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The Combined Effect of Tai Chi and Weight Loss on Physical Function in Community Dwelling obese Older Wommen

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THE COMBINED EFFECT OF TAI CHI AND WEIGHT LOSS ON PHYSICAL FUNCTION IN COMMUNITY DWELLING OBESE OLDER WOMEN

BY

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Abstract

Introduction: Older obese women are at risk of obesity-related disability, but Tai Chi has not been explored as an exercise modality along with weight loss for their effects on physical function. **Methods:** A 16-week community-based intervention was conducted to assess the impact of Tai Chi plus behaviorally-based weight loss (TCWL, n=29) on obese (BMI=35.4 ±0.8 kg/m^2) older (68.2±1.5 yr) women compared to a control group (CON, n=9, BMI=38.0±1.5kg/m^2, 65.6±2.7 yr). The major outcome was the short physical performance battery (SPPB), consisting of 4-m gait speed (GS), standing balance, and chair stand (CS) tests. The TCWL group participated in two Tai Chi sessions and one dietary weight loss session per week with a goal of 5-10% weight loss. The CON group was asked to maintain their normal lifestyle. **Results:** The TCWL group lost weight, (1.6±2.9 kg, P=.006) while the CON group showed no significant change (1.2 ± 1.9 kg P=.11). SPPB score improved in TCWL (0.59±1.28, P=.023) when compared to the CON group (-0.56±1.81, P=.38). TCWL group improved GS (-0.14±0.76 sec, P=.34) time better (P=.004) than CON (0.56±0.81 sec, P=.07) and also improved CS (-0.80±1.71 sec, P=.02) time better (P=.065) than CON (0.28±2.83 sec, P=.77). Participants in the TCWL group who lost ≥ 3.0% (n=9) body weight saw improvements in SPPB (P<0.01) and flexibility (P<0.05). Weight losers in the TCWL group saw improvements compared to the CON group in SPPB (P<0.001). **Discussion:** Tai Chi combined with dietary weight loss may represent an effective intervention strategy to maintain and improve physical function in older obese women.

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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: *The Combined Effect of Tai Chi and Weight Loss on Physical Function in Community Dwelling Obese Older Women.*

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Publication Status

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Introduction

Obesity combined with age related muscle loss act synergistically resulting in reduced physical function capabilities (3). The National Health and Nutrition Examination survey estimated 42.3% of women aged 60 and older are obese (15), defined as a body mass index (BMI) of ≥ 30.0 kg/m^2. Obesity is shown to be associated with a higher incidence of cardiovascular disease, diabetes, low physical function and mortality compared to normal weight (32). In addition, over the past 10 years the total number of older adults in the U.S. has increased at a faster rate (15.1%) than the total U.S. population (9.7%) (9). Aging is associated with a loss of muscle, decreased bone density, and fat gain (14, 38). Women with BMIs ≥ 30.0 kg/m^2 are twice as likely to have limited activities of daily living (ADL) and women with BMIs ≥ 35.0 kg/m^2 are four times as likely of having an ADL (32).

Treatments for obesity include weight loss surgery and medications, however surgeries have not been shown to be completely safe and most pharmacotherapy studies exclude older obese individuals so efficacy and safety have yet to be determined (37). Dietary weight loss can be an effective strategy for weight loss (24, 37). The Dietary Approaches to Stop Hypertension (DASH) program (32) has been shown to be an effective intervention for weight loss (31), although it was originally designed to treat hypertension (6). Dietary weight loss alone has been shown to be an effective weight loss strategy (24, 37), however weight lost through diet alone is 75% fat and 25% muscle (37). The amount of muscle lost further adds to the muscle loss associated with aging, exacerbating physical function limitations (3). Research has shown that resistance training combined with the DASH diet has positive effects on

physical function in older overweight adults (6, 30) However, alternative exercise modalities need to be explored as effective options for older women during weight loss.

Tai Chi, a traditional Chinese martial art exercise, is a potential alternative form of exercise for preserving physical function in older adults (39). Tai Chi is a moderate intensity exercise (16, 21) equal to 60% of maximum heart rate (21) and well-tolerated in older adults (1). Tai Chi effectively improves physical function measures such as the chair stand test, up-and-go test, and grip strength in older populations (16, 36). A recent study by Katkowski et al. (18) examined the outcome of Tai Chi on older, overweight women. Participants were randomized into a weight loss or weight loss plus Tai Chi intervention. Both groups lost a statistically significant amount of weight ($p<0.05$), but no significant physical function changes were found between the two groups. While our studies are similar, Katkowski (18) employed a randomized design and was done in a laboratory setting. Despite research showing improvements in physical function using Tai Chi in an older population (16), no studies have looked at the effect of Tai Chi during intentional weight loss in a community setting on older obese women. There is a need to examine the effects of Tai Chi and dietary weight loss in a community setting. It is important to deliver community based interventions because that community setting may continue to carry the program after completion of the intervention allowing the ability for participants to conveniently continue exercising. Therefore the purpose of this study was to assess the changes in physical function in older, obese women using a combination of Tai Chi and dietary weight loss in a community setting. We hypothesized that Tai Chi

plus weight loss (TCWL) will result in physical function improvements compared to a control (CON) group as measured by changes in short physical performance battery (SPPB) performance.

Methods

Study Design

This study employed a non-randomized experimental design consisting of baseline testing, a 16 week intervention, and post-intervention testing in older obese women. The intervention took place at both the South Kingstown and North Kingstown Senior Centers in Rhode Island. This study was approved by the Institutional Review Board at the University of Rhode Island in November, 2011.

Participants

This study had a series of inclusion and exclusion criteria to assess eligibility to the study. Eligibility criteria included 1) Being a female 2) BMI between 30.0-50.0 kg/m^2, 3) currently (within past six months) not engaged in a regular exercise program, 4) weight-stable (within 5%) within the last three months, 5) post-menopausal by self report. Exclusionary criteria included 1) failure to provide informed consent, 2) significant or suspected cognitive impairment, defined as known diagnosed dementia, 3) severe hearing loss, speech disorder, language barrier or visual impairment, 4) terminal illness with life expectancy of <12 months as determined by physician, 5) severe pulmonary disease, uncontrolled diabetes, blood pressure, or anemia, 6) medications not taken for > 3 weeks, lipid lowering medications for > 6 months, 7) major joint, vascular, abdominal, or thoracic surgery within three months,

8) significant cardiovascular disease, 9) inability to safely engage in mild to moderate exercise with muscular exertion.

Participants were recruited from the South Country area through advertisements in local papers, flyers placed in monthly senior center newsletters, internet announcements on social media sites, and flyers mailed to women over 55 years in the local community. To assess eligibility, individuals interested in the study completed an over-the-phone interview providing information regarding height, weight, medication usage and past medical history. If a participant appeared to qualify, she was asked to come to an orientation session to learn more about the study, ask questions, provide an informed consent and complete a second, more detailed medical history. Participants were given medical clearance forms for their primary care physicians to sign, but this was not required. After completion of the orientation sessions, interested and qualified participants were scheduled for baseline testing. Fifty-four participants were initially recruited for the study (Figure 1). Sixteen participants did not complete the duration of the study (4 individuals were lost to follow up, six developed unrelated health issues, four dropped out due to time constraints, and two dropped out due to family matters) which yielded an analytic sample of 38 participants.

Outcome Measures:

Physical Function: The primary outcome for physical function was the short physical performance battery test (SPPB). The SPPB is composed of a series of three tests: a balance assessment, gait speed assessment, and timed chair stands, and is a valid measure of lower body physical functioning in older adults (17). The balance assessment determines whether the participant can maintain a side by side stance, semi-tandem stance, and full tandem stance for 10 seconds each. The gait assessment consists of walking 4 meters at usual walking pace. The test was done twice with the better of the two times (sec) taken in order to assess normal walking speed. The timed chair stand test assesses how fast the participant can rise from a chair and sit down 5 times with their arms crossed over their chest. Each test was scored from 0-4 based on performance, with the best possible score being 4. A summary score was calculated with a best possible score of 12 and each part was analyzed individually.

Physical function was also measured with the 8-foot up and go (UG). The UG test was done according to standardized protocol; participants were verbally cued to rise from a 46-cm high chair, quickly walk forward 8 feet, turn 180º around a cone walk back to the chair and sit down. The UG is a valid test which has been shown to be a valid predictor of physical function in older adults (28).

Muscle Strength: Grip strength, an excellent predictor of total body strength, (23) and was measured using a hand-grip dynamometer (Jaymar Hydraulic Dynamometer, J.A. Preston, Corp., Jackson, MS). Leg strength was measured using a manual muscle dynamometer (Nicholas Manual Muscle tester) (13). Knee extensor strength was measured as the peak force that the examiner had to apply to break the

isometric contraction, indicated by a slight movement of the participant's leg in the direction opposite to the voluntary movement. The manual muscle dynamometer is portable and has been successfully used in older adults.

Flexibility: The chair sit-and-reach test is a measure of flexibility designed for older adults (33). This test requires the participant to sit on the edge of a chair with one leg bent and the other leg extended straight in front with the heel on the floor and foot bent at 90°. While keeping the leg straight, the participant reached forward sliding their hands down their leg attempting to touch their toes. Participants were given a demonstration before performing the test. A practice trial, followed by two recorded trials was completed. The char sit-and-reach was scored with a positive value if the participant could not reach their toe, a negative value if they could reach past and a zero if they could touch their toe.

Descriptive Measures

Anthropometrics: Height and weight were measured under standardized conditions BMI and was calculated as weight in kilograms divided by height in meters-squared. Waist and hip circumferences were measured using a standard tape measure with an attached tensometer (Creative Health Products, Ann Arbor, MI). Body composition was measured using a simple, foot-to-foot bioelectrical impedance analysis device (Tanita BC-534, United States). This test is a valid and reliable measure of body composition (27).

Physical Activity: The Yale Physical Activity Survey (YPAS) is a questionnaire used to measure physical activity in older adults (26). From the YPAS,

total hours of activity as well as total energy expenditure per week can be calculated (12).

Dietary Assessment: Dietary patterns and quality 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 (8). It is a simple and practical tool composed of 24 questions, with a best possible score of 100, that characterizes risk into three categories: at risk (<60), possible risk (60-75) and not at risk (>75) (7).

