion of the orientation session, the participants who were interested and qualified were scheduled for baseline testing, and participated in the intervention.

**Primary Outcomes:**

*Body Fat Percentage:* Body composition was measured using a simple, foot-to-foot bioelectrical impedance analysis device (Tanita BF-556, Arlington Heights, IL, United States). The bioelectrical impedance analysis device is a battery powered, portable device that resembles a bathroom scale, but uses a very low electrical current (battery powered, 50 kHz) in order to estimate fat mass and percentage body fat. This test is a valid and reliable measure of body composition with very few risks [33]. Even

though the risk of harm is low, each individual was asked if they had a pacemaker. If a participant did have a pacemaker, their body fat percentage was not assessed.

**Exploratory Outcomes:**

Additional anthropometric measures included in this study were waist and hip circumferences, which were measured using a standard tape measure with an attached tensometer (Creative Health Products, Ann Arbor, MI). Waist circumference was measured in centimeters around the umbilical line, and hip circumference was measured around the broadest part of the hips above the gluteal fold. Height (cm) and weight (kg) were taken with a stadiometer (Webb City, MO, USA) and BMI was determined using the standard equation of calculating weight (kg) divided by height (m) squared.

**Other Measures:**

*Diet Quality*: Dietary patterns were measured using the Dietary Screening Tool (DST). The DST was created to assess diet quality and dietary patterns among older adults and to relate the patterns to markers of general health and nutrition status [34]. The DST is a simple and practical tool composed of 24 questions, with a highest possible score of 100 plus 5 additional bonus points. The DST characterizes risk into three categories: at risk (<60), possible risk (60-75) and not at risk (>75) [35].

*Physical Activity Level:* Participants were administered the Yale Physical Activity Survey (YPAS), which is a validated questionnaire used to evaluate energy expenditure in older adults [36]. Total hours of activity were obtained as well as total kcal expenditure per week for each individual. A seasonal adjustment is also included for the total hours of activity per week during different seasons of the year. Activities

included in the questionnaire include regular physical activity such as walking, caring for others, and activities of daily living such as housework and cooking [37].

*Education:* Education level was assessed by a survey question with nine options to best describe their highest level of education completed which included: high school or GED, some college, two-year college degree, four-year college degree, masters degree, doctoral degree, professional degree, or other and asked to specify. Education levels of the participants were broken into three groups.

*Blood pressure*: Blood pressure (BP) was taken with the participant in the seated position, pre- and post- intervention, with the cuffed arm supported at heart level after five minutes of quiet rest using a standard sphygmomanometer. All readings were taken at the same time of day for each participant. All resting BPs were averaged from three separate days prior to the start of the intervention and three separate days during the final days of the intervention. Additionally, BP was measured and recorded before all testing and exercise training sessions.

**Group Assignment:**

After completion of baseline testing there were 33 participants, 23 participants were assigned to the EXD group in the order they were screened, and 10 participants in the CON group were assigned also by the order in which they were screened. This project was an extension project, with a goal of translating clinical research to an urban community setting. Thus, to maximize participation in the intervention arm of the project a non-randomized design was chosen.

**Intervention (EXD):**

*Tai Chi*: Participants in the EXD group engaged in Tai Chi sessions three times per week on non-consecutive days (MWF) for 12-weeks. All Tai Chi sessions were

conducted in a dedicated space in the senior center. The Tai Chi exercise intervention was the modified 24-movement Yang style and supervision of the Tai Chi intervention was overseen by Dr. Furong Xu, a Kinesiology faculty member who has over six years of experience in Tai Chi instruction, including extensive experience with obese older women. The Tai Chi form was taught based on previous research and in similar populations of older women [22]. Every week for 6-weeks, 4-5 movements were taught, and the complete form was practiced during the last 6-weeks of the study. Emphasis was placed on performing the Tai Chi movements in a slow and controlled manner. Each session began with a 5-minute warm-up, followed by 35 minutes of practice and exercise using Tai Chi movement forms, finishing with a 5-minute cool-down phase, which included flexibility exercises for all the major muscle groups [34]. Hand-outs were given to participants during the first few weeks so that they could study the Tai Chi movements learned at each session and so they were able to practice at home. A DVD of the first 12 movements was distributed to the participants once these movements were mastered, and a DVD of the complete set of movements was distributed when participants learned the complete form.

Participants were supervised by trained study team members, during each training session in order to reduce deviations from study protocol and to ensure participant safety. Study team members worked with each participant to perform the exercises according to each participant's ability and progression over the course of the study. By continuously adjusting the Tai Chi program based on improvements, this training program allowed participants to progressively exercise in a safe manner. Participants were encouraged to practice Tai Chi on other days of the week when they felt comfortable with the forms.

*Resistance Training*: The RT program for the EXD group was based on prior work [38] and ACSM guidelines [35]. Resistance training sessions consisted of two 45-minute sessions of supervised RT on non-consecutive days of the week for 12 weeks. The RT program was done using elastic tube bands with handles and elastic bands with no handles. Eight upper body and lower-body exercises for the major muscle groups were completed with 2-3 sets of 8-15 repetitions for each exercise. Exercise intensity was aimed to be between 13 – 15 on the RPE (ratings of perceived exertion) scale, which is a 15-grade scale, that measures an individuals' perception of how hard they are working during exercise [39]. Progression was made once the participant was, with proper form, and able to complete 15 repetitions with a band color.

*Dietary Intervention*: Participants in the EXD group met once a week for 12-weeks for a 45 minute behaviorally-based dietary session, which met immediately after one of the weekly Tai Chi exercise sessions [40]. The concept of SMART (specific, measurable, attainable, realistic, and timed) goals [41] was introduced during the first session. Following the first session, participants were encouraged to make SMART goals. Additionally, the dietitian incorporated the transtheoretical model of change [42, 43] in recommendations to participants. During the dietary sessions, the dietitian encouraged the participants to choose to make changes in areas that they were thinking about changing, started to make plans to change, or were actively trying to change. Participants filled out weekly food logs and were provided feedback on them focusing on compliance with the DASH diet and behavioral change.

All sessions were led by a registered dietitian, and the best practices of the Academy of Nutrition and Dietetics and the American College of Sports Medicine for

weight management were utilized for session content and delivery [44]. A modified DASH-based diet was utilized as the dietary plan since it has been shown that older adults can comply with it [45]. The modified-DASH diet, which was modified from the original DASH diet, was used and contains goals which include low intake of saturated fat (≤ 7% of caloric intake) and total fat intake of up to 35% from < 27% fat of the total caloric intake, high intake of fruit, vegetables, whole grains, and refined carbohydrates, consumption of low fat dairy, lean meats, and moderate intake of sodium (3,000 mg or less per day) [12]. Basic topics of keeping food and physical activity logs, estimating portion sizes, reading food labels, and decreasing caloric intake were reviewed in the first few classes.

Once basic topics were reviewed, during each session, the dietitian encouraged participants to focus on making lifestyle changes that they could feasibly do for the rest of their life, such a making health substitutions in recipes by lowering fat and sodium content, participants also taste tested food products that are consistent with the DASH diet, and learned how to properly read food labels. Additional changes such as decreasing total, saturated, and trans fat intake, increasing intake of fruits and vegetables, and utilization of lean meats and dairy products were also encouraged. The DASH diet is behaviorally based and tailored to the individual needs of each participant; therefore, all participants completed at least three days of food logs weekly and were provided with constructive feedback. The food logs were utilized as a guidance tool for the participants of the study, to provide feedback to the participants and were not analyzed using software, to ensure that each participant was adhering to the healthy eating habits that were taught through the modified DASH Diet guidelines.

**Control Group (CON):**

Participants in the CON group (n=9) underwent the same baseline and post testing as the EXD group, but did not receive the 12-week intervention. These participants were asked to maintain their normal activities during the intervention period. Finally, as an incentive and for further benefit to these participants, after the 12-week intervention completed and post testing concluded, those who chose to participate in two weeks (i.e. six sessions) of supervised exercise and dietary instruction at the senior center were allowed to do so. The participating participants were able learn proper exercise form and basic nutrition concepts, as this was not part of the intervention, no data were collected after. Written instructions and a copy of the DVD were also given to these participants.

**Statistical Analysis:**

*Sample Size Calculation:* Based on a sample size analysis with a beta of 0.80, an alpha of 0.05, a % fat loss of 3.4 (S.D. = 2.2) [46] in the EXD group compared to no change in the CON group, we needed a total of 26 participants in our final analytic sample to detect between-group differences. Exercise intervention studies have shown with a similar sample size that changes in percent body fat can be detected [47, 48].

*Data Analysis:* An independent samples *t*-test was conducted for baseline characteristics. For categorical data analyses, Fisher's exact test was conducted. A Shapiro-Wilk Test was used to test for normal distribution of the changes in the primary and exploratory outcome measures. Non-normally distributed data were analyzed using Wilcoxin rank sum tests for within-group analysis; while normally distributed data was analyzed using a paired samples *t*-test. Outliers for changes in the primary and exploratory outcome variables were identified as any individual data point

≥ 3 standard deviations above or below the mean. Therefore, the data points which were identified as outliers in the EXD group for BMI and waist-hip-ratio, as well as BMI in the CON group as having a variable greater than 3 standard deviations above or below the mean of any data point. One outlier was excluded from the waist hip ratio change analysis as it significantly changed within-group interpretation. However, a BMI change outlier in the EXD and CON group did not significantly change the results within- or between-group so those outliers remained in the analysis. Between-group (EXD vs. CON) changes in the primary and exploratory outcome variables from baseline to post-testing were analyzed using covariance (ANCOVA) adjusted for baseline values. Additionally, we further stratified our results using analysis of covariance based on attendance (good or poor) to determine the efficacy of the intervention on the primary and exploratory outcome measures.

**RESULTS**

This 12-week intervention completed with a total of 26 participants with 17 of those participants in the EXD group and 9 participants were in the CON group. Originally, there were a total of 23 participants who began in the EXD group, and 10 who were in the control group. Towards the beginning of the intervention there were 4 dropouts from the EXD group and 1 dropout from the control group. There were no significant baseline differences when comparing those who dropped out vs. those who did not drop out. However, those who did not drop out had a greater waist circumference (p=0.03) compared to those who did dropped out. Explanations for those participants who dropped out are shown in Figure 1. Throughout the intervention, the attendance at intervention sessions was 67.5% in the EXD group.