Education: Education level was collected via self report, and each participant had nine options: 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. The participant's selection was then categorized into three options for analysis: high school, GED or less; associates degree or some college, and bachelors or higher.

Group Assignment:

After completion of baseline testing, participants were assigned to the TCWL group or to a CON group by the order in which they completed baseline testing. This project was a community outreach program with the primary goal of benefitting the community and because of the space and time limitations of each site, a limit was placed on the number of participants who could safely participate in the intervention For this reason participants were not randomly assigned to groups, the first 40 participants to complete baseline testing were invited to the TCWL group, once all spaces were filled, participants were asked to be in the wait list control group.

Following completion of the intervention the TCWL group was separated into weight losers and non weight losers for statistical analysis

Intervention:

Tai Chi plus Weight Loss

Dietary Weight Loss: The TCWL group received an evidence-based behavioral dietary weight loss intervention. All dietary weight loss sessions were held at the senior center where a DASH diet education program was taught by a nutrition graduate student and supervised by a registered dietitian. Goals of the DASH diet include: low intake of saturated fat (<7% of caloric intake), moderate intake of total fat (<35% of caloric intake, modified from the original DASH diet recommendation of 27%) (4), high intake of fruits, vegetables, and whole grains, consumption of low-fat dairy and meat products, and a moderate intake of sodium (3,000 mg or less/day). Weekly topics related to the DASH diet included: how to eat out in a healthy manor and how to read food labels. Participants were asked to complete food logs three days per week so that the nutrition staff could review for adherence and make weekly feedback. The weight loss goal for the TCWL group was 5 to 10% of initial body weight.

Tai Chi: Participants in the TCWL group also participated in Tai Chi exercise twice per week on non-consecutive days. All sessions were held at the senior centers and led by study staff and supervised by an experienced Tai Chi instructor. Sessions included pre- and post-exercise blood pressure, a Tai Chi specific warm up, Tai Chi practice, and cool down. Participants were taught a modified 24 form Yang style Tai Chi emphasizing slow and progressive movements (5). A progressive overload of the

muscles took place with the encouragement of deeper knee bends and the addition of new moves each week. During the first half of the intervention, two to four movements were taught each week until all 24 movements were taught. Additionally, each participant was encouraged to progress at their own rate with more exaggerated movement such as deeper knee bends. Instructional DVDs were provided to participants to encourage practice outside of class.

Wait List Control Group:

The CON group did not receive an intervention and was asked to maintain their normal lifestyle throughout the intervention period. The CON participants received the same benefits as the TCWL group: gift card, study t-shirt, DVD, nutrition binder and two weeks of Tai Chi lessons after post testing when the intervention group received these benefits throughout the study.

Statistical Analysis

All primary outcome variables were analyzed to determine if they were normally distributed using a Shapiro Wilk test. Normally distributed baseline comparisons were made using independent sample -*t* test while non-normally distributed data were analyzed using the Wilcoxon rank sum test (SPPB, gait speed, chair stand, grip strength and leg strength) and categorical data were analyzed using a Fisher's exact test (education). To test the main hypothesis, the data (changes from baseline) was analyzed to examine the differences between groups (TCWL vs. CON) using analysis of covariance (ANCOVA). Because the groups were not randomized, it was expected that the groups may be different in certain demographic and/or physical traits. Thus, we adjusted our models for baseline values to ensure appropriate

between-group comparisons. Additional analyses were done comparing weight losers (≥3.0% total body weight) (2) in the TCWL group to TCWL non-weight losers and comparing TCWL weight losers to the CON group.

Sample Size Calculation

Sample size calculations are based on an alpha of 0.05, a power of 80%, and a between-group difference in SPPB score change of 0.75 with a common standard deviation of 0.5. Based on these criteria, the sample size calculation produced a sample size of at least 9 subjects per group (Table 1). Change in SPPB score needs of greater than 0.3 points has been shown enough of a change to be considered clinically significant (19).

Table 1. Statistical power to detect changes in SPPB score.

Group	N	Baseline	Post-Intervention	Change ± SD
Intervention	9	10.25	11.00	0.75 ± 0.5
Control	9	10.25	10.25	0.00 ± 0.5
			Between-group diff (% change)	0.75 (7.3%)

Results

The final analytic sample consisted of 38 total participants with 29 in the intervention (BMI = 35.4 kg/m²) and 9 in the control group (BMI = 38.0 kg/m²). A study flow chart can be seen in Figure 1. Baseline data of participants who did not complete the study were compared with participants who completed. Participants who

did not complete the study had a lower weight ($P<0.05$), smaller waist and hip circumferences ($P<0.05$) and lower fat and fat-free mass ($P<0.05$). Attendance to exercise and dietary sessions for the completers was 76.5% and 86.5% respectively. Baseline characteristics of both TCWL and CON groups are described in Table 2. No significant differences between groups were observed.

Weight change, percent weight change, and BMI all statistically changed in the TCWL group as seen in Table 3. The TCWL group had a decrease of 1.62±2.91 kg ($p<0.01$) of total weight resulting in a change of 1.8±3.2% from baseline ($p<0.01$), a change in BMI of -0.7 ± 1.0 kg/m² from the baseline value of 35.4±0.8 kg/m² ($p<0.01$), and a decrease in fat mass of -0.6±2.6 kg ($p<0.05$) and waist circumference -4.5±7.0 cm ($p<0.001$). The CON group saw no changes from baseline except for a significant reduction in waist circumference ($p<0.05$). Data not described can be found in Table 3.

Table 3 shows within group changes in physical and muscle function measures for TCWL and CON groups. While no statistically significant changes occurred in the CON group, the TCWL group showed improvements in SPPB ($p<0.05$), chair stand ($p<0.05$) and flexibility ($p<0.05$). For TCWL, SPPB scores increased 0.59±1.28 compared to baseline, chair stand time decreased -0.80±1.71 sec from baseline and flexibility improved 2.3±4.7 cm from the previous baseline value.

Table 3 also shows a between group comparison for physical and muscle function changes from baseline measures between the TCWL and CON groups. There were between group differences in SPPB ($p<0.001$), gait speed ($p<0.01$), and UG ($p<0.05$). The TCWL group improved SPPB score by 0.74±0.21 while the CON

group's score decreased by -1.01±0.38. TCWL improved gait speed time (-0.18±0.13 sec) while CON increased time by 0.67±0.24 sec. CON scored better on UG improving -0.49±0.46 sec compared to TCWL's change of 0.59±0.26 sec.

Further analyses were done separating the TCWL intervention group into weight losers (n=9) and non-weight losers (n=20). Weight loss was determined to be ≥ 3.0% body weight loss and Table 4 shows the results. Weight losers in the intervention group had better attendance in both the dietary and exercise components compared to non-weight losers. While no between group differences were seen in any physical function or strength measure between the two groups, weight losers ($p<0.01$) and non-weight losers also ($p<0.05$) improved SPPB score. With regards to chair stand time, both weight losers ($p<0.01$) and non-weight losers improved ($p<0.05$). UG time for weight losers worsened ($p<0.05$) and no change was seen in non-weight losers resulting in no difference between groups ($p>0.05$). Flexibility improved only in weight losers ($p<0.05$) and significance was not seen between groups ($p>0.05$).

The TCWL weight losers were then compared to the CON group, as seen in Table 4. One member of the CON group lost ≥ 3.0% body weight but was kept in the analysis as a CON member. In this analysis the TCWL weight losers improved SPPB score 1.1±0.4 ($p=0.007$), increased UG time by 1.1±0.5 sec ($p=0.021$) and improved flexibility by 3.9±1.6 cm ($p=0.021$). The CON participants saw a reduction in SPPB score by -1.0±0.4 ($p=0.013$) and a worsening gait speed by 0.7±0.2 ($p=0.009$).

Discussion

The major finding of this study was that a behaviorally-based dietary intervention in combination with Tai Chi improved some measures of physical function in older, obese, community dwelling women. The TCWL participants lost a small yet significant amount of weight and improved short physical performance battery (SPPB) score compared to CON.

The SPPB is a sum of balance, gait speed and chair stand time scores. In our study the TCWL changed significantly from baseline compared to CON in gait speed and chair stand time. This was expected because similar improvements were seen in a study by Tsang et al. (35) in which older obese participants saw gait speed improvements as a result of a 16 week Tai Chi intervention. Tsang and colleagues attributed gait speed improvements to Tai Chi as they did not use a dietary intervention. Our intervention showed the Tai Chi and weight loss combination can provide similar gait speed improvements as an intervention that does not result in weight loss, meaning function was not worsened by weight loss.

Chair stand time improved within the TCWL group, however between group changes from baseline were not significant ($P<0.065$). Similar within group improvements were seen in an investigation by Taylor-Piliae et al. (34). Participants in that study were older and mostly women who participated in six-month Tai Chi intervention. Improvements in chair stand were documented for Tai Chi practitioners immediately post and six-months after the intervention. So while our study did not show between group differences, Tai Chi has been shown to be effective at improving chair stand time. This study may not resulted in significant changes because Tai Chi

classes were only twice a week. Adding a third session each week may have caused an increased improvement.

A possible explanation for the improved physical functioning could be Tai Chi's effect on muscle. Our study showed no loss in grip or leg strength, a normal occurrence during weight loss (3). This study's findings of Tai Chi and diet maintaining strength during weight loss are in line with previous exercise plus diet studies (3, 6, 30). Similarly, Anton et al. (3) saw improvements in SPPB as well as non-significant changes in muscle strength in older, obese women compared to a sedentary control. However, Anton and colleagues (3) used a combination resistance and aerobic exercise along with diet. While both studies saw no increase in strength, the age-related and weight loss exacerbated loss of muscular strength was not present, which may have factored into SPPB improvement.

A surprising result was seen with the UG test, as the CON group significantly improved compared the TCWL group. The CON group's slight but not significant within group improvement may be attributed to a learning effect from baseline testing; however tests were performed twice at baseline and post testing to counteract that effect and the non significant worsening of performance for TCWL was not expected.