Baseline characteristics of the participants are presented in Table 1. There were

no statistically significant differences in these baseline variables between groups, other than physical activity, where the EXD group was significantly ($p < 0.05$) more active than the CON group. Other baseline characteristics are also presented in Table 1, which include education and race, which also had no between-group differences. Race was broken into two groups, 76% non-white participants in the EXD group vs. non-white participants in the CON group.

The DST was used to assess diet quality and patterns of general health, the EXD group at baseline had 6 (37.5%) individuals who were at nutritional risk ($\leq 60$), 8 (50.0%) at possible risk 60-75, and 2 (12.5%) who were not at nutritional risk ($\geq 75$). At the end of the 12-week intervention there were 4 (25%) individuals at nutritional risk, 9 (56.3%) at possible risk, and 3 (18.8%) not at nutritional risk. While the CON group at baseline had 4 (50.0%) individuals who were at nutritional risk ($\leq 60$), 3 (37.5%) at possible risk 60-75, and 1 (12.5%) who were not at nutritional risk ($\geq 75$). At the end of the 12-week intervention there were 5 (71.4%) individuals at nutritional risk, 2 (28.6%) at possible risk, and 0 (0%) not at nutritional risk.

The amount of weekly expended calories (kcals) at baseline were different between groups with the EXD group expending 7,966 ± 5,697 kcals/wk, while the CON group only expended 3,100 ± 3,657 kcals/wk, $p = 0.038$. The final analytic sample consisted of 17 participants from the intervention group and 9 remained in the CON group. However, 2 participants were excluded from %BF analysis due to missing %BF data points as they did not want to remove their tights, 1 participant was also excluded from %BF analysis from the CON as she too did not want to remove her tights. One influential outlier was identified in the EXD group and excluded; therefore, 16 participants were in the final analytic sample for waist to hip ratio

change. Although two outliers were identified in BMI change for the EXD and CON groups, they did not significantly impact the results, therefore remained in analysis. Changes in anthropometric variables between the EXD group and the CON group can be found in Table 2. There were no significant between-group changes in weight, BMI, %BF, waist circumference or waist to hip ratio, as well as no within-group changes in weight, BMI, %BF, or waist circumference. However, there was a significant within-group increase in waist to hip ratio in the EXD group ($0.02 \pm 0.04$; $p < 0.05$).

There were 12 good attenders vs. 5 poor attenders when comparing key anthropometric outcome variables, good attenders were defined as attending 60% of the EXD classes. There was a significant within-group increase in BMI for good attenders ($1.55 \pm 4.5$ kg/m$^2$; $p < 0.001$) while poor attenders also had a significant WHR change ($-0.09 \pm 0.36$; $p < 0.002$). There were no significant between group changes.

Although significant results in body composition measures were not observed, physical changes were seen in a participant who originally began the intervention with a walker, then progressed to a cane a couple weeks later and by the end of the 12-week intervention, she was no longer using any form of walking assisted device.

**DISCUSSION**

The primary findings of this study, in contrast to our hypothesis, indicate that the combination of Tai Chi, resistance training, and diet did not significantly reduce body fat percentage between or within the EXD or CON groups. This study to our knowledge is the first to combine Tai Chi, resistance training, and diet in obese post-menopausal women in an urban community setting, with a high percentage of minority

women in the study. Additionally, the current study found that anthropometric variables did not change in the EXD or CON groups except for a slight, yet unexpected increase in waist to hip ratio in the EXD group which is in contrast to the findings of current literature, which have typically seen decreases in anthropometric measures [11, 51-53].

Attendance in the current study was fairly low, at 67.5% for the EXD sessions and 69.4% for the dietary sessions when compared to previous studies which have an attendance rate between 88-98% [8, 17, 25, 49, 54-57] with predominately Caucasian women. However, Lemacks et al. [58] mentioned, attendance to programs for African Americans were lower (58.0%) than the attendance rate of studies with predominately white participants (95.0%) [58]. Therefore, the decreased attendance rate may be a contributing factor to the reason why there were no significant between-group changes in weight, BMI, %BF, waist circumference and waist to hip ratio, or within-group changes in weight, BMI, %BF, and waist circumference, but a significant change in waist to hip ratio.

Similar in design and aims to the current study, Bekke et al. [11] found with a 16-week intervention conducted on obese older Caucasian women in a community-based setting that there were significant within group changes in body fat mass ($p < 0.05$), weight ( $p < 0.01$), BMI ($p < 0.001$), waist circumference ($p < 0.001$), and waist-to-hip ratio ($p < 0.001$) were seen in the intervention group when compared to the control group. Whereas, the current study was only 12-weeks with a large majority of the participants being minorities (~77%) and did not have any significant between- or within-group changes, aside from the significant ($p < 0.05$) within-group change in waist to hip ratio in the EXD group.

Additionally, Straight et al. [51] conducted a community-based 8-week RT intervention and found significant ($p < 0.001$) changes in body mass, waist circumference, and percent body fat, whereas the current study only saw a significant increase in waist to hip ratio in the EXD group. The results of that study show that a combination of RT with a dietary intervention can show favorable changes in body composition [51]. However, that study used a combination of resistance bands, dumbbells, and ankle weights, whereas the current study only used resistance bands. Straight et al. also had a larger sample size (95 participants), compared to the current study. Additionally, that study employed a dietary modification intervention to promote weight loss whereas the current study did not.

Currently there are no studies in the literature that combine Tai Chi, RT, and diet, but Tai Chi has been shown to be a low-intensity aerobic exercise modality similar to brisk walking and previous research has reported the potential impact of these combined intervention strategies on body composition in obese older women [10, 49, 59-61]. Layman et al. [50] conducted a 16-week intervention that looked at the additive effects of diet, aerobic training and resistance training, whereas the current study consisted of Tai Chi, RT, and diet. After 16-weeks, fat mass and body fat were reduced ($p < 0.05$) and there was a decrease in absolute body fat by 21.4%, therefore the additive effects on body composition were apparent with significant main effects on diet ($p < 0.01$) and exercise ($p < 0.001$). Layman et al. may have seen significant results due to the dietary component which focused on weight loss and provided the participants with specific food menus with dietary goals, in contrast to the current study which focused on teaching the participants about a healthier diet quality.

The combination of intervention studies demonstrate that favorable changes may

be seen in a combination of aerobic exercises, RT, and diet [50]. However, the significant findings in the Bekke et al. [11] Straight et al. [51] and Layman et al. [50] can be attributed to the dietary component, as each studies dietary component focused on weight-loss as the main goal, in contrast to the current study which focused on a healthier diet quality.

This study has several strengths. First this study sample included a strong representation of minorities (~65% Black, non-Hispanic, ~6% Hispanic in the EXD group). As, it is important to include minorities into interventions as minority women are under investigated and Africa-American women have the highest rates of physical inactivity. When comparing African-American women to white or Hispanic women, equating up to 46% of non-Hispanic Black women are physically inactive, and 44% of Hispanic women are physically inactive [62]. Therefore, it is also important to include minorities in studies so that more study results can be generalizable to a variety of ethnic backgrounds [63]. Another strength to this intervention method was the combination of TC, RT, and diet. As previous studies have demonstrated benefits such as improvements in body composition, physical function and increased strength in a combination of TC and diet [10, 11, 47, 56, 64, 65], RT and diet [8, 17, 25, 52, 55], or a combination of TC and RT [50, 53, 66] the present study combined all three interventions. This current study also included a control group, which was used as a comparison to strengthen the study design, and for an analysis to occur to effectively evaluate the impact of the intervention.

Despite the strengths listed above, this study also has some limitations. First the study employed the use of a non-randomized design. This was a community based study, and the goal was to include as many community members as possible in the

EXD group as the space in the senior center would safely allow. Participants were assigned to their group based on a first come first serve basis. There were only minor baseline differences between the groups which suggest the groups were not substantially different at baseline values. Second, the sample size of this study was relatively small, but an estimated sample size was calculated prior to the start of the study and the sample size is comparable to prior studies that did a similar type of intervention [8, 10, 11, 47, 49]. Finally, only the combined intervention effects were examined as individual intervention effects were not able to be tested as there were only two groups. However, other studies [1, 66] have examined these individual intervention effects.

In conclusion, this study is the first to demonstrate the effects of a community-based, combination of Tai Chi, resistance training and a dietary intervention study on anthropometric changes in obese older women. The combination of Tai Chi, resistance training, and dietary intervention did not significantly reduce percent body fat or other measures of body composition in the EXD group when compared to the CON group. As obesity rates are high and continue to increase, especially in older women [3, 67], there is a need to examine alternative forms of physical activity that have not yet been thoroughly investigated to determine if they are effective in modifying body composition in obese older women. Since most exercise interventions have utilized traditional exercise modalities such as aerobic or RT [15], non-traditional methods such as combining RT, Tai Chi, and a dietary intervention should be examined in future studies with a larger sample size in an obese minority population to better evaluate the effects of a combined intervention on body composition.

**Table 1:** Baseline participant characteristics for the Tai Chi, resistance training and dietary intervention (EXD) and Control (CON) groups.

| **Variable:** | EXD (n = 17) | CON (n = 9) | Between-group: *p-value* |
|---|---|---|---|
| Age (years) [2, 4] | 65.2 ± 8.1 | 65.6 ± 8.6 | 0.912 |
| Education [3] | | | 0.132 |
| High School, GED or Less | 10 | 5 | |
| Associates or Some College | 6 | 1 | |
| Bachelors or Higher | 1 | 3 | |
| Race [1, 3] | | | 0.263 |
| Non-White | 13 (76) | 9 (100) | |
| White | 4 (24) | 0 (0) | |
| Height (cm) [2, 4] | 158.3 ± 6.6 | 159.7 ± 5.9 | 0.593 |
| Weight (kg) [2, 4] | 97.9 ± 16.1 | 94.5 ± 12.0 | 0.578 |
| BMI ($kg/m^2$) [2, 4] | 38.8 ± 5.1 | 36.6 ± 3.4 | 0.241 |
| Waist Circumference (cm) [2, 4, 6] | 114.9 ± 8.9 | 106.8 ± 9.7 | 0.042 |
| Hip Circumference (cm) [2, 4] | 124.3 ± 11.1 | 120.1 ± 6.2 | 0.305 |
| Waist-to-hip ratio [2, 4] | 0.9 ± 0.1 | 0.8 ± 0.1 | 0.167 |
| % Body Fat [2, 4] | 49.8 ± 3.3 | 49.6 ± 2.9 | 0.888 |
| Systolic Blood Pressure [2] | 143.4 ± 15.6 | 134.8 ± 14.3 | 0.187 |
| Diastolic Blood Pressure [2] | 80.8 ± 7.8 | 78.0 ± 8.6 | 0.728 |
| Physical Activity (kcals/wk) [2, 6] | 7,966 ± 5697 | 3,100 ± 3657 | 0.038 |
| SPPB Score (0-12) | 8.35 ± 2.5 | 8.89 ± 2.9 | 0.628 |
| Dietary Screening Tool [1] | | | 0.716 |
| At nutritional risk (≤ 60) | 6 (40) [5] | 4 (44) | |
| At possible risk 60-75 | 7 (47) [5] | 4 (44) | |
| Not at nutritional risk (≥ 75) | 2 (13) [5] | 1 (12) | |