Not all participants in the TCWL intervention lost weight. Weight losers, defined as $\geq 3.0\%$ weight loss, showed significant physical function improvement compared to the CON group. It is important to note that the participants who actually lost weight saw SPPB and chair stand improvements while doing so. Li and colleagues (20) support the changes seen in physical functioning as a result of Tai Chi. After a six-month intervention (n=49) which met twice per week for an hour, this

older (72.6±5.1 y/o) group of men and women significantly improved ($p<0.05$) compared to a control group (n=45) in self reported physical functioning (20). Santanasto et al. (29) saw SPPB improvements in older, obese men and women (n=36, 70.3 ± 5.9 y/o, 32.9 ± 3.2 kg/m²) who underwent a one-year, calorie restriction plus aerobic and resistance training exercise program. Weight loss exceeded 5% and SPPB improved similarly to that observed in our study. Our study presents an exercise and dietary intervention for older, obese women to lose weight while improving physical function.

Our study further adds to the literature focusing on changes in physical function associated with a Tai Chi plus weight loss intervention. Katkowski et al. (18) conducted a similar intervention over 16 weeks involving dietary weight loss and Tai Chi with older, obese women. A total of 27 participants were randomized to a weight loss or Tai Chi plus weight loss group. The Tai Chi plus weight loss group experienced a 2.6% reduction in weight and saw no changes in physical function. Katkowski et al.'s (18) study had a relatively small sample size and lacked a true control group and took part in a clinical setting. While our study employed a true control group we did not randomize participants to the TCWL or CON interventions as this was an extension study developed primarily to benefit the community. Katkowski and colleagues [17] conducted their study in a laboratory setting while we brought our intervention into the community. It is important for studies to be done in a community setting, clinical setting interventions teach exercise and diet for the length of the intervention and then asks the participants to go out on their own and maintain what is taught in class. Community based interventions, such as this one

done in a senior center teach the exercise and diet in the same way but also introduce a possible location to continue practicing in order to maintain the program.

Strengths of this study included the use of a true control group, the homogenous nature of the participants and the studies length which was equal to or longer than many Tai Chi interventions (10, 11, 22). However, this study has several limitations. First, this study lacked a randomized design; participants were assigned to groups in order of acceptance into the study. This design is susceptible to between group imbalances in baseline characteristics; however this study did not reveal any baseline imbalances in anthropometric measures or functional abilities. Additionally, we lost 16 participants to drop out resulting in a relatively small sample size. Finally, overall weight loss in the TCWL group was statistically significant yet not clinically significant (<3.0%). Our Tai Chi and weight loss intervention only met twice a week when many research studies have shown weight loss employing three exercise sessions a week (3, 25) in combination with diet. Our study was unable to meet two days per week due to the senior centers busy schedule. Participants were asked to practice Tai Chi outside of class and all extra sessions were recorded prior to the start of each class, however these extra practices were not analyzed. Weight loss strategies that employ multiple exercise interventions such as resistance training and aerobic exercise in combination with diet may be most effective. Miller et al. (25) saw reductions in body weight when employing an aerobic plus resistance training program in combination with a calorie restricting diet. Participants met three times a week for six months and resulting in a reduction of $\geq$ 8.0% body weight. While our

study showed modest weight loss, interventions incorporating resistance and aerobic exercises may be most effective for weight loss.

In conclusion, our study showed Tai Chi combined with intentional dietary weight loss in older, obese female population results in improved physical function. Future studies should look at the impact of Tai Chi in combination with other exercise modalities alongside dietary weight loss in order to see improved weight loss and changes in physical function in an obese, female population.

Table 2. Baseline Characteristics: Tai Chi and weight loss (TCWL) and control (CON) groups

Variable	TCWL (*n*=29)	CON (*n*=9)	*p* Value
Age (yr)[1,3]	68.2 (1.5)	65.5 (2.6)	0.390
Height (cm)[1,3]	161.0 (0.1)	162.6 (0.2)	0.540
Weight (kg)[1,3]	92.2 (5.7)	100.9 (10.2)	0.390
Body Fat %[1,3]	47.7 (0.7)	48.0 (1.2)	0.786
BMI (kg/m^2)[1,3]	35.4 (0.8)	38.0 (1.5)	0.133
Education: (N (%))[2]			0.242
High school, GED or less	4 (13.8%)	0 (0%)	
Associates or some college	12 (41.2%)	2 (22.2%)	
Bachelor's degree or higher	13 (44.8%)	7 (77.8%)	
Physical Activity[1,3] (kcal/wk)	8020.90 (784.57)	7610.73 (1408.34)	0.801
Physical Activity Index[1,3]	35.69 (3.62)	40.33 (6.49)	0.536
Dietary Screening Tool (DST)	68.2 (11.1)	65.6 (9.6)	$\geq$ 0.05
SPPB[1,3]	10.75 (0.28)	9.78 (0.50)	0.100
Gait speed[1,3] (sec)	4.20 (0.14)	4.53 (0.26)	0.293
Chair stand[1,3] (sec)	11.07 (0.64)	11.58 (1.16)	0.704
UG[1,3] (sec)	11.15 (0.35)	10.35 (0.64)	0.279
Grip Strength[1,3] (kg)	27.76 (1.16)	27.56 (2.08)	0.933
Knee extensor torque[1,3] (kg-m)	9.57 (0.65)	7.88 (1.17)	0.311
Flexibility[1,3] (cm)	1.44 (1.78)	1.78 (3.29)	0.927

[1]Data analyzed using student *t* test [2] Data analyzed using Fisher's Exact Test [3]Data expressed as means (SE) BMI-Body Mass Index, SPPB-Short Physical Performance Battery, UG-8 foot up and go

Table 3: Physical and muscle function changes: Tai Chi weight loss (TCWL) vs. control (CON) groups

Variable	TCWL (*n*=29)	CON (*n*=9)	*p* between group
SPPB	0.74 (0.21)*	-1.01 (0.38)	<0.001
Gait Speed (sec)	-0.18 (0.13)	0.67 (0.24)	0.004
Chair Stand (sec)	-0.84 (0.33)*	0.42 (0.58)	0.065
UG (sec)	0.59 (0.26)	-0.49 (0.46)	0.047
Grip Strength (kg)	-0.38 (0.43)	-1.24 (0.49)	0.339
Knee extensor torque (kg-m)	1.50 (0.80)	0.48 (1.39)	0.531
Flexibility (cm)	-2.3 (0.9)*	-2.5 (1.6)	0.914

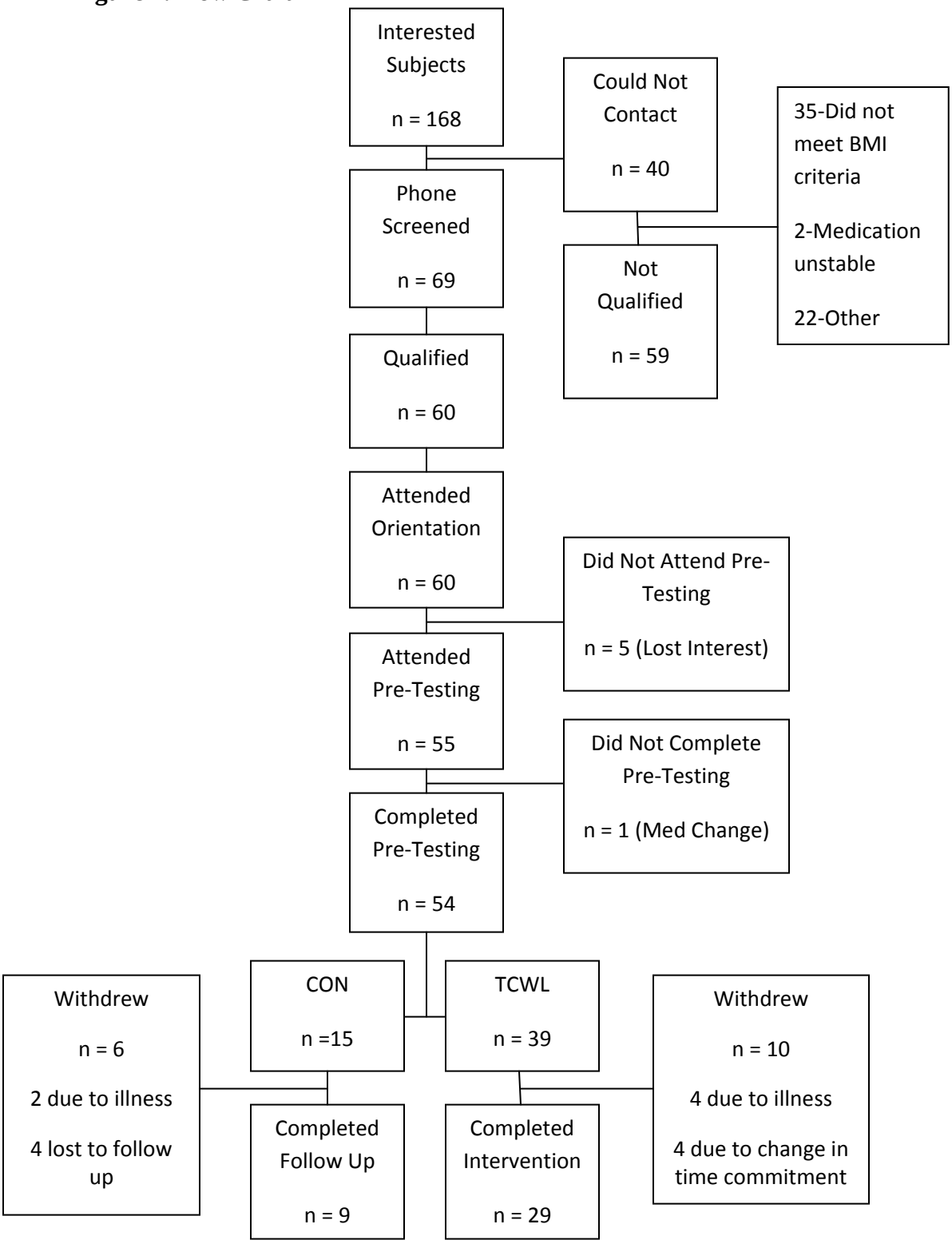
All data analyzed using analysis of covariance adjusted for baseline values.
All data expressed as least squared means (standard error)
SPPB-Short Physical Performance Battery, UG-8 Foot Up and Go, Physical Activity and Physical Activity Index determined from Yale Physical Performance Assessment
*Significant within group change from baseline ($p<0.05$)
**Significant within group change from baseline ($p<0.01$)