Abbreviations: BMI, Body Mass Index (calculated as weight in kilograms divided by height in meters squared)

[1] Data expressed as "n" and (percentage)

[2] Data expressed as mean ± SD

[3] Data analyzed using Fisher's exact test

[4] Data analyzed using independent samples *t*-tests

[5] Data contain 15 participants as 2 did not complete the DST

[6] Baseline difference: $p < 0.05$

**Table 2:** Anthropometric changes with the 12-week intervention between the Tai Chi, resistance training and dietary intervention (EXD) and Control (CON) groups. [3]

| **Variable:** | EXD (n = 17) | CON (n = 9) | Between-group: *p-value* |
|---|---|---|---|
| Weight (kg) [1] | 0.08 ± 0.69 | 0.34 ± 0.95 | 0.829 |
| BMI (kg/m$^2$) [1] | 1.10 ± 0.79 | -0.34 ± 1.10 | 0.305 |
| % Body Fat [1, 2] | -0.30 ± 0.54♦ | 0.26 ± 0.74◊ | 0.549 |
| Waist Circumference (cm) [1] | 0.77 ± 1.56 | 3.19 ± 2.20 | 0.397 |
| Waist to Hip Ratio [1] | 0.03 ± 0.01*° | 0.04 ± 0.01 | 0.542 |

Abbreviations: BMI, Body Mass Index (calculated as weight in kilograms divided by height in meters squared).

[1] Data expressed as mean ± SE

[2] Data missing from two participants in these variables

[3] Data were analyzed using analysis of covariance adjusted for baseline values.

♦ Data only contains 15 participants

◊ Data only contains 8 participants

*Data only contains 16 participants as an outlier was excluded

° within-group change: $p < 0.05$

**Table 3:** Anthropometric changes with the 12-week intervention between the EXD Good Attenders vs. EXD Poor Attenders. [2]

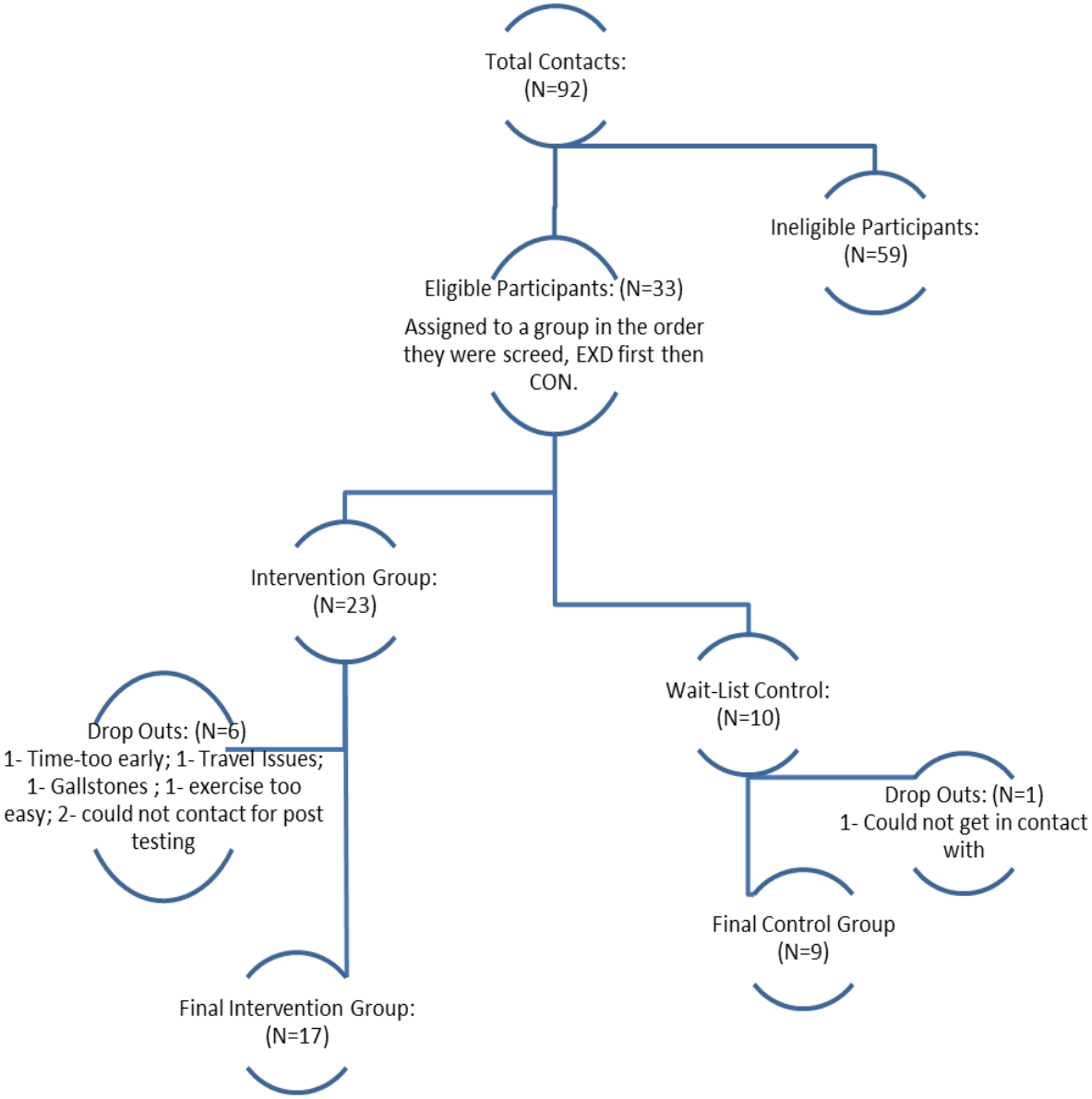
| **Variable:** | Good Attenders | Poor Attenders | Between-group: *p-value* |
|---|---|---|---|
| Weight (kg) [1] | 0.59 ± 0.81 | -1.15 ± 1.29 | 0.267 |
| BMI (kg/m$^2$) [1] | 1.62 ± 0.93 | -0.20 ± 1.46 | 0.302 |
| % Body Fat [1] | -0.24 ± 0.64 | -0.53 ± 1.45 | 0.854 |
| Waist Circumference (cm) [1] | -0.26 ± 1.81 | 3.47 ± 2.87 | 0.383 |
| Waist to Hip Ratio [1] | 0.02 ± 0.04 | -0.09 ± 0.07 | 0.179 |

Abbreviations: BMI, Body Mass Index (calculated as weight in kilograms divided by height in meters squared).

[1]Data expressed as mean ± SE

[2] Data were analyzed using analysis of covariance.

**Figure 1:** Study Flow Chart



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## List of Appendices

# APPENDIX A: REVIEW OF LITERATURE

## Introduction

The purpose of this literature review is to discuss the public health problem of obesity, and the associated problems such as causes, and consequences of obesity in older adults, particularly in older women. Treatment methods for obesity, especially exercise when combined with diet and dietary weight loss, will be discussed. Finally, a review of the literature on present and previous research on interventions regarding, dietary weight loss, exercise interventions, and combined interventions on its effects on body composition in obese older women will be examined.

## Obesity

Obesity is a growing problem for older adults with as the prevalence of obesity is on the rise [1]. Obesity, defined by a body mass index (BMI) $\geq$30 kg/m$^2$ [1-3] increases the risk for on a host of chronic disease that occur with increasing age [4], including the increased risk of physical disability [5]. The elderly population continues to represent one of the fastest growing populations in developed countries [4]; this proportion is expected to grow from 40.2 million to 88.5 million in persons aged 65 years or older by 2050 [9]. Moreover, in the United States, an unhealthy excess of body weight increases the risk of chronic disease and premature mortality in older women than in older men [6] and several research studies support these conclusions.

Sturm et al. [3] combined the estimates from the Health and Retirement Study (HRS) and the Behavioral Risk Factor Surveillance Survey (BRFSS) from 1985 to 2002 to compare the obesity trends then, now and the predictions for 2020. Americans

are increasingly becoming obese, which is associated with 60% higher health care costs in women as opposed to women of normal weight, moderate obesity increases health care costs by 31% [3]. Over the past 25 years, the obesity prevalence in all age categories has increased [6] as an estimated 97 million adults in the United States are overweight or obese [7] while 68.6% of adults aged 60 years of age or older are overweight or obese [2].

Newman et al. [8] concluded that during the past 30 years, the proportion of older adults who are obese has doubled, and currently 7% of the world's population is over the age of 65, which is projected to rise to 12% by the year 2030. These increases among older adults are substantial and suggest that as this aging population continues to increase in numbers, so will the number of chronic diseases, such as arthritis, diabetes, hypertension, and heart disease which are the most common and often debilitating chronic conditions in older adults [8]. After 65 years of age, the rate of weight loss occurs at an average rate of 0 to 0.65 kg per year, although the probability of activities of daily living (ADL) limitations doubles for those who are moderately obese, and quadruples for those who are severely obese. If this obesity trend were to continue, by 2020 without changes in behavior or medical technology the proportion reporting fair/poor health would increase by 14.1% for women compared to the year 2000. The excess costs of obesity would increase from 12.7% in the year 2000 to 19.9% by 2020 with the largest effect of increased weight being on disability with the prevalence of ADL limitations increasing to 21.8% for women [3].

In the United States, obesity accounts for 5 to 15% of deaths each year [5]. Overweight and obesity are especially prevalent in some minority groups, such as

African-Americans, as well as in those with lower incomes and less education [7]. Obesity among older Americans will likely become a significant problem in the future as older adults who are obese are often faced with the challenge of not being able to walk, go shopping, or participate in other activities [8]. As the older population is increasing, the obesity population is also rapidly increasing and is now being recognized as an important global public health problem [4]. However, some recent data suggests that the number of obese adults can grow, regardless of the increasing obesity prevalence [9].