Table 4: Physical and muscle function changes: non weight losers and CON vs. weight losers within the intervention (TCWL) group

Variable	Non Weight Losers (n=20)	Weight Losers[1] (n=9)	CON (n=9)	Between groups p value
SPPB	0.43 (0.19)*	0.91 (0.27)**	-1.00 (0.38)***	0.001
Gait Speed (sec)	-0.25 (0.14)	0.08 (0.21)	0.66 (0.24)	0.007
Chair Stand (sec)	-0.60 (0.26)*	-1.21 (0.38)*	0.43 (0.58)	0.151
UG (sec)	0.09 (0.27)	0.97 (0.44)*	-0.49 (0.45)***	0.060
Grip Strength (kg)	-0.22 (0.56)	-0.73 (0.86)	-1.23 (0.78)	0.542
Knee extensor torque (kg-m)	2.11 (1.03)	0.04 (1.47)	0.45 (1.38)	0.374
Flexibility (cm)	-1.70 (1.11)	-3.56 (1.66)*	-2.50 (1.58)	0.482

All data analyzed using ANCOVA
All data expressed as least squared means (standard error)
[1]Weight loss determined as ≥3.0% loss in body mass
*Significant within group change from baseline ($p<0.05$)
**Significant within group change from baseline ($p<0.01$)
***Significant between group differences compared to TCWL weight losers
SPPB-Short Physical Performance Battery, UG-8-Foot Up-and-Go

Figure 1. Flow Chart



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List of Appendices

APPENDIX A: REVIEW OF LITERATURE

Introduction

The rates of obesity in women over the age of 60 are on the rise (20). Obesity can lead to physical function limitations especially in combination with the age related loss of muscle (3, 34) which may result in disability (47). While dietary (43), exercise (13) and combined diet and exercise interventions (6, 45) have been explored as viable treatments for obesity and declining physical functioning, alternative interventions such as Tai Chi have yet to be fully examined as effective modalities in older women.

The purpose of this review of the literature is to explore the problems related to obesity such as physical function declines and treatment methods for obesity and physical function declines in older women. Present previous research on interventions regarding, dietary weight loss, various exercise interventions, and combined interventions on physical functioning will also be presented. Tai Chi will be discussed in depth as a viable method for affecting physical functioning by itself and in combination with dietary weight loss.

Obesity in Older Adults

Recent studies have shown that obesity is a growing health problem in the United States (7, 20) with over 30% of adults categorized as obese defined as a body mass index (BMI) >30.0 kg/m² (7). In the United States 35.8% of all women ≥ 20 years old are obese with 42.3% of women over the age of 60 classified as obese (20). One explanation for obesity in the older population comes from the progressive increase in fat mass associated with the aging process (25). Between the ages of 45-54 years fat-free mass reaches its peak in women and begins to decline (25). The loss of

muscle combined with increased fat mass leads to disability and limitations in physical functioning (47). Should current obesity trends continue, disability rates in the older population will continue grow (47). Weight loss interventions are needed to decrease fat mass, while maintaining fat free mass to prevent disability and loss of physical function capabilities.

Riebe et al. (39) looked at the association between obesity, physical activity levels and physical function in community dwelling (n=821) older (76.9±6.3 y/o) men (28.5%) and women (71.5%). Measurements included body weight and height, BMI, physical activity level via the Yale Physical Activity Survey, the timed up and go was used to determine physical function, and stages of change were measured using a questionnaire. Measurements were taken at baseline, 12 and 24 months post baseline analysis. Groups were divided by BMI: normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obese (≥ 30.0kg/m²), age groups: 60-74, 75-84, and ≥85 y/o, and sex. Results showed that overweight was not associated with lower levels of physical function in women, but obesity was associated with lower levels of physical function. In all BMI groups, lower physical activity levels were associated with lower physical function scores. Compared to men, obese women had a higher likelihood of having a physical function limitation and aging was associated with lower levels of physical activity and physical function (39). This study showed that obese, older women are the most likely to have low levels of physical activity and physical function.

The National Health and Nutrition Examination Survey (NHANES III) (32) examined 16,884 adults from 1988 to 1994 examined the prevalence of disease in

overweight and obese women. From 1988-1994, 7,896 women became involved in the study with 3,425 of those women over the age of 55. Of the 3,425 women aged 55 and older, approximately 60% were overweight with 27% considered obese (32). Compared to a normal-weight reference group, a graded increase in the risk of developing type 2 diabetes (PR=5.8, 95% CI: 4.2-7.4), gallbladder disease (PR=2.98, 95% CI: 2.10-4.07), high blood pressure (PR=1.41, 95% CI: 1.26-1.50), and coronary heart disease (PR=1.59, 95% CI: 1.17-2.11) were seen as BMIs increased (32). An increased risk of dislipidemia was also observed in the overweight group compared to the normal-weight reference (PR=1.18, 95% CI: 1.01-1.35) (32). This study shows the chronic health conditions associated with obesity in women and highlights the need for new treatments.

Furthermore, using the Nurses' Health Study, Field et al. (19) looked at the development of chronic disease in overweight and obese women (n=77,690, 52.9 y/o) from 1986-1996. Compared to a referent group of women whose BMIs are <25.0 kg/m², women with BMI's between 30.0-34.9 kg/m² had an increased risk of developing diabetes (OR= 10.0 95% CI: 8.4-11.8), gallstones (OR=2.5 95% CI: 2.3-2.7), hypertension (OR= 2.1, 95% CI: 1.9-2.2), and heart disease (OR= 1.5 95% CI: 1.3-1.7) (19). The authors also found that it is 20 times more likely women will develop type 2 diabetes with BMI's greater than 35.0 kg/m² compared to women with healthy BMIs (19). This study further demonstrated the impact obesity has on the risk of developing chronic disease.

Obesity has more of a health impact on women than the increased risk of developing a chronic disease. Blaum et al. looked at an older (70-79 y/o) cohort of

women (n=599) from the Women's Health and Aging Studies I and II in order to examine the relationship between obesity and frailty (8). Of the 599 women in the study, 224 were considered overweight and 175 were classified as obese (BMI 34.6± 4.6 kg/m²) (8). Frailty indicators included weight loss, exhaustion, weakness, as seen by low grip strength, slow walking speed and decreased activity levels. This study showed that obesity was associated with pre-frailty (OR=2.23, 95% CI: 1.29-3.84), defined as meeting one or two of the previously mentioned frailty criteria (8). Obesity was also shown to be associated with frailty (OR= 3.52, 95% CI: 1.34-9.13), defined as meeting three or more of the frailty criteria (8). The authors demonstrated through this study that there is a significant connection between obesity and the likelihood of becoming frail in older women.

Apovian et al. (4) looked at the direct association between BMI and physical function disability in women (n=90, 71 ± 4.9 y/o) (4). Participants were stratified into three groups by BMI, 22 kg/m² to <27.0 kg/m², 27 kg/m² to <30.0 kg/m², and ≥ 30.0 kg/m². The researchers found that higher BMIs impeded upper body physical function and to a lesser extent lower body physical function affecting everyday functional abilities such as writing, dressing, standing and walking (4).

Similarly, Sternfeld et al. (44) examined the association between body composition, physical performance and functional limitations in older men (n= 708, 69.5 y/o) and women (n= 947, 69.3 y/o). Higher fat mass was shown to have an association with decreased walking speed as well as increasing the likelihood of developing a functional limitation (44).

In addition, Reynolds and colleagues explored the impact of obesity on disability in community dwelling older adults (≥70 y/o) using data from the Asset and Health Dynamics Among the Older Old (AHEAD) survey (38). From 1993-1998, 7,132 older adults were assessed for obesity (BMI >30.0 kg/m^2) and disability. Disability was reported as having one or more of the six ADL limitations which included walking across a room, bathing, eating, dressing, toileting, or transferring in or out of bed. Any person living in a nursing home was also considered to have a disability. This study showed women were more likely to be obese (15.1%) compared to men (10.2%) (38) and also more likely to develop a disability (47.7% for women and 32.0% for men) (38). Importantly, obese disabled women were found to live longer (7.4 yrs, 95% CI: 6.5-8.3) than obese, disabled men (4.0 yrs, 95% CI: 3.4-4.5) after the age of 70 (38). This study demonstrates that women are in greater need of obesity interventions as they are likely to live longer with an obesity related disability (38).

Aging and Physical Function

Significant physiological adaptations occur with age, and some typical changes include the age related loss of muscle, known as sarcopenia (18, 53), decreases in bone density and increases in body fat (18) all of which may have a detrimental effect on physical functioning. Physical functioning has been associated with the preservation of independence in older persons and as an indicator of quality of life (11). Women have been shown to outlive men and spend more of their lives with a disability (38) and thus interventions need to be designed and aimed at the maintenance of physical function in older women.

One of the negative effects of aging is the loss of muscle mass. Goodpaster et al. (22), using data from the Health Aging and Body Composition study, examined changes in the lean mass and strength over a three year period in older (73.5 ± 2.8 y/o) men (n= 929, 73.6 ± 2.8 y/o) and women (n= 951, 73.2 ± 2.8 y/o). At baseline and three year follow-up knee extensor strength, measured using isokinetic dynamometry, and whole body lean mass, assessed using duel-energy x-ray absorptiometry (DXA) were documented. Over the course of three years women lost a significant amount of lean mass (-.30 ± 1.97 kg, P<.001), leg lean mass (-.21 ± .47 kg, P<.001) and leg strength (-10.21 ± 19.76 N-m, P<.001) (22). Declines in strength were shown to be correlated to the loss of lean mass and age (22).

The aging process can also negatively affect physical functioning. Jette et al. used The Framingham Disability Study (23) and to investigate the ability of men (n=1,070) and women (1,564) to complete activities of daily living over time. All participants in the study were between the ages of 50-84 at the time of examination. Both men and women were confident in their abilities to perform basic activities of daily living, however there was significant differences in who could perform heavy household work, walk half a mile and walk up and down stairs (23). A significantly greater percent of men were able to perform all three of these tasks compared to women in their same age group (23). Also, decrements in the ability to perform house work (P<.001), climb stairs (P<.05) and walk half a mile (P<.001) (23) were seen in women as age increased.

Brill and colleagues looked at muscle strength and the association it may have with physical function in men (n=3,069) and women (n=589) (11) between the ages

of 30 and 82 years. Participants had received a clinical examination at the Cooper Clinic from 1980-1989, which served as the baseline data. After an average follow up time of 5 years, 12% of the women reported developing a physical limitation (11). The authors found that functional limitations were associated with advancing age, increases in BMI, and decreases in lower extremity strength (11).

In a similar study, The Women's Health and Aging study (34) looked to quantify changes in physical performance seen with the age related declines in strength in older (78.9 ± 8.1) female (n= 1,002) participants. Upper and lower extremity physical function was measured at baseline, one year follow up and three year follow-up. At one year post-baseline, lower extremity physical function declined as much as 11.2% (34). After three years lower extremity physical function declined as much as 26.6% (34) while upper extremity function declined at a lesser rate of 7.4% in the first year and as much as 23.9% after three years (34). While the authors found a relationship between advancing age and degradations in physical function the explanation of why it was occurring was unclear.

Visser et al., using data collected during The Health, Aging and Body Composition study (53), looked at the effect of aging on leg muscle and lower extremity performance. A combination of black (n=698, BMI=29.6 ± 5.8 kg/m^2, 73.4 ± 3.0 y/o) and white (n=839, BMI=26.0±4.6, 73.6 ± 2.8) women between the ages of 70-79 yr completed physical function measures including the six-meter walk and repeated chair stands to determine lower extremity performance. Dual x-ray absorptiometry was used to assess body fat and computed tomography scans at the mid-thigh were used to assess muscle. After analysis, smaller leg muscle area was

found to be associated with poorer lower extremity function as was greater fat infiltration into the muscle (53). The aging process causes the decreases in muscle mass and increases in fat mass, which this study shows to be associated with poor physical function (53).

Treatments

The prevalence of obesity increases the risk of developing disease and exacerbates the age related decline in physical function. Modest reductions of 5-10% of body weight can lead to improved physical functioning (30, 41) and quality of life, as well as improve obesity related disease, however even minimal weight loss can improve health (29, 52). With obesity rates on the rise (20) interventions aimed at the reduction of body fat are needed. Some options for weight loss include pharmacotherapy and surgery. Surgeries such as gastric bypass and laparoscopic adjustable gastric band procedures are common surgical forms of weight reduction. Research suggests these surgeries are an effective way of reducing body fat, with the adjustable gastric band being shown to be the safest option for older adults (52). However, surgeries have not been shown to be completely safe and are expensive. Most pharmacotherapy studies exclude older obese individuals, so efficacy and safety have yet to be determined (52). A safe, feasible option for weight loss is dietary weight loss (9, 29).

Dietary Interventions

Literature has shown dietary weight loss to be an effective weight loss strategy (9, 29). Brochu and colleagues (12) examined the effects of a 6-month diet (goal of 10% body weight reduction) in older (58.0 ± 4.7 y/o,) obese (32.2 ± 4.6 kg/m²) women (n=71). Calorie restriction was determined by subtracting 500-800 calories from individuals resting metabolic rate, multiplied by a physical activity factor of 1.4 which corresponds to a sedentary lifestyle. The average calorie reduction for the 71 participants was 33.7±3.8% kcal/day (12). As a result of the six month restrictive calorie intervention the participants saw reductions in body weight ($p<.0001$), BMI ($p<.0001$), and total fat mass ($p<.0001$). The authors demonstrated that a calorie restricting diet can result in a change in body weight between 5-10% (-5.1 ± 4.7%)(12).

Similarly, Messier et al. (29) examined 82 (72 % female) older (68 ± 0.7) obese (34.5 ± 0.6 kg/m²) participants who were given a dietary weight loss program and followed for 18 months. Primary outcomes for the intervention included changes in weight and physical function as seen through the 6-minute walk, stair climb time, and self reported physical function. The dietary weight loss program was designed for the loss and maintenance of 5% body weight. The intervention consisted of three phases: an intensive (months 1-4), transition (months 5-6) and maintenance (months 7-18) phase. After 18 months, a weight loss of 4.9% ($p<0.05$) (29) and an 18% ($p<0.05$) improvement in self reported physical function was seen (29). This study shows a dietary intervention can result in weight loss which may improve physical function. While caloric restriction results in weight loss, a specific well balanced diet that improves other health outcomes is needed.

The Dietary Approaches to Stop Hypertension (DASH) diet was originally created for the purpose of reducing blood pressure (40) but has shown other benefits such as weight loss (46) as well. Goals of the DASH diet include: low intake of saturated fat (<7% of caloric intake), moderate intake of total fat (<35% of caloric intake) high intake of fruits, vegetable, and whole grains; consumption of low-fat dairy and meat products, and a moderate intake of sodium (3,000 mg or less/day) (40).

Avila et al. (6) introduced the DASH diet to 12 older (67.4±4.8 y/o) obese (BMI=31.9±3.4 kg/m²) men (n=5) and women (n=7) over a 10-week period as part of a larger investigation. Participants saw a change in body weight of -2.0±0.9% while improving functional measures such as the 4-meter walk ($p<0.05$), 5-chair stand test ($p<0.05$) and 400-meter walk ($p<0.05$). While this study had positive results the sample size containing both men and women was relatively small and had a short intervention period.

Blumenthal et al. (9) implemented the same DASH diet to older (51.8±10 y/o), obese (32.8±3.4 kg/m²) men (n=17) and women (n=29) over a four month period compared to a regular diet control (n=49, 51.8±9 y/o, 33.0±3.9 kg/m²). Similar to the previous study, the DASH diet intervention group experienced weight loss (-0.3 kg) ($p>0.05$) (9), however no functional measures were improved and analysis included both men and women.

Katkowski and colleagues (24) looked at the impact of the DASH diet only on women (n=13) who were both older (62.7±6.0 y/o) and obese (34.9±2.9 kg/m²). Participants participated in the dietary intervention for 16-weeks and experienced a weight loss of 3.7±0.9 kg ($p<0.001$) equaling 4.1±0.9% of total body weight lost and

improvement in grip strength ($p<0.05$). Katkowski's study added to the literature supporting the DASH diet's ability to reduce weight in older, obese women, however only minor physical function benefits were seen. Further research may need to explore additional interventions to improve physical function.

While it has been demonstrated that weight loss can benefit obese, older women (12, 29), further research has shown that there are negative impacts associated with dietary weight loss (52). However, approximately 75% of weight lost during a dietary intervention is fat while the remaining 25% consists of muscle (52). Loss of muscle may result in a loss of strength causing a decline in functional ability. Older individuals are already undergoing a loss of muscle associated with age, so an intervention needs to be studied that allows dietary weight loss while maintaining muscle mass.

Exercise and physical function

Aging causes a progressive decrease in physical function because of a continued decline in muscle mass and strength (52). Studies have shown that exercises such as resistance training (1, 13, 14), aerobic exercise(36), and a combination of the two (3) may improve physical function in older individuals. Time spent not exercising may contribute to decreases in physical function in older women. Seguin and colleagues (42) examined the association between sedentary time and physical function declines in 61,609 older (50-79 y/o) women who are part of the Women's Health Initiative Observational Study. Sedentary time was estimated by questionnaire and physical function was measured using the RAND SF-36 physical function scale. Greater amounts of sedentary time were strongly associated with

diminished physical function and were most strongly associated with older women with greater sedentary times (42). Compared to women who were sedentary less than 6.0 hours per day, women who were sedentary 8-11 hours per day were more likely to see physical function declines (RR= -1.48, 95% CI: -1.71,-1.25) and sedentary women greater than 11 hours per day were most likely to see declines (RR= -3.13, 95% CI: -3.36,-2.89) (42). Increased sedentary time is associated with decreased physical function over time.

Brochu and colleagues (13) looked at the impact resistance training may have on older adults, specifically regarding changes in physical functioning. That study involved older women with coronary heart disease who were assigned to a resistance training (n=13, 70.5±4.0 y/o, BMI=28.5±3.8 kg/m²) or a stretching (n=12, 70.7±5.3 y/o, BMI=31.0±5.6 kg/m²) intervention for six months. The resistance training intervention met three times a week for six months to perform eight exercises focusing on legs, arms and shoulder strength. The stretching group acted as a control and met three times a week to perform 30-40 minutes of stretching exercises. Physical function was assessed using questionnaires, body composition was measured through DXA and muscle strength was measured from single-repetition maximal lift, isokinetic grip strength and isometric leg strength. Following the six-month intervention participants in the resistance training group improved physical function scores ($p<0.001$), upper body strength ($p<0.01$), and lower body strength ($p<0.001$) (13) while no changes were seen in functional ability or strength in the stretching control group.

In a similar study Ades et al. (1) studied the effect of a resistance training intervention compared with a stretching intervention on physical function in 33 women over the age of 65 with physical function impairments. Both interventions met three times a week for six months and participants were randomized into a resistance training (n=19) program that utilized eight exercises targeting the major muscle groups or into a cardiac rehabilitation based stretching program (n=14). Physical function was assessed by way of the continuous-scale physical performance (CS-PFP) test and self report. Muscle strength was measured by grip strength and one-repetition maximum. Following the intervention, the resistance training group improved CS-PFP ($p<0.0001$), upper and lower body ($p<0.05$) (1). Both of these studies show improvements in physical function through resistance training; however both sample sizes are relatively small.

Chandler et al. (14) studied the impact of resistance training on physical performance in 100 functionally impaired older (77.6±7.6 y/o) men (n=50) and women (n=50). Participants were randomly assigned to a resistance training or control group. Control participants were asked to maintain their normal lifestyle while the resistance training group met individually with a physical therapist three times a week for ten weeks to perform lower body strengthening exercises with therabands. As a result of the intervention, the resistance training group improved strength, which was associated with improvements in mobility skills ($p<0.001$), gait speed ($p<0.05$) and falls efficacy ($p=0.05$) (14). Chair rise improvements were seen in those who were more impaired ($p<0.05$) (14). This study showed that lower extremity strength gains as a result of resistance training can improve functional ability in older men and

women. Resistance training's positive impact on physical function in older adults is clear; however other forms of exercise need to be examined.