Houston et al. found that as adults age, fat-free mass decreases while fat mass increases [2, 6] and becomes redistributed throughout the abdominal area. Although the prevalence has increased in older adults, the prevalence of overweight and obesity among older adults is associated with an increased risk of physical and cognitive disability. Therefore, health professionals have become a valuable resource in guiding and managing weight and health issues in older adults [2]. In those aged 65 years of age or older, hormonal changes begin to occur naturally with age, which may cause the accumulation of fat, and increase the risk of disease, loss of function and mortality [8].

**Causes and Consequences of Obesity**

Obesity occurs when a person consumes more calories than are expended, as there needs to be a balance between the amount of energy that is ingested in the form of foods and the amount of energy that is expended in the form of physical activity [8]. When weight gain begins to occur and individuals consume more calories than the body requires, the balance had been tipped and not enough energy is being expended

to maintain a healthy weight [8]. A decrease in energy expenditure for adults between the ages of 50-65 years contributes to the increase in body fat as aging occurs [8]. Along with dietary patterns, there are other factors that can influence the weight gain in an older person, including lack of/or reduced exercise and hormonal changes. During the aging process, it is natural for hormones, such as growth hormone and thyroid, to begin to shift and change, which often results in an increase of body fat [10]. Elderly individuals who partake in physical activity can regain fitness and prevent themselves from falling beneath functionally important tasks such as rising from a chair or everyday household tasks [4].

Williamson et al. [11] analyzed a sample of 3,515 men and 5,810 women aged 25-74 years to determine the effect that physical activity played on the incidence of obesity and found that low physical activity levels were associated with weight gain (> 13 kg) over a 10 year period. Women with low physical activity levels to be at an almost four times greater increased risk for gaining weight. While the study results suggest that weight gain can be caused by and be a consequence of decreased physical activity in older women [11]. Williamson et al. [11] focused on weight gain due to decreased physical activity, while another study by Visser et al. [12] focused on the risk of disability due to a not enough activity and having a high BMI.

Visser et al. [12] examined 2,714 older (aged 72.4 ± 5.4 years) women to determine their BMI and additionally, used bioelectrical impedance to determine body composition and the effect changing body composition had on disability risk. It was found that in a longitudinal analysis that women in the highest quintile of fat mass were >2 times more likely to be disabled than the women in the lowest quintile. At

follow up, women with higher fat mass at baseline were 2-3 times more likely to become disabled three years later. While BMI is used to classify individuals as obese, it can also be associated with increases in fat mass. This study found that increases in body fatness were associated with increases in the risk for disability [12]. Disability occurs when diminished muscle mass, in relation to an increase in body fat causes an inability to perform normal daily activities [13].

Older women with a high BMI, waist circumference, and greater fat mass tend to have an early onset of physical disability as well as an increased risk for developing dementia. Abdominal obesity is measured by a waist circumference of 88 cm (~35 in) or higher in women as an independent risk factor for cardiovascular disease, type 2 diabetes, dyslipidemia, hypertension, as well as a variety of poor health outcomes. The prevalence of abdominal obesity has particularly risen in women and especially in African-Americans [2]. Higher body weights are associated with increases in all-cause mortality and morbidity in overweight and obese women [2, 7]. Body fat increases through most of adulthood, and older individuals tend to have an increase in the proportion of visceral and abdominal fat [4].

Riebe et al. [14] conducted a study with 821 community-dwelling older adults with a mean age of 76.9 ± 6.3 years old and containing 234 men, and 587 women ranging from a healthy weight to obese. The primary goal of this study was to observe the relationship between adults of normal weight, overweight and obese and how the weight classes are affected by various factors including physical functioning. Overweight participants were at a much higher risk for developing limitations in physical function when compared with those in the normal body weight range.

Results demonstrated that those individuals who were sedentary and not physically active were more likely to have abnormal physical functioning scores when compared with participants who engaged in regularly in physical activities. Women demonstrated lower scores on physical functioning ability compared to the male participants (10.5 ± 0.3 seconds vs. 9.5 ± 0.5 seconds), which can ultimately place the women in a higher risk category for future disability. Also women tend to have a higher percentage of stored body fat and higher rates of obesity and severe obesity when compared to men. Therefore, the authors of this study concluded that obesity has negative effects on physical activity and function in older [14].

Field et al. [15] conducted a 10-year follow up with the women in the Nurse's Health Study to determine if overweight and obesity are risk factors for numerous diseases including cardiovascular disease, diabetes, cancer, hypertension, gallstones, and musculoskeletal problems. In that study, it was determined that the risk for developing some of the above listed diseases increased as BMI increased. Thus, those women with a BMI of 35.0 $kg/m^2$ or more were about 20 times more likely to develop diabetes, (RR = 17.0; 95% CI = 14.2-20.5). The relationship between BMI and the risk of developing chronic diseases was evident among adults with a high BMI, suggesting that adults should try to maintain a healthy BMI as results have constantly shown the adults with a BMI >30 are at an increased risk of death [15].

**Obesity Treatments**

Weight loss can reduce risk factors for diabetes, and cardiovascular disease [8] and there are a variety of treatment options available to assist overweight and obese individuals to lose weight. Although weight loss may not only help to control/prevent

diseases, it may help to decrease the likelihood of developing diseases which can be worsened by obesity [7]. The treatment options available include pharmacotherapy, surgery, behavior therapy techniques, altering physical activity patterns, and dietary therapy [6, 7].

Weight loss medications should never be used without concomitant lifestyle modifications. Weight loss medications may be used as part of a comprehensive weight loss program, which includes diet therapy and physical activity [6, 7]. Thus, the number of obese older adults has increased, due to an increase in both total number of older persons who are living longer and to the percentage of older persons who are obese [6]. Therefore, motivation for the patient is a key component for success in a weight loss program. However, series adverse side effects have been reported, while using weight loss medications such as development of valvular heart disease [7], constipation, insomnia, increases in heart rate and/or blood pressure, as well as gastrointestinal side effects [6].

Weight loss surgery is typically a last option for carefully selected patients who have a BMI >35 $kg/m^2$ with comorbid conditions, and when less invasive weight loss methods have failed [7]. Although these surgery procedures are meant to help, they can also come with serious complications. The laparoscopic-adjustable gastric band may be a better choice than the Roux-en-Y gastric bypass for older adults because the adjustable band is associated with fewer serious complications and a lower mortality rate [6]. Approximately 20% of individuals receiving surgery experience complications, with less than a 1% death rate in all age groups [16]. Surgical interventions are usually safe for older adults, however younger patients have

been found to have better outcomes including greater weight loss and greater resolution of comorbidities [17] than their older counterparts. Although weight loss surgery is beneficial at reducing body composition, it does not improve physical function, or help preserve muscle and bone mass [6] the way physical activity does, and almost all individuals who have weight loss surgery are under lifelong necessary medical surveillance [7]. Therefore, with the risks associated with unhealthy dieting or surgery more effective and safe strategies are needed for the improvement of body composition in older adults.

Behavioral therapy strategies reinforce changes in diet and physical activity in obese adults to produce weight loss in the range of 10% over four months to a year [7]. When behavioral therapy is used in combination with other weight loss approaches, it provides additional benefits in assisting patients to lose weight short-term up to a year, with no additional benefits between three to five years [7]. As changes in the diet and activity levels for older adults present challenges, there is an increased burden of disease, adverse quality of life, depression, and cognitive dysfunction [7]. Therefore, it is particularly important to consider weight-loss therapy for the improvement of physical function in obese older adults.

Physical activity alone results in modest weight loss and increases cardiorespiratory fitness, and decreases abdominal fat in overweight and obese adults, independent of weight loss [7]. However, a combination of a reduced calorie diet and physical activity produces greater weight loss results than diet or physical activity alone [7]. Weight loss results in a decrease in both fat mass and lean body mass, therefore adding endurance and resistance training exercises to a diet program can

help preserve fat-free mass (FFM) during weight loss [6]. Diets should be individually planned as an integral part of any program [7].

Increasing evidence suggests the combination of diet with exercise may yield more superior benefits than diet or exercise alone in reducing weight [18]. Therefore, dietary weight loss is a viable treatment option for obesity, as previous studies have shown promising results for dietary weight loss in older adults. However, there are a few weight loss concerns for the older population, such as nutritional deficiencies, which may be due to a reduced caloric intake, loss of muscle mass and strength [19, 20]. Therefore, further research is needed to determine safe and effective ways to prevent weight gain in obese older adults [21].

Sacks et al. [22] conducted a 2-year study and randomly assigned 811 overweight adults to a diet derived from fat, protein, and carbohydrates, the diets consisted of similar foods. The participants were offered group and individual instructional sessions, and after 2 years a two-by-two factorial comparison of low versus high fat, average vs high protein and a comparison of the highest and lowest carbohydrate content. Weight loss results after 2-years was similar in participants who were assigned to a diet with 25% protein and to those with 15% protein (3.6 and 3.0 kg p=0.22), also similar results were noted in those assigned to a diet of 40% fat and with 20% fat (3.9 and 4.1 kg p=0.76). However, there was no effect on weight loss in the group that consumed 35 to 65% carbohydrates; also, there were no significant changes in waist circumference among either group. Therefore, Sacks et al. concluded diets of fat, protein, and carbohydrates are equally successful in promoting clinically meaningful weight loss that can be maintained over a 2-year

period [22].

Similarly, Miller et al. [23] conducted a six-month randomized trial, where 71 participants were either placed in a weight stable control group (WS) or into an intensive weight loss group (WL) where the goal in the WL group was to lose 10% of the initial body weight by the six month period. Those in the WL group consumed about 1,000 calories per day as the energy intake goal, and the participants were provided two meal replacements such as shakes and bars, the participants were also given a weekly menu plan with recipes to follow for the third meal. The WS group was encouraged to maintain their weight and met bimonthly as a group for general health presentation sessions. At the end of the six month period weight significantly ($p>0.05$) decreased by -8.8 ± 0.7 % in the WL group, while the WS group decreased by -0.1 ± 0.7 %, BMI decreased 3.1 $kg/m^2$ in the WL group, and the WS group showed no change in BMI from baseline to six months. Percent body fat demonstrated significant ($p>0.05$) changes with 2.7% loss in the WL group and a 1.0 %BF increase in the WS group. A limitation to this study was the participants were provided with meal replacements and this study took place in a laboratory setting. Therefore a caloric restricted diet in combination with an aerobic and strength training program may yield body mass and composition benefits from weight loss [23]; similar results were also seen in a study by Frimel et al. [24].