Aerobic exercise is another form of exercise that may have a beneficial impact on physical function in older adults. Penninx et al. (36) analyzed data from the Fitness, Arthritis and Seniors Trial (FAST) study. Four-hundred thirty-eight participants were included in the study, 70% were female with an average age of 68.8±5.6 y/o. Participants were assigned into a resistance training (n=146) group, aerobic training (n=143) group or an educational control (n=149) group for 18 months. Both interventions began with three months of supervised facility-based exercise sessions which met three times each week for an hour, followed by a 15-month home based intervention. Resistance training consisted of various upper and lower body exercises utilizing dumbbells and weight cuffs while walking for 30 minutes as the aerobic exercise. The resistance training group saw improved disability ($p<0.05$) and a reduction in pain ($p<0.05$). The aerobic group experienced similar improvements in disability ($p<0.05$) and pain ($p<0.05$) while also increasing walking speed ($p<0.001$) (36). This study shows both aerobic exercise and resistance training to be effective at improving disability in older women.

Blumenthal et al. (10) studied the effects of a 4-month aerobic only exercise training program on 101 men and women with a mean age of 67 y/o. Participants were randomly assigned to an aerobic intervention (n=33), stretching intervention (n=34) or a wait list control group (n=34). Participants in the aerobic exercise group met three times a week for 16 weeks to participate in 30 minutes of continuous bicycle ergometry at approximately 70% maximum heart rate followed by 15 minutes of brisk

walking and arm ergometry. The exercise sessions began with a 10 minute warm up and concluded with a 5 minute cool down. Women who participated in aerobic exercise achieved an 8.6% improvement in peak VO_2 (10).

Resistance training and aerobic exercise have physical function benefits, Cuff and colleagues (16) compared the benefits of aerobic exercise versus aerobic exercise combined with resistance training to see if the combination would cause greater improvements in function. Twenty-eight obese postmenopausal women with type 2 diabetes were randomly assigned to either a control (n=9, 60.0±2.9 y/o, BMI=36.7±2.0 kg/m²), aerobic only (n=9, 59.4±1.9 y/o, BMI=32.5±1.4 kg/m²) or aerobic plus resistance training (n=10, 63.4±2.2 y/o, BMI=33.3±1.5 kg/m²) intervention for 16 weeks. Both interventions met three days a week for all 16 weeks. The combined aerobic plus resistance training group met for 75 minutes with each class consisting of a warm-up, aerobic phase, resistance training phase, and cool-down. The aerobic phase consisted of exercise using modalities such as treadmills and stationary bicycles at 60-75% heart rate reserve. The resistance training consisted of two sets of 12 reps for five exercises that targeted major muscle groups. The aerobic only group also met for 75 minutes for a warm-up, aerobic phase, and cool-down with aerobic exercise performed at 60-75% heart rate reserve. Compared to the control group, aerobic exercise alone induced weight loss ($p<0.05$) and improved mid-thigh skeletal muscle density ($p<0.05$) (16). Aerobic exercise plus resistance training improved over the control in weight loss ($p<0.05$), total abdominal adipose tissue ($p<0.05$), and mid-thigh skeletal muscle density ($p<0.05$), while also improving mid-thigh skeletal muscle density ($p<0.05$) compared to the aerobic only group (16).

While both aerobic and resistance training have physical function benefits in overweight older women, this study shows a combination of the two exercises to be most beneficial.

An intervention of resistance training plus aerobic exercise may be the best intervention to elicit beneficial physiological responses and improve physical function in obese, older women. Takmakidis et al. (50) explored the effects of an aerobic plus resistance training intervention on sedentary, obese, post-menopausal women (n=9, 55.2±6.7 y/o, BMI=31.5±3.1 kg/m^2) with type 2 diabetes. The intervention took place four days a week for 16 weeks. Aerobic exercise consisted of walking or jogging on a treadmill twice each week for 45 minutes at an initial intensity of 60-70% maximum heart rate progressing up to 70-80% heart rate max. Strength training was completed on days where there was no aerobic exercise and consisted of six exercises targeting major muscle groups. Three sets of 12 repetitions were completed for all exercises at 60% of one-repetition maximum. Anthropometric data were collected and muscular strength was measured using a one-repetition max. Measurements were taken at baseline, 4, and 16 weeks into the intervention. Upper and lower body strength increased from baseline to 4 weeks ($p<0.05$) and again from week 4 to 16 ($p<0.001$) (50). Weight and BMI did not significantly improve throughout the duration of the intervention, but time spent exercising increased ($p<0.001$) from baseline to week 16 showing an improved exercise tolerance (50). This study showed that aerobic plus resistance training exercise has functional benefits in older, obese women; however, no weight loss was seen. Dietary interventions have shown weight loss (9, 29) in this same population, but have resulted in minimal functional improvements. The

combination of the two interventions may elicit the greatest benefit, both lowering BMI and improving physical function.

Exercise and Diet

Recently, studies have been incorporating both diet and exercise as a treatment for improved physical function in obese, older women. Santanasto and colleagues (41) combined exercise and diet to examine changes in physical function and fat mass in a group of mostly female (n=30) older (≥ 60 y/o), overweight to obese (28.0-39.9 kg/m²), participants (n=36, 70.3 ± 5.9 y/o, 32.9 ± 3.2 kg/m²). Participants were randomly assigned to either a one year physical activity plus weight loss (PA + WL) (n=21) intervention or a physical activity plus successful aging education (PA + SA) (n=15) intervention. The physical activity program involved aerobic exercise combined with lower extremity resistance training, balance training and stretching. The weight loss component of the intervention targeted a reduction of 7% body weight through calorie restriction. The successful aging education program was a lecture based program held once a month discussing healthy aging techniques. Main outcomes included physical function, measured using the short physical performance battery (SPPB), fat mass assessed using DXA, and cross-sectional abdominal adipose tissue measured using computed tomography. Major anthropometric findings included reductions in body weight ($p<.0001$), body fat ($p<.0001$) and abdominal fat ($p<.01$) (41) for the PA +WL group, while the PA + SA group had no significant changes. Both groups improved physical function through the SPPB however, PA +WL significantly improved from baseline (0.70 ± 1.42, $p<.05$) (41), while the PA +SA group showed no significant improvement. Importantly, change in SPPB score

was strongly inversely correlated with change in fat mass (41). This study shows physical activity combined with dietary intervention can result in weight loss while maintaining and even improving physical function. However, the sample size was small and while the study included mostly women, men were involved in the analysis.

Miller at al. (30) conducted a calorie restriction combined with exercise intervention (n=87) composed of both male (n=33) and female (n=54) older (≥ 60 y/o) obese (≥ 30.0 kg/m²) adults with symptomatic knee osteoarthritis over a six month period. The participants were randomly assigned to either a weight loss (WL) (n=44, 69.7 y/o, 34.9 kg/m²) intervention or weight stable (WS) (n=43, 69.3 y/o, 34.3 kg/m²) control group. The investigators set a goal of 10% weight loss and used a 1000 kcal/day energy deficit diet combined with exercise 3 days per week. The exercise component consisted of 30 minutes aerobic exercise, a 20 minute strength training session and a 5 minute warm-up and cool down. After 6 months of intervention the WL group saw a significant decrease in body weight (8.7 ± 0.8%) (30), and had greater functional improvements compared to the WS group, specifically greater 6-minute walk distance ($p<0.05$) and faster stair climb time ($p<0.05$) (30). This study showed a modest weight reduction of ≥ 5% and improvement in 6-minute walk distance and stair climb time however other changes in other measures of function such as knee extensor strength, grip strength and balance were not documented. Another limitation is the combined men and women in the analyzed sample.

Avila and colleagues (6) combined the DASH diet with resistance training in obese (31.6±3.8 kg/m²) older (66.0±3.8 y/o) men (n=6) and women (n=9). The intervention lasted 10-weeks and participants received one 30-minute dietary

education session each week focused around aspects of the DASH diet, and resistance training for 40-minutes, three days per week. Four sets of 8-12 repetitions were completed for a total of six lower and upper body exercises. Primary functional outcomes included leg extensor strength, SPPB score, 4-meter gait speed, 5-chair stand test and the 4-meter walk. Participants experienced a 3.6±0.8% weight loss while improving leg extensor strength ($p<0.01$), chair stand time ($p<0.01$), and 400-meter walk time ($p<0.001$). This study represents resistance training combined with the DASH diet as an adequate intervention for weight reduction and physical function improvement in obese, older participants. However, follow up time was only 10-weeks, and the sample size was small and included both men and women.

Anton et al. (3) looked at the impact of a dietary weight loss plus exercise intervention (n=17) on the physical functioning of obese (37.8±5.5 kg/m²), older (63.7±4.5 y/o) women compared to an educational control (n=17, 63.7±6.7 y/o, 35.8±6.8 kg/m²). The weight loss component of the intervention entailed an approximate 750 kcal/day deficit from baseline estimated energy intake. This deficit was intended to promote weight loss at a rate of 0.7 kg per week. Energy intake contained 55% carbohydrates, 30% fat and 15% protein. Exercise sessions met three times a week and consisted of aerobic, strength, and flexibility exercises. The primary form of aerobic exercise was walking at a moderate intensity effort for approximately 150 minutes each week. Resistance training consisted of five lower body exercises. Two sets of 10 repetitions were completed at a hard intensity, as shown by the Borg perceived exertion scale. The educational control group was asked to maintain their normal diet and physical activity levels while meeting once a month to discuss health

related topics relevant to older adults. Physical function outcomes included the 400 meter walk test, SPPB, and knee extension isokinetic strength. Anthropometric measures such as body weight were also assessed. The exercise intervention group lost significantly more weight than the control ($p<0.05$). Along with weight loss, the intervention group significantly improved 400 meter walk time ($p<0.05$) and SPPB score ($p<0.05$) compared to the control group, while no changes in muscle strength were seen in either group (3). The effects of resistance and aerobic training combined with a dietary intervention are widely documented as beneficial for physical function in older, obese individuals (52). Villareal et al. (52) support the previous study with a technical review regarding obesity in older adults. The authors found that a moderate diet induced weight loss in combination with exercise therapy improved all measures of physical function and was more beneficial than either diet or exercise alone (52). However, more exercise modalities are needed that are well tolerated in an older population.