Frimel et al. [24] reported a significant amount of weight loss of ~10% within a six month span in a diet plus exercise group and in a diet-only group of sedentary, obese adults. This six month randomized study involved 30 older (70 ± 5 years) obese

adults with a BMI of 37 ± 5 kg/m$^2$ or more who were assigned to one of two groups: the diet group (n = 15) or the diet and exercise group (n = 15). The measurements of body composition were recorded at baseline and follow-up. Results showed both groups had similar decreases in overall weight (diet: 10.7 ± 4.5 vs. exercise and diet: 9.7 ± 4.0 kg) and fat mass (diet: 6.8 ± 3.7 vs. exercise and diet: 7.7 ± 2.9 kg). While a weight loss approach using diet alone can be effective in reducing body mass, the negative consequence of a loss of lean muscle mass, especially in frail, older adults which can accelerate sarcopenia [24]. This study focused on a diet that was standardized to everyone. Therefore, use of a behavior-based diet can result in significant and meaningful reductions in abdominal fat and overall weight, as a behavior-based diet is tailored to each individual [25].

*DASH Diet:* The Dietary Approaches to Stop Hypertension (DASH) diet program was initially designed for individuals with hypertension; however, the DASH diet has been deemed applicable to most populations [26] thus making it appropriate for older adults as it is behaviorally-based. The modified-DASH diet, which was modified from the original DASH diet, contains goals which include low intake of saturated fat (≤ 7% of caloric intake) and total fat intake of up to 35% from <27% fat of the total caloric intake, high intake of fruit, vegetables, whole grains, and refined carbohydrates, consumption of low fat dairy, lean meats, and moderate intake of sodium (3,000 mg or less per day) [26].

Whitt-Glover et al. [78] conducted a study on African-American adults in an urban community. Therefore, purpose of the intervention was to test the feasibility of

a DASH diet among African Americans in an urban community setting, as cultural barriers occur with DASH adherence, and the perceived higher cost of DASH foods. The 12-week modified DASH intervention consisted of 14 participants in the intervention group and 11 in the control group. The intervention used the social cognitive theory to engage in behavior change that requires social and physical support changes. Participants were also given informational binders tailored to the program to facilitate grocery shopping, budget management, and meal planning. Behavior goals were to increase fruit and vegetable consumption by 9 to 12 servings, low-fat dairy by 2 to 3 servings, to decrease fat consumption to less than 25% of total energy, saturated fat consumption to less than 7% of total energy and sodium consumption to less than 2,300 mg per day. The intervention group participated in one-on-one individual sessions as well as group sessions weekly. While the control group only had one individual counselling session following the DASH diet at baseline and then again at follow-up with no contact between the two testing points, and were offered a modified version of the intervention at the end of follow-up. Post 12-weeks the intervention group decreased systolic and diastolic blood pressure, although the decreases were not significant, while the control group increased systolic and diastolic blood pressure, however, this increase was also not significant. Participants in the intervention group felt confident in their ability to reduce salt and fat consumption, as well as consume healthier snacks. Although this study was not powered to detect anthropometric measures, it was able to detect a decrease in blood pressure, in those who attended at least 6 sessions. Adherence increased when positive messages were associated with their dietary goals. Therefore, this study

determined it is feasible for African Americans in an urban community to partake in a DASH diet [78].

Additionally, Romaguera et al. [27] conducted a study with 48,631 men and women from 5 different countries who participated in the European Prospective Investigation into Cancer and Nutrition (EPIC) Study. The study used detailed questionnaires to assess the participants' diet, lifestyle, medical history, and anthropometric measurements were obtained at baseline. After 5.5 years, results of this study concluded the consumption of 100 kcal of fruit was associated with a -0.04 (95 % CI -0.05 to -0.03) cm/y lower gain in BMI-adjusted for waist circumference ($WC_{BMI}$), and the consumption of 100 kcal of dairy products was associated with -0.01 (95 % CI -0.02 to -0.01) cm/y lower gain in $WC_{BMI}$, whereas those who consumed white bread, processed meat, margarine, and soft drinks were all associated with a positive change in $WC_{BMI}$. A100 kcal increment consumption was associated with 0.01 (95% CI 0.01 to 0.02) cm/y for white bread, 0.04 (95% CI 0.02 to 0.06) cm/y for processed meat, 0.03 (95% CI 0.01 to 0.05) cm/y for margarine, and 0.04 (95% CI 0.02 to 0.07) cm/y gain in $WC_{BMI}$. Therefore, this study concludes a diet high in diary and fruits and low consumption of white bread, processed meat, margarine, and soft drinks may help to prevent abdominal fat accumulation. A major limitation to this study was at follow-up all anthropometric results were self-reported [27]. Although the DASH diet was not designed for weight loss; research has linked the DASH diet with body weight changes [28].

As Blumenthal et al. [29] conducted a study in 144 overweight participants with an average BMI of 33.1 ± 3.9 kg/$m^2$ who had an elevated systolic or diastolic blood pressure. Participants were randomized into one of three groups, the DASH diet alone (DASH-A), the DASH plus weight management (DASH-WM) and a control group. The use of antihypertensive medication, caffeine and smoking was not allowed during participation in this study. Upon completion of the study, there were significant changes in the DASH-WM group body fat percentage (-4.5 %, $p < .001$), trunk fat (-4.1 kg, $p < .001$) and lean body mass (-1.7 kg, $p < .001$) when compared to the DASH-A and control groups. Most notably was the DASH-A group did not show any significant differences in these variables when compared to the control group. However, the DASH-WM group lost an average of 19 pounds over a month period, as well as increased their aerobic capacity by 19%. Therefore, this indicates that the addition of exercise to a diet program in an overweight or obese person's lifestyle can show positive changes in body composition [29] and the best outcomes can be seen in those who participate in both diet and exercise programs [21].

**Resistance Training**

Resistance training (RT) may be a powerful intervention strategy for the retention of lean mass, and improvements in muscle function during weight loss, which may have beneficial long-term implications [30]. Resistance training has been reported to preserve or increase skeletal muscle mass and functional status, as well as improve memory and well-being [31]. Resistance training helps to prevent or reverse increases in body fat, as well as assist in weight control as it increases muscle mass by

a minimum of 1 to 2 kg in older adults in as little as a 10 week RT period [32, 33]. Resistance training is known to be an effective intervention strategy for all age groups, including older populations [34-39].

Minorities, such as African-American women, tend to have the highest prevalence of obesity, with over half the women classified as being obese [2, 40]. Therefore, examining the efficacy of resistance training programs in minorities may be a means of reducing obesity and frailty while maintaining independence, as muscle strength loss is one of the major causes of physical disability in the elderly [41].

To examine the effects of an exercise training program using a group setting for older inner-city African-American women Rogers et al. [41] conducted a four week intervention. Twenty-two older women between the ages of 62 – 94 years were recruited from a senior center in an urban Wichita area and were assigned to either an exercise (n = 16) group, or into a control (n = 6) group. The exercise group met three days per week for four weeks; each session lasted a total of 50 minutes and consisted of seated upper body exercises using elastic bands and dumbbells, and lower body exercises using elastic bands. Each exercise was performed for three sets of 15 repetitions, progression was encouraged by increases the weight of the dumbbells or by increasing the resistance of the resistance bands. The control group maintained their daily routine throughout the four weeks. After 4-weeks, there was no change in BMI in the exercise group (pre- 24.4 ± 1.9; post- 24.3 ± 2.0) or in the control group (pre- 24.1 ± 2.3; post- 24.1 ± 2.2). However, the exercise group did improve in physical function scores. A few limitations to this study were that the women were not obese and more favorable changes in BMI may have been seen, also this study was

only four weeks, and if the study was longer or had more control participants, there may have been more significant results. Also, it is important to note that this community-based RT training intervention lacked a dietary component in the intervention, which may have shown favorable changes in body composition [41].

Resistance training can reduce total fat mass in women independent of dietary caloric restriction [33], lower intensity RT may be a more tolerable exercise modality in older adults, and additionally may increase muscle mass and glucose uptake [42]. To further investigate this with higher weights Castaneda et al. conducted a 16-week trial to test the efficacy of progressive RT on glycemic control in Latino older adults with type 2 diabetes. A total of 62 participants were randomized into either a full body supervised progressive RT group (n = 31) or into a control group (n = 31). The individuals in the RT group exercised three times per week for a 45 minute supervised session, using RT machines for 16 weeks. The control group was asked to maintain their usual care, and did not receive any dietary counseling from any of the study members. After 16 weeks, trunk fat mass was lower in the PRT (18.1 ± 1.2 kg vs. 19.0 ± 1.1 kg; $p < 0.01$) when compared to the control group, as well as a reduction in waist circumference (97.5 ± 2.3 cm vs. 102.0 ± 2.2 cm; $p < 0.07$), leisure time physical activity also increased significantly in the RT group versus the control group (28.3 ± 0.9 vs. 7.2 ± 2.8; $p < 0.001$). This study demonstrates that a RT program is beneficial for older adults in significant improvements in glycemic control, decreased blood pressure, and a reduction in waist circumference, and trunk fat mass [42].

Similarly, Levinger et al. [43] conducted a 10-week RT study with 55 untrained men (n=28) and women (n=27). Each participant was randomized into

either a high number of metabolic risk factors (HiMFT) group, a HiMF control (HiMFC), a low number of metabolic risk factors (LoMFT), or into a LoMF control (LoMFC) group, based on their number of metabolic risk factors. The RT groups performed exercises using weight machines; 3 days per week, for 50-60 minutes including a 3-minute warm up and consisted of 7 exercises for 10-weeks with a 48 hour recovery period between each session. After the 10-weeks both the HiMFT and LoMFT groups demonstrated no effects on body mass ($p > 0.05$), but did demonstrate significant ($p = 0.03$) increases in lean body mass (LBM) when compared with the corresponding control groups. However, LoMFT had positive effects on waist circumference, total fat percentage, and total fat ($p \leq 0.05$). Therefore this study demonstrates RT does have a powerful effect on LBM for both training groups and demonstrated favorable changes in total fat content in the LoMFT group. Although this study did not separate the results by gender as it would have been better to identify the changes per gender, it did depict the total results with favorable outcomes [43].

However, Schmitz et al. [44] conducted a study with 60 moderately obese women between the ages of 30-50 years were randomized to either a treatment group or control group. The treatment group practiced a twice a week RT program for 15 weeks and then the participants participated in a 6 month unsupervised program following the same regimen they learned during the 15-weeks. Improvements in body mass ($-0.35 \pm 0.067$ kg; $p = 0.60$), fat free mass ($0.89 \pm 0.33$ kg; $p = 0.009$), fat mass ($-.098 \pm 0.51$ kg; $p = 0.06$), %BF ($-1.63 \pm 0.58$ %; $p = 0.006$), and waist circumference ($-1.15 \pm 0.80$ cm; $p = 0.15$). This study focused on middle aged adults as opposed to

older adults, and included a large Caucasian population with only 3 minority women. However, this study demonstrated a twice weekly resistance training program can have favorable changes in body composition that can be maintained over time, and applied to the older adult population [44]. Thus, favorable changes may continue to be seen if an exercise program is combined with a dietary intervention.