Tai Chi

Tai Chi is a traditional Chinese martial art exercise that shows potential as an alternative form of exercise for preserving physical function in older adults as they age (55). Studies have shown Tai Chi to be a moderate intensity exercise (21, 27) that focuses on maintaining a technique driven, slow, controlled tempo (21) at an intensity equal to 60% of maximum heart rate (27). Tai Chi has been shown to be well-tolerated in older populations (2).

Many studies have explored the effects of a Tai Chi intervention on physical function, strength and cardiovascular disease risk factors. Palasuwan and colleagues

(35) examined the impact of a regular Tai Chi program with pre- (n=8, 39±6.o y/o, 21.9±4.0 kg/m²) and post- (n=7, 54±3 y/o, 26.2±3.2 kg/m²) menopausal women. The Tai Chi program lasted eight weeks and participants met twice in class and were asked to complete two sessions at home for 60-75 minutes. Participants were asked to maintain their normal dietary and activity habits throughout the intervention. Anthropometric data, dietary intake, physical activity levels, and measures of physical fitness were assessed. Energy intake and energy expenditure were similar between groups at pre and post testing ($p>0.05$) while balance, flexibility, and leg strength all significantly improved ($p<0.05$) after eight weeks for both pre and post menopausal women. This study demonstrates the efficacy of Tai Chi to improve measures of physical function. However, this study lacked a true control group to compare to and had a relatively small sample size.

Lu et al. (28) looked at the effects of a 16 week Tai Chi intervention in 31 elderly women on knee extensor strength. Participants were randomly assigned to a Tai Chi intervention (n=15, 73.9±6.6 y/o, 24.6±3.1 kg/m²) or to an educational control (n=16, 68.9±5.8 y/o, 24.8±3.3 kg/m²) group. The Tai Chi intervention met three days per week for a 15 minute warm-up, one hour Tai Chi session, and 15 minute cool-down. The control group experienced similar contact time but learned about music, handicrafts, and other non-exercise related subjects. Knee extensor strength was measured on participants' dominant leg using a dynamometer. Following the 16-week intervention the Tai Chi group showed significant improvements in knee extensor strength ($p<0.05$) while the educational control group showed no improvements (28). While this study demonstrated a functional improvement with increased knee extensor

strength, no effects were seen on other measures of function such as balance and gait speed and the participants were considered to be at a healthy weight according to BMI.

In a similar study, Thornton and colleagues (49) examined if Tai Chi had beneficial effects on balance. Participants were relatively healthy, sedentary, middle aged women between the ages of 33-55 who were asked to take part in a three day a week, 12-week, Tai Chi intervention. This study employed an opportunistic sample of volunteers from the community for the Tai Chi intervention (n=17, 47.2±4.07 y/o) along with a control group (n=17, 48.4±4.3 y/o) comprised of randomly selected individuals from the same community. Groups were demographically similar. Balance was measured using the functional reach test. For the Tai Chi group, functional reach test improved ($p<0.05$), (49). The studies conducted by Lu (28) and Thornton (49) show Tai Chi's ability to improve physical function components such as muscle strength and balance. Other studies look more in depth, primarily at the impact Tai Chi has on multiple measures of physical function in older women.

Lan et al. (26) ran a pilot study examining the possible impact Tai Chi has on muscular strength and endurance in an elderly population. Included in the study were 41 community dwelling men (n=15, 62.5±8.2 y/o) and women (n=17, 60.0±8.7 y/o). All participants took part in a 6-month Yang style Tai Chi training program. Tai Chi practice was held every day in a local park. Each session began with 20 minutes of warm-up exercises, 24 minutes of Tai Chi practice, and 10 minutes of cool-down exercises. Men attended an average of 3.8±1.2 sessions per week and women attended an average of 4.1±1.3 sessions per week during the six month intervention, nine participants dropped out. Major outcomes included knee extensor strength measured

with an isokinetic dynamometer. Both concentric and eccentric strength was tested at 60°, 180°, and 240°/sec. Knee extensor muscular endurance was also measured with the dynamometer. Participants were asked to perform 25 maximal contractions on the dynamometer at a velocity of 180°/sec. Men increased concentric knee extensor peak torque by 15.1% and eccentric peak torque by 18.3%. Women increased concentric torque by 13.5% and eccentric by 18.3%. Men increased knee extensor endurance by 9.6% and women by 10.1% (26). This pilot study indicates regular Tai Chi exercise may improve muscular strength and endurance in older men and women.

Nomura and colleagues (33) looked at the effect of Tai Chi on measures of physical function in a mostly female (n=40, female: n=35) frail, elderly population of Japanese participants. Frailty was assessed using the Kihon Checklist, and this study used two intervention groups that received the same intervention but began three months apart. Group one (n=20, 72.8±4.7 y/o, 23.7±3.4 kg/m^2) began in October and group 2 (n=20, 71.6±5.6 y/o, 23.5±2.8 kg/m^2) began shortly after in January. Both groups practiced Tai Chi for 90 minutes, once a week for three months and were encouraged to practice on their own at home. Physical function was assessed using measures such as knee extension force, single leg balance, trunk antiflexion, comfortable gait speed and timed up and go. The motor fitness scale is a 14-item questionnaire and was used to assess daily activity ability. Group two saw no improvements from baseline in any of the physical function measures, however group one saw significant improvements in the single leg balance test ($p<0.05$), trunk antiflexion ($p<0.05$) and total motor fitness scale score (33). These results indicate that Tai Chi can improve some components of physical functioning and daily activity

ability. However physical function was assessed using a self report questionnaire, the study involved both men and women, and did not duplicate results using matching interventions. Both Lan (26) and Nomura's (33) studies lacked the use of a true control group to compare and validate such results.

In a 2006 study Audette and colleagues (5) compared the training effects of two 12 week interventions on VO_2 max, grip strength, leg strength and balance with 26 older, sedentary, community dwelling women. Participants were randomly assigned to a Tai Chi intervention (n=11, 71.5±4.6 y/o), brisk walking intervention (n=8, 71.3±4.4 y/o) or a sedentary control (n=8, 73.5±5.7 y/o). Both Tai Chi and brisk walking participants met with their respective groups three times per week for 60 minute sessions. For both groups, sessions began with a 15 minute warm-up and concluded with a 5 minute cool-down. The Tai Chi group practiced a 10 form Yang style Tai Chi for 40 minutes while the brisk walking group walked at an intensity of 50-70% of estimated maximum heart rate for 40 minutes. The Tai Chi intervention group saw significant improvements in VO_2 max compared to the sedentary control group and approached significantly improving compared to the brisk walking group ($p=0.08$). Lower extremity strength ($p<0.05$), balance ($p<0.05$) and flexibility ($p<0.05$) all improved for Tai Chi participants when compared to the brisk walking group (5). Based on those findings, Tai Chi may be more beneficial for physical functioning than a walking only group, but physical functioning improvements in older adults have been seen to be more beneficial from a combination of resistance training and aerobic exercise compared to an aerobic only exercise (3).

Taylor-Piliae and colleagues (48) compared the effects of a western exercise intervention (n=39, 68.5±5.0 y/o) to a Tai Chi intervention (n=37, 70.6±5.9 y/o) and an attention control group (n=56, 68.2±6.2 y/o). Study participants were mostly female. The western exercise group received endurance training, resistance training, and flexibility exercises. Each class consisted of a 10-minute warm-up, followed by 15-25 minutes of vigorous walking, followed by 15-20 minutes of resistance training with light hand weights and rubber exercise bands, and each session concluded with stretching exercises. The Tai Chi intervention group practiced 12 postures of the Yang style Tai Chi with classes lasting 45 minutes. The attention control group met to discuss healthy aging techniques once a week for 90 minutes. The exercise interventions consisted of a 6-month adoption and 6-month maintenance phase. Primary outcomes include physical functioning assessed by balance, muscle strength and endurance, flexibility, and cardiorespiratory endurance measures. Balance was measured using the single-leg-stance and functional reach tests, muscle strength and endurance was measured using 30-second timed arm-curl and chair stand tests, and flexibility was assessed using the back-scratch and sit-and-reach tests. Following the 6-month adoption phase Tai Chi participants showed a greater improvement ($p<0.05$) than the western exercise and attention control groups in the single leg-stance. Following the 6-month maintenance phase, the Tai Chi participants showed significant with-in group changes in the single leg stance ($p<0.05$), arm curls ($p<0.001$), chair stands ($p<0.001$) and heart rate ($p<0.001$) (48). Tai Chi participants experienced better balance results than the combined intervention, but importantly Tai Chi

participants were able to make and maintain with-in group changes in physical function for a full 12 months.

Along with brisk walking Tai Chi has also been compared to yoga to see which exercise results in greater physical function. Hakim et al. (37) used a convenience sample of 52 healthy, mostly female (n=45), older adults over the age of 65 yr to see if Tai Chi or yoga had more of an impact on balance. Tai Chi (n=21, 74.09±5.63 y/o), yoga (n=11, 73.09±4.13 y/o) and non-exercisers (n=20, 76.20±5.30 y/o) underwent a series of balance related tests including the single limb stance, the multidirectional reach test and the activities-specific balance confidence scale. Eligibility criteria required a minimum of eight weeks of training for either Tai Chi or yoga. While most tests produced no significance between the two intervention groups, the Tai Chi group improved multidirectional reach test scores compared to yoga and the non-exerciser group ($p<0.01$) (37).

Chyu et al. (15) studied the effect of a 24-week Tai Chi intervention that met three days a week for 60 minute sessions. Sixty-one women over the age of 65 with low bone mass were randomized into a control group (n=31, 71.3±6.0 y/o, 26.1±5.4 kg/m^2) or Tai Chi intervention group (n=30, 72.4±6.2, 26.1±3.5 kg/m^2). Primary outcomes included gait analysis, timed up and go, and quality of life. Gait analysis was done using a treadmill fitted with force plates and was set at three different walking speeds (0.50, 1.75 and 3.00 mph) where stride length, frequency, and cadence were recorded. Quality of life was measured using the SF-36 Health Survey. After completion of the intervention, compared to the control group, the Tai Chi exercisers demonstrated an increased stride width ($p<0.05$), improved health ($p<0.01$), and

decreased bodily pain ($p<0.05$) (15). Stride width is a risk factor for fall prevention, and an increased stride width aids in fall prevention.