*Combined Resistance Training and Dietary Interventions:* Ballor et al. [45] conducted a study over the course of an 8-week intervention to assess the individual and combined effects of weight loss and weight training on body weight and body composition. Forty obese women were randomly assigned into a control (C) group, diet without exercise (DO) group, diet plus weight training (DPE) group, or into the weight training without diet (EO) group. Post 8-weeks weight significantly decreased in the DO group compared to the DPE, C, and EO groups (DO: -4.47 ± 0.45 kg; DPE: -3.89 ± 0.32 kg; C: -0.38 ± 0.65 kg; EO: 0.45 ± 0.64 kg; $p<0.05$). Fat weight decreased significantly in all four groups (DPE: -4.32 ± 0.38 kg; DO: -3.56 ± 0.37 kg; EO: -0.62 ± 0.52 kg; C: 0.07 ± 0.37 kg; $p<0.05$). Significant changes were also noted in %BF (DPE: -3.85 ± 0.35%; DO: -2.83 ± 0.46%; EO: -1.21 ± 0.41%; C: 0.03 ± 0.39%; $p<0.05$). This study demonstrates the most significant reductions are observed in the diet plus weight training group. Although the other groups saw changes, overall, the combination of diet and weight training yielded more significant results than any of the other groups alone. The women participating in this study were not older adults as they had a mean age of 32.9 ± 1.5 years, therefore it may be beneficial to conduct a study with obese older adults as similar results to this study can be estimated [45].

Ryan et al. [46] conducted a 16-week RT or RT with weight loss (RT&WL) study on 13 moderately obese postmenopausal women between the ages of 50-65 years. The 6 women who were more obese were placed in the RT&WL group, while the remaining 7 women were placed in the RT group. The RT program consisted of 3 exercise classes per week on nonconsecutive days for 16-weeks using 14 different exercises on resistance machines, dumbbells, and floor exercises. Those in the RT&WL group began the diet sessions 4-weeks prior to the start of the study and continued the diet consisting of 50-55% carbohydrates, 15-20% protein, ≤30% fat, and ≤300mg of cholesterol per day throughout the remainder of the study. After the 16-weeks the RT&WL group lost weight, reduced body fat mass, and %BF ($p < 0.001$), as well as significantly decreased waist circumference ($p < 0.05$), however, there was no change in waist to hip ratio, while the RT group did not change body composition results. Thus, Ryan et al. concludes the greatest reductions were seen in the RT group with a dietary intervention compared to the RT group alone. Although this study saw significant results, the study was not randomized and the participants were specifically placed in their respective groups, based on their level of obesity, also, this study did not include a control group and the diet was specifically focused on weight loss [46].

Wycherley et al. [47] conducted a study with a total of 83 men and women with type 2 diabetes, with a mean age of 56.1 ± 7.5 years took part in a 16-week intervention. The participants were randomly assigned to an energy-restricted standard carbohydrate, low-protein, low-fat diet alone (CON) group, or with RT (CON + RT); or an isocaloric higher-protein, moderate-carbohydrate, low-fat diet alone (HP), or with RT (HP + RT). The resistance training sessions lasted about 45 minutes,

which allowed ~8-12 repetitions for 2 sets for each of the 8 exercises performed. Post 16-weeks, only 59 participants completed the study, with significant ($p<0.001$) changes from baseline to post testing in all four groups in body weight, BMI, total body fat mass, waist circumference, and total fat free mass. Between the four groups, the greatest and most significant ($p<0.001$) changes were seen in the HP + RT group. This study demonstrated that the addition of RT to a protein diet further magnified weight and fat mass loss. Although this diet demonstrated significant results, it lacked a true control group, it also kept the men and women's results together, rather than separating the two and demonstrating the results per gender [47]. By separating the two genders, it would be easier to see if any changes within the genders on body composition have occurred.

In a more recent study by Valente et al. [48] combined a dietary intervention with a resistance training program. Twenty-seven participants (11 males, 16 females) between the ages of 60-75 years, who were also overweight or obese (BMI 25 – 39.9 $kg/m^2$) were randomly assigned to either a diet education only (DE) group (n=12) or into a dietary education plus resistance training (DERT) group (n=15). All participants took part in a 30-minute DASH-based DE class per week, for the 12-week study duration, focusing on interpreting nutrition labels, recognizing whole grains, and self-monitoring. All DE classes were led by a registered dietitian, and all participants were encouraged to engage in at least 30 minutes of physical activity most days per week. The DERT group, along with the DE classes they participated in a 40 minute supervised session, three days per week on non-consecutive days focusing on six lower and upper body exercises on RT machines, along with age appropriate

stretching techniques. Each participant completed four sets of 8-12 repetitions per exercise and resistance was gradually increased. Over the 12-weeks, the DERT group was able to significantly reduce body weight from baseline to post testing (87.1 ± 14.5 kg, 83.8 ± 12.6 kg; $p < 0.05$) when compared to the DE group (87.2 ± 13.5 kg, 85.5 ± 13.7 kg). Percent body fat decreased in the DERT from baseline to post testing (41.4 ± 8.1%, 38.3 ± 9.1%; $p < 0.05$), as did BMI (31.5 ± 3.8 kg/m$^2$, 30.4 ± 3.4 kg/m$^2$; $p < 0.05$), as well as fat mass (36.1 ± 8.9 kg, 32.0 ± 8.3 kg; $p < 0.05$), while the DE group did not have any changes in percent body fat, BMI, and fat mass. This study found the addition of RT to a DE intervention is an effective way in reducing body composition measurements in overweight and obese older Caucasian men and women [48]. A limitation to this study is that the results were not separated by gender, and the study consisted of Caucasian older adults. Including an aerobic exercise intervention, such as Tai Chi may yield beneficial results in body composition.

**Tai Chi**

Tai Chi (TC) is a traditional Chinese martial art callisthenic exercise, which shows potential as an alternative form of exercise for preserving physical function, balance, flexibility, mental well-being, reduces blood pressure, and shows positive effects on body composition such as a decrease in body fat in older adults [31, 49]. Studies have shown TC to be a moderate intensity exercise [50, 51] that focuses on maintaining a slow controlled tempo [50] at an intensity equal to 60% of maximum heart rate [51]. Tai Chi has been shown to be appropriate and well-tolerated in older populations [52].

Tai Chi has shown to be a beneficial form of aerobic exercise [53-60]. For example, Audette et al. compared TC to brisk walking in 19 sedentary healthy women aged 71.4 ± 4.5 years from the Boston area and randomly assigned them to one of two groups. One group was the TC group and the other was the brisk walking group (BWG). Both exercise groups practiced for 3 days per week for 1hour for 12-weeks. After 12-weeks, significant improvements were seen in estimated VO2max in the TC group compared to the BWG ($p = 0.08$). Therefore TC was found to be an effective way to improve fitness measures in elderly women within a 3-month period and was found to be significantly better than brisk walking [57].

Similarly, Imayama et al. randomized a group of overweight/obese women into a 12-month study, 118 were assigned to a diet weight loss group, 117 were assigned to a moderate-to-vigorous aerobic exercise group, which participated in 225 minutes of exercise per week, then 117 were randomized into a combined diet and exercise group, lastly, 87 women were randomized into a control group. Body weight decreased from baseline to the 12 month follow up in the diet group by 8.5% ($p < 0.01$), a decrease in the exercise group by 2.4% ($p < 0.03$), and the diet and exercise group decreased by 10.8% ($p < 0.01$) compared to the control group. However, the diet portion of this study focused on weight loss as opposed to a healthier diet quality. Therefore, this study further verifies that the combination of diet and exercise may have a larger beneficial effect than diet or exercise alone [18].

Tai Chi is known is also known for its many other benefits and Chyu et al. found that TC has reduced the risk of falling and has improved physical function in adults older than 65 years. These results were determined based on a 24-week

randomized trial where Chyu et al. randomly assigned 30 participants to the TC group, which practiced three days per week for 60 minute sessions for 24-weeks, and 31 participants were randomly assigned to a control group, yielding a total of 61 participants. After the 24-week study, stride length, timed up and go, improved, and the number of falls reduced from baseline to post testing, in the TC group when compared to the control group. Although this study did not assess changes in body composition, it does demonstrate other benefits from practicing TC in improving physical function and reducing fall risks [61].

Similarly, Murphy et al. [62] examined the effects of TC in 31 community-dwelling older women who were at risk for osteoporosis or who had osteoporosis. Participants participated in two, 60 to 90 minute TC classes per week for 12 weeks. After 12 weeks, significant improvements were reported in balance on the right leg which was not maintained at the 6 or 12 month follow up, and on the left leg which was maintained at the 6 month follow up. There was a significant decrease in timed up and go and repeated chair stand times that was maintained at 6 and 12 months ($p \leq 0.001$). Therefore, TC demonstrated benefits in balance and physical function [62]. However, similar to the previous study examined, this study also did not report on how the TC intervention affected body mass or body composition.

Although most studies have demonstrated that TC positively affects physical function, balance, well-being, and blood pressure, Man et al. conducted a study in a slightly different direction, focusing on attention and memory function on community-dwelling seniors aged 60 years or older. The study compared TC practitioners (n = 42), regular exercise practitioners (n = 49), and a sedentary control (n = 44). During

this cross-sectional study, those who practiced TC at least three times a week for about 45 minutes individually for three or more years were randomly selected to participate, a similar comparison exercise group was also selected. Although this study did not focus on any other health aspects other than attention and memory, it was able to conclude that TC practitioners did better in attention (sustained and divided) ($p < 0.05$) as well as memory (memory function, recall, organization, and encoding) ($p < 0.05$) when compared to regular exercise practitioners and sedentary individuals of the same age group [63].

**Tai Chi Effects on Body Composition**

There are a wide variety of reports on the benefits of TC; however, very little research has been done to study the effects TC has on body composition. Lan et al. [64] is one of the few groups who have looked into the effects of TC on body composition by examining the five year changes in aerobic capacity on fat ratio and flexibility in older adults who regularly practiced TC. A total of 69 community dwelling older adults with a mean age of 68.6 ± 6.3 years, were divided into two groups; those who practiced TC (n = 35, (18 men, 17 women)) regularly for the past 6.3 ± 3.7 years, and a sedentary control group (n = 34, (16 men, 18 women)) who remained inactive throughout the study. Both baseline and follow up measures were recorded for the TC group, where 4.9 ± 0.43 years past between measures, and the control group, waited 4.86 ± 0.41 years between measures. At baseline, those in the TC group had lower levels of body fat ratio compared to the control group. Results at follow up showed both groups had increases in body fat ratios ($p < 0.05$); however the increase was smaller in the TC group. The results of this study suggest that although

substantial differences were not seen in body fat ratio levels, the use of regular Tai Chi practice may reduce the onset of weight gain associated with the natural aging process [64].

Similar to his previous study, Lan et al. [65] conducted another study examining the effects of Tai Chi on health and fitness measures in 38 community dwelling men and women, between the ages of 58-70 years. Participants were randomized into a Tai Chi group, which participated in approximately one hour per day, 4.6 ± 1.3 days per week for 12 months, and a sedentary control group. Percent body fat was assessed via skinfold measurement at the triceps and subscapular sites. The TC group determined a tendency towards decreasing percent body fat compared to the control group. Male TC participants had a reduction in percent body fat (20.6 ± 4.0% vs. 19.5 ± 4.2%) compared to males in the control group (20.2 ± 4.5% vs. 20.6 ± 4.3%; $p = 0.114$). Female TC participants also had a reduction in percent body fat (28.8 ± 4.5% vs. 27.5 ± 4.8%) compared to control subjects (29.0 ± 4.6% vs. 29.5 ± 5.1%; $p = 0.089$). Although the decreased percent body fat in the TC subjects was not significant, the decreasing trend is promising not only for women, but also for men [65]. To further improve body composition, along with TC, a dietary intervention may be an appropriate variable to add in combination with TC.

**Tai Chi and Dietary Intervention**

A 10-week pilot study was conducted by Dechamps et al. [66] with 21 obese women who were randomly assigned to either a two-hour weekly session of TC (n = 11) or a conventional structured exercise program (E) (n = 10). Both groups underwent a 10-week weight management program that focused on a hypocaloric

individualized balanced diet that was monitored weekly by a dietitian. Both of the exercise classes met once per week in a hospital setting. All participants who took part in the study completed the 10-week study and returned for the 30-week follow up. Post study measurements found the TC group has demonstrated a reduction in BMI (TC: 36 ± 5.6 kg/$m^2$; CI 95% -2.3 to -0.3 vs. E: 39.3 ± 8.2 kg/$m^2$; CI 95% -2.1 to 3.5), fat mass (TC: 42.6 ± 9.5 kg; CI 95% -6.4 to -1.7 vs. E: 51.5 ± 13.6 kg; CI -4.9 to 8.5), and percent body fat (TC: 45.6 ± 5.1 %; CI 95% -4.4 to -1.2 vs. E: 48.1 ± 4.7 %; CI 95% -6 to 1.7) when compared to the E group. Although this study was lacking a control group, it was able to demonstrate that TC plus diet may be beneficial for reducing body composition in physically deconditioned patients since TC encourages slowly fluid movements [66].

In a recent 16-week study conducted by Katkowski et al. [67] randomized 27 women into a Tai Chi during dietary weight loss (TCWL) group (n=14) and into a weight loss (WL) group (n=13). The participants in the TCWL intervention group saw a significant within-group reduction in body weight (-2.2 ± 0.9 kg, p = 0.017). Within-group differences were also observed in BMI (-0.9 ±0.3 kg/$m^2$, p = 0.018), waist circumference (-3.4 ± 1.1 cm, p = 0.006), body fat mass (- 2.0 ± 0.7 kg, p = 0.011), and percent body fat (-4.8 ± 1.7 %, p = 0.010). Although this study took place in a laboratory setting, it demonstrated significant reductions in body weight; however, a control group would have been beneficial to further compare the results independent of a laboratory based intervention [67].

Similarly, Bekke et al. [68] conducted a 16-week community-based intervention in obese older women between the ages of 55-80 years. Participants were

assigned to one of two groups in the order they were screened, either the Tai Chi during dietary weight loss (TCWL) group or into the Control (CON) group. The TCWL group met two times a week for 16-weeks for about 30-35 minutes to practice TC and met once per week for 45 minutes implementing the modified DASH diet. After 16-weeks, significant ($p < 0.05$) within group changes were found in the TCWL in body fat mass (-3.0 ± 1.5 kg, $p = 0.05$) when compared to the CON group. Also there were significant ($p < 0.01$) changes for within group measures for TCWL in weight (-1.6 ± 0.5 kg, $p = 0.003$), BMI (-0.67 ± 0.2 kg/m$^2$, $p < 0.001$), waist circumference (-4.8 ± 1.2 cm, $p < 0.001$) and waist-to-hip ratio (-0.03 ± 0.01, $p = 0.001$) when compared to the control group [68]. Although this study saw significant results in body fat mass, weight, waist circumference, and waist-to-hip ratio, most of the weight loss may be attributed to the caloric restriction as this was a weight loss study and the aerobic exercise may not have been a sufficient enough. As the USDA recommends participants to participate in 150 minutes of moderate intensity aerobic activity each week as well as at least two days a week of strength training activities [69]. Another limitation to this study, was it had a strong Caucasian representation, and no minorities [68].

Tai Chi is not the only form of exercise safe for older adults that is known to yield benefits to prevent/delay the onset of age-related declines, which occur naturally [70]. Not only does TC improve physical function, resistance training can also successfully increase function in older adults and are now, more commonly being recommended [71]. Therefore, there is a need for more studies to combine aerobic

and strength training along with healthy eating habits in community settings.

**Combined Resistance Training and Tai Chi**

Very few studies have addressed the combination of TC and RT. However, Thomas et al. examined the effects of a 24 form Yang style Tai Chi compared to resistance training and to an active control group. A total of 207 men and women, with a mean age of 68.8 ± 2.9 years were randomized to complete either a three time per week Tai Chi intervention session for one hour each visit, or into a three time per week resistance training program for one hour each visit, or into a usual physical activity control group for 12-months. At the 12 month follow up, no significant changes were observed in waist circumference between all three groups (TC group -1.5 cm vs. RT group -1.7 cm vs. control -0.1 cm, $p = 0.35$) and percent body fat assessed using dual energy x-ray absorptiometry (TC group -0.1 % vs. RT group -0.2% vs. control -0.4%, $p = 0.43$). All three groups had an increase in BMI (TC group 0.3 $kg/m^2$ vs. RT 0.1 $kg/m^2$ vs. control 0.1 $kg/m^2$, $p = 0.82$) that too was not significant. There was a significant within group reduction in percent body fat among the control subjects (-0.4%, $p < 0.05$) and within group reductions in waist circumference in the TC (-1.5 cm, $p < 0.05$) and RT groups (-1.7 cm, $p < 0.05$). The study did not have a dietary intervention, which may have aided in the reduction of body fat mass when added to a Tai Chi program or to a RT program [31].

In a similar study, Woo et al. conducted a randomized controlled trial of TC and resistance exercise in community-living elderly people. In that study, 180 participants (90 men, 90 women) between the ages of 65-74 years were recruited, from local community centers in Hong Kong, China. Participants were randomized

into one of three groups. Either into the TC group (n=60, 30 men, 30 women), the resistance exercise (RTE) group (n=60, 30 men, 30 women), or into the control group (n=60, 30 men, 30 women). The TC group met three days per week for 12-months focusing on the 24-form Yang style. While the RTE group met three times per week for 12 months focusing on motions such as arm lifting, hip abduction, heel raise, hip flexion, hip extension, squatting ankle dorsiflexion; all exercises were repeated 30 times using medium strength therabands as the mode of resistance. The control group was asked to maintain their normal routine for the duration of the study. At 12-weeks, no changes were observed in BMI for either group. Quadricep strength and flexibility increased in the RTE group when compared to the TC and control groups. As both the TC and the RTE groups demonstrated increased leg strength and flexibility, it may be appropriate apply this combination to community exercise programs as both TC and RTE tend to have good compliance [72]. This study lacked a dietary intervention, and did not focus on other body composition outcomes; however, it was able to yield benefits in strength and flexibility between the groups.

Similarly, Zhuang et al. conducted a study to determine the effectiveness of a combined exercise intervention in community-dwelling older adults. For a 12-week intervention, Zhuang et al. recruited 56 community-dwelling older adults between the ages of 60-80 years from a Shanghai community. All participants were randomly assigned to either the intervention group (n=22), or into the control group (n=28). The intervention group underwent a 12-week exercise program, meeting three times per week for 60 minutes participating in exercises which consisted of strength training targeting the lower extremities, postural muscles, abdominal muscles, and back

exercises. All strength exercises used only body weight, no additional equipment was used. Along with the resistance exercises, an 8-form Tai Chi series was also taught. Throughout the 12-weeks, the control group was asked to maintain their normal lifestyles. After 12-weeks, the intervention demonstrated there was a significant ($p < 0.001$) improvements in the 30-second chair stand, timed-up-and-go test, and walking speed also significantly ($p< 0.001$) improved in the intervention group compared to the control group. Even though this study did not focus on body composition, it was able to improve fall related risks, indicating a reduction in falls among community dwelling older adults [74]. Although TC and RT were combined, this study lacked a dietary intervention for healthy eating habits, which may yield favorable changes in body composition, reducing the risk of chronic diseases, as well as improved strength and aerobic capacity with all three interventions combined.

As aerobic training is similar to TC, Willis et al. [73] conducted a 4-month run in phase study on 119 overweight and moderately obese adults between the ages of 18-70 years. The participants were randomized to an aerobic training, RT, or a combination (AT/RT) group. Resistance training practiced 3-days a week, 3 sets a day, for 8-12 repetitions, the aerobic training group exercised at a calorically equivalent to ~12 miles per week at 65-80% VO2, and the AT/RT group did the same workout the RT and aerobic groups participated in. After the 4-month study completed body weight significantly decreased in the aerobic training group ($p < 0.001$) and AT/RT group ($p = 0.004$), but significantly increased in the RT group ($p < 0.05$). Fat mass and waist circumference both significantly ($p < 0.001$, $p < 0.05$) decreased in the aerobic and AT/RT group but did not change in the RT group.

However, lean mass did significantly ($p < 0.001$) increase in the RT and the AT/RT group, but not the aerobic training group. However, the combination of AT/RT significantly ($p < 0.001$) reduced waist circumference more than the RT or aerobic training groups alone. Willis et al. concluded that the combination of aerobic plus resistance training did not provide an additive effect in reducing fat mass or body mass when compared to RT or aerobic training alone. A few limitations to this study were the lack of a dietary component, the majority of the participants were Caucasian (n= 101) with few minorities (n= 18), and this study did not have a control group. Therefore, a combination of interventions with diet may have yielded greater benefits in the reduction of body composition.

Similarly, as aerobic training is similar to TC, Hornbuckle et al. [75] conducted a 12-week intervention where middle aged overweight African-American women were randomly assigned to either a walking (W) group (25), or a walking plus resistance training (WRT) group (19). Both walking groups were instructed to increase their daily walking steps by ≥10,000 steps per day as measured by a pedometer. The WRT group in addition to the walking they participated in a supervised RT program 2 days a week for 12-weeks. After the 12-weeks, both groups significantly ($p < 0.001$) increased walking and the WRT significantly reduced waist circumference (94.8 ± 12.3 cm to 92.9 ± 12.0 cm; $p = 0.021$), total fat mass (42.6 ± 11.1 kg to 41.8 ± 10.8 kg; $p = 0.036$), and body fat (45.8 ± 6.2 % to 45.3 ± 6.2 %; $p = 0.018$) when compared to the W group who showed no changes. Both interventions increased their steps per day, however, only the WRT group was more effective in improving body composition, thus making the combination of aerobic and RT an

effective intervention strategy to facilitate favorable reductions in body composition in overweight and obese African-American women. A couple of limitations to this study are that it did not incorporate a dietary intervention to promote healthy eating nor did it contain a sedentary control group [75].

**Combination of Aerobic, RT, and Diet interventions**

The combination of Tai Chi, RT, and diet is under investigated; however, there are similar studies such as Layman et al. [76], who conducted a 16-week study that looked at the additive effects of diet, aerobic training and resistance training. Forty-eight women were randomized into either a low carbohydrate: protein ratio (PRO) group, a high carbohydrate: protein ratio (CHO) group, or a PRO plus exercise (PRO+EX) or a CHO plus exercise group (CHO+EX). The exercise group was required a minimum of walking for five days per week for 30 minutes, plus two days a week of resistance training for 30 minutes, using weight machines and completing a minimum of one 12-repetition set on each machine with weight heavy enough to feel fatigued by the final repetition. Post 16-weeks participants in the PRO and PRO+EX groups reduced fat mass by 7.3 ± 0.8 kg, while the CHO and the CHO+EX groups only reduced fat mass by 5.3 ± 0.3 kg ($p<0.05$). Body fat was also reduced in the PRO+EX and the CHO+EX by 7.2 ± 0.7 kg ($p<0.05$). The combined effects of the PRO+EX group had a decrease in absolute body fat by 21.4%, therefore the additive effects of the PRO+EX treatments on body composition were apparent with significant main effects of diet ($p<0.01$) and exercise ($p<0.001$). The participants who consumed more protein and less carbohydrates (PRO and PRO+EX) lost more total weight and fat mass than ($p=0.10$) than the groups consuming more carbohydrates and

less protein (CHO and CHO+EX) [76]. Although favorable alterations in body composition, muscle strength and physical function have been observed following community-based interventions, there remains a lack of data on the effects of community-based programs that integrate TC, RT and dietary interventions for healthy eating habits on body composition in overweight and obese older adults, especially in minority women.

**Conclusion**

Obesity is a growing public health problem in the United States, as obesity rates are high and continue to increase, especially in older women [1, 2]. Obesity exacerbates the age-related decline in chronic diseases, physical function, increases BMI, and causes frailty in older adults [3, 77]. Therefore, there is a need to examine alternative forms of physical activity that have not yet been thoroughly studied to determine if they are effective in modifying body composition in older women, since most exercise interventions have utilized traditional exercise modalities such as aerobic or resistance training [30], non-traditional methods such as combining resistance training, Tai Chi, and a dietary intervention may be effective. Unfortunately, there currently is little information reported on older women in an urban setting that has examined effects of a combined Tai Chi, resistance training, and dietary intervention program. Little information has also been reported on interventions with a strong minority representation of obese older women. As previous studies have been performed to examine the effects of exercise alone, such as resistance training or Tai chi, and diet alone on its benefits in change in body composition, weight loss, and the improvement in overall health, a combination of

aerobic, strength and diet may be beneficial and yield favorable results. Therefore, it may be necessary for research to examine these combined effects on an obese, postmenopausal population in a community setting in order to find a suitable intervention that may be applied to obese older women, and minorities to prevent further unhealthy changes/increases in body composition.

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## APPENDIX B: 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 $kg/m^2$, 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.

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.

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 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 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.

*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.***

Approved by the University of Rhode Island IRB on October 2, 2012

## APPENDIX C: PHONE SCREENING

### RHODE ISLAND DIETARY EDUCATION AND ACTIVE LIFESTYLE (UR-IDEAL) STUDY – PHASE 5

### Data Sheet for Detailed Subject Telephone Interview

**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
  Within reasonable commute___ Willing to make unreasonable commute___
  Too far to commute_____

- **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

- **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 <u>detail</u> (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:_____
  _____

- **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:_____

  _____

- **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 _____Need More Information
  _____Needs Drs. Delmonico, Xu, or Lofgren to review _____ Not Qualified

  Questions/Comments:_____

**UR-IDEAL Study - Medication/Dietary Supplement Form**

| | |
|---|---|
| **Name** | |
| **Date** | |

| Condition/Reason | Severity | Name of Medication/Supplement | Date started | Dose (mg/times/day) | Expected to Change? |
|---|---|---|---|---|---|
| | | | | | |
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**APPENDIX D: MEDICAL HISTORY**
**The University of Rhode Island Dietary Education and Active Lifestyle (UR-IDEAL) Study**

**Name:**_____ **Sex: M F 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.

**SECTION *A***

YES NO

**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. 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 resting? _____ _____

   If yes, is it a current problem? _____ _____

4. If yes, is this pain relieved by rest or by discontinuing your walk _____ _____

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? _____

Was Echocardiography ever done?

7. Have you ever had any chest pain or discomfort other than breast pain

(in women) 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-

Other-

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

If yes,

What was the diagnosis?

Were you given any medications?

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

Comments:_____
_____
_____
_____

**SECTION *C***

**Respiratory System:** YES NO

1. Have you ever had persistent cough with sputum production (on most days) for 3 months for consecutive 2 years? _____ _____

If yes,

a. How long did it last?
b. Did your doctor prescribe any medications?

2. 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?

Comments:_____
_____
_____

**SECTION *D***

**Endocrine system:**

Have you ever had any of the following symptoms? **YES** **NO**

a. Thyroid problems?

b. Adrenal problems? _____ _____

c. Diabetes mellitus? _____ _____

If yes, which type? Type 1 Type II _____ _____

Date of onset- _____ _____ _____

Were you on any medication, diet control

_____ _____

**SECTION *E*** **YES NO**

**Reproductive system:**

Menstrual History

a. Have you attained menopause?
If so, move on to question b and then to section F. If not, proceed to the question c.

b. Are you on Hormone Replacement Therapy?

Comments:_____
_____
_____
_____

**SECTION *F*** **YES NO**

**Neurological system:**

1. Do you have any problems with your memory? If yes,

a. When answering the telephone, do you recall what _____ _____
you were doing before it rang? _____ _____

b. If someone calls you, can you give the directions to your house? _____ _____

c. Can you keep appointments without a reminder? _____ _____

d. Can you remember what clothes you wore yesterday? If the subject answers "no" to any of the above questions _____ _____

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?

**YES NO**

12. Pain in your lower back?
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 you 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***

**YES NO**

**Hematology/Immunology/Oncology :**

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?

If yes,

a. Where and for what purpose?

b. Date of Surgery?

c. Length of stay in hospital

d. Any complications of Surgery?

Comments:_____
_____
_____

**Has your doctor ever told that you have been suffering from**

i. Cystic medial degeneration

ii. Any other Connective tissue disorder?

**YES NO**

Has any of your family member had an intracranial aneurysm or bleeding? _____ _____

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***

**YES NO**

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

If yes, please do specify.

Comments: _____
_____
_____

## APPENDIX E: MEDICAL CLEARENCE

# Medical Clearance to Participate in a Healthy Diet and Exercise Research Project

_____ 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 $kg/m^2$) 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

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
5. _____ 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: _____

**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 |
|---|---|---|---|---|---|

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 |

## APPENDIX G: 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: WEEKLY DIET EDUCATION SESSIONS OUTLINE

1. Intro/common food beliefs (Feb 6th):
a. Snack: Granola bars
b. Give-away: nutrition binder

2. Food label reading (Feb 13th):
a. Snack: Valentines – Chocolate and vanilla animal crackers
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)
b. Give-away: Fiber one cereal samples

4. DASH (Feb 27th):
a. Snacks: dark chocolates
b. Give-away: Dark Chocolates

5. Fats (March 6th):
a. Snacks: nuts
b. Giveaway: Tablespoon/teaspoon

6. Fruits and vegetables (March 13th):
a. Snacks: fruit salad
b. Give-away: chip/veggie clip

7. Grains (March 20th):
a. Snack: brown rice chips.
b. Give-away: whole grain pens, whole grain pins , whole grain stickers

8. Protein (March 27th):
a. Snacks: almond butter and crackers (or sunbutter and/or peanut butter and/or cashew butter) Give-away: Mrs. Dash packets

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
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
b. Give-away: flax seed packets

11. Healthy beverages (April 17th):
a. Snack: Sparkling water and crystal light
b. Give-away: crystal light packets

12. Wrap up (April 24th):
a. Snack: Ppt can request a healthy snack
b. Give-away: URIDEAL pens

## APPENDIX I: DATA COLLECTION SHEET

Name: Baseline Checklist Date:

| Test | Checklist | Completed By: | Date Completed |
|---|---|---|---|
| Blood Pressure 1 | | | |
| Blood pressure 2 | | | |
| Height | | | |
| Weight | | | |
| Waist Circumference | | | |
| Hip Circumference | | | |
| Body Composition | | | |
| SPPB | | | |
| TUG | | | |
| Grip Strength | | | |
| Chair Sit and Reach | | | |
| Leg Strength | | | |
| DST | | | |
| PSQI (Sleep Quality) | | | |
| YPAS | | | |
| NCI | | | |
| Body Satisfaction | | | |
| Life Satisfaction | | | |
| Resiliency | | | |
| Education | | | |
| Blood Markers | | | |

Pacemaker/Internal Defibrillator? Yes_____ No _____