Wayne et al. (54) examined the influence of Tai Chi on bone mineral density, quality of life, and fall predictive sway measures compared to a usual care group of post-menopausal osteopenic women. For this nine month intervention, 86 women between the ages of 45-70 were randomly assigned to a Tai Chi group (n=43, 58.8±5.6 y/o, 25.8±4.2 kg/m²) or a usual care group (n=43, 60.4±5.3 y/o, 24.5±4.0 kg/m²). Tai Chi participants were allowed access to seven Tai Chi schools in the Boston area and were asked to attend a minimum of two sessions per week for the first month and a minimum of one session per week for the remaining eight months in combination with usual care. Usual care consisted of daily calcium and vitamin D supplements. Primary outcomes included quality of life, assessed using the SF-36 health status survey, and sway assessment measured with force plates. Post testing analysis was done on three groups: the Tai Chi intervention, the usual care group, and the Tai Chi per-protocol group (n=26, 59.1±4.9 y/o, 25.8±3.8 kg/m²). The per-protocol group consisted of Tai Chi participants who attended ≥75% of the assigned classes. Per-protocol significantly improved quality of life ($p<0.05$) and sway parameters ($p<0.05$) compared to the usual care group (54). Similar to the previous study, Wayne and colleagues (54) demonstrate Tai Chi's ability to improve fall related risk factors, in addition Tai Chi can be used to maintain and improve bone mineral density in an older female population. Participants in the study were considered slightly overweight, not obese, and were allowed access to seven different studios leads to lack of control over progression of Tai Chi movements.

Murphy et al. (31) studied the impact of a 5-form Yang style Tai Chi in 31 community dwelling women with or at risk for developing osteoporosis. Physical function was the major outcome and was assessed through the activities-specific balance confidence (ABC) scale, one-legged stance test, repeated chair stands, and the timed up and go test. In this study, participants (n=31, 67.3 y/o) acted as their own control as they met for two sessions a week for 12-weeks and were required to practice a third day on their own using an instructional video. Sessions typically lasted between 60-90 minutes and consisted of 10-20 minutes of warm-up, 45-60 minutes of Tai Chi practice, and approximately 7 minutes of cool-down. Measurements were taken pre-intervention, immediately following, 6 and 12 months post-intervention. Immediately following the intervention all measures of balance performance, functional strength, and mobility showed significant improvements ($p<0.05$), except the ABC scale. At six-month follow up, right legged one leg stand, chair stand, and timed up and go improvements were maintained. After 12 months the timed up and go and the chair stand tests were the only measurements that sustained improvement. Very few participants reported that they were still practicing Tai Chi on their own 12 months after the conclusion of the intervention, which could explain the loss of improvements over time.

In a 2007 study by Tsang et al. (51) Tai Chi was compared to a sham exercise program in patients with type 2 diabetes. A group of 38, mostly female (78.9%) older, sedentary individuals were randomized into a Tai Chi (n=18, 66.0±8.0 y/o, 33.7±5.0 kg/m^2) or sham intervention (n=20, 65.0±8.0 y/o, 30.9±7.2 kg/m^2). The intervention lasted 16 weeks and both exercise groups met for two supervised one-hour sessions.

The Tai Chi group practiced Tai Chi for Diabetes, which is a 12 form combination of the Sun and Yang style Tai Chi. Each session began with a total body 10-minute warm-up and concluded with a 5-minute cool-down. The sham exercise group practiced calisthenics and gentle stretching, previously shown to have no effects on physical or psychological outcomes. Calisthenics took place in a mostly seated position with no other resistance besides opposing gravity. Both interventions were presented to the participants as being potentially beneficial. Primary outcomes included anthropometric measures, physical function, muscle performance and balance. Physical function was assessed using the 6-minute walk test, habitual gait speed was calculated by taking the average of the two trials and the faster 6-minute walk test was used for maximal gait speed. Bilateral knee extensor strength, peak power and endurance were assessed using pneumatic resistance equipment and done on both legs, and six tests of balance and postural control were used. After the 16-week intervention the Tai Chi group significantly improved compared to the control group in total balance ($p<0.05$) and maximal gait speed ($p<0.01$). No other measures improved (51). This study shows Tai Chi to have had a positive impact on physical function for older, obese participants with type 2 diabetes.

Overall, Tai Chi has been shown to have a positive impact on physical functioning in older and obese individuals, however more multidisciplinary Tai Chi studies need to be conducted that include a dietary component, to determine the combination effect of weight loss in conjunction with Tai Chi.

Tai Chi and Weight Loss

Few studies have been conducted involving intentional dietary weight loss in combination with a Tai Chi intervention in obese, older women. Dechamps and colleagues (17) conducted a pilot study with obese women that combined Tai Chi with a weight management program that used a hypocaloric balanced diet and weekly dietician group sessions. Participants were randomly assigned to a weekly 2-hour Tai Chi session or a conventional structured exercise program for 10 weeks. Outcomes included measures of body composition, physical functioning and general self efficacy, assessed through questionnaire. Post testing was done immediately following the intervention and six-month post completion. The Tai Chi group saw an improvement in chair rise time ($p<0.05$) along with reductions in body fat percent at both immediate post testing and the six-month follow up (17). This study indicates Tai Chi may be beneficial in improving functional measures in obese women undergoing dietary weight loss. However this study had a small sample size (n=21), had few measures of function, did not include any older participants, and lacked a control group.

Katkowski et al. (24) looked at the additive effect of a 16-week Tai Chi during a weight loss program on obese, older women. Twenty-seven women were randomly assigned to a Tai Chi plus weight loss (n=14, 60.4±5.9 y/o, 34.3±5.1 kg/m^2) group or a weight loss only (n=13, 62.7±6.0 y/o, 34.9±2.9 kg/m^2) group. Both intervention groups received the behaviorally-based dietary weight loss intervention. A modified Dietary Approaches to Stop Hypertension (DASH) diet was introduced with the goal of low intake of saturated fat, moderate intake of total fat, high intake of fruits, vegetables, and whole grains. The participants were also asked to consume low-fat

dairy and meat products with moderate intakes of sodium. Dietary education sessions met once a week and a weight loss goal was set at 5-10% total body weight. Participants in the Tai Chi plus weight loss group along with the dietary component met three days per week to practice a 24-form Yang style Tai Chi. Outcomes included anthropometric and physical function measures such as grip strength, leg strength and the timed up and go. Both groups lost a significant amount of weight ($p<0.05$), and there was no between group difference. For physical functioning, no statistical difference was seen between groups, but there was a tendency for a between-group difference in changes in leg strength ($p=0.06$), grip strength ($p=0.07$), and timed up and go ($p=0.07$) (24). While this study employed a weight loss only group it lacked a true control group, was performed in a laboratory setting, saw a weight change of less than 5% in both interventions and had a small sample size.

The two studies above show that Tai Chi can be an effective intervention at improving physical function in obese women A study needs to be conducted in older, obese women that compare changes in physical functioning resulting from dietary weight loss combined with Tai Chi to a true control group.

Conclusion

Obesity leads to declines in physical functioning especially in women. Dietary weight loss has been shown to be an effective strategy for weight loss (9, 29); however this may worsen physical function declines especially in an older population that is already undergoing an age related loss of muscle. Exercise training combined with

dietary weight loss (3, 6, 45) is effective at maintaining physical function during weight loss: one exercise that has been shown to be well tolerated in older adults is Tai Chi (28, 35). Tai Chi has been shown to have positive effects on physical function (31, 51), but few studies have examined the impact of Tai Chi during weight loss and no study has examined this combination of intervention strategies in a community-based setting. Further research is needed to examine the combined effect of Tai Chi with dietary weight loss in obese, older women.

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Appendix B: Consent Form

The University of Rhode Island
Department of Kinesiology
25 West Independence Way, Suite P, Kingston, RI 02881

Department of Nutrition & Food Sciences
106 Ranger Hall, Kingston, RI 02881

CONSENT FORM FOR RESEARCH

Title of Project: A community-based Tai Chi and weight loss study obese in women at Rhode Island senior centers

You are invited to take part in a 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 (Phone: 401-874-5440), Ingrid Lofgren (401-874-5706), and Furong Xu (401-874-2412) from the Departments of Kinesiology and Nutrition and Food Sciences at the University of Rhode Island, the persons mainly responsible for this study, will discuss them with you. The general eligibility criteria for inclusion to this study include having/being 1) female, 2) age 55-80 years, 3) a body mass index (BMI) of 30-50 kg/m^2, 4) body weight stable, 5) no recent medication changes, 6) post-menopausal, and 7) free of diseases or conditions that would prevent safe weight loss and/or participation in a Tai Chi exercise program.

Description of the project:

You understand that the primary purpose of this study is to assess the role that a 16-week Tai Chi exercise program plays in improving physical functioning, retaining muscle mass, losing fat mass, and improving heart disease risk factors when combined with intentional weight loss (~ 5-10%). Tai Chi is a form of martial arts that is a slow and low-impact exercise and has 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 weight loss with Tai Chi training on changes in bone density, blood pressure, blood sugar metabolism, blood fats, muscle function, and other important health-related measures. Your participation will vary depending on which group you are assigned. However, the study may require your participation of 2-3 hours per week. All of the testing and intervention sessions will take place at your local senior center (North Kingstown, South Kingstown, or Warwick). 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 (a 1-2 hour 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. These include the National Cancer Institute fat screener questionnaire, a dietary screening tool, a food frequency questionnaire, a physical activity survey, a sleep quality questionnaire, a cognitive function test, life and body satisfaction surveys, and a general health survey.

You will also complete two finger sticks that will be used to analyze blood sugar, fats, and C-reactive protein (CRP, a blood protein associated with heart disease risk). 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 9:00am on a Wednesday, you are asked to not eat and/or drink anything besides plain water after 9:00pm 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.

You understand that trained personnel, using universal precautions and established methods, will conduct the two finger sticks. You understand that the two finger sticks require 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 qualified 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 bioelectrical impedance analysis, which is 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 bioelectrical impedance analysis device.

At the end of the first phase (testing), you may be assigned (based on group availability) to either a weight loss plus Tai Chi group or to a control group.

PHASE 2: INTERVENTION

Dietary Sessions (Weight Loss plus Tai Chi Group)

For those assigned to the weight loss plus Tai Chi intervention, you will be asked to participate in a diet designed to produce a moderate weight loss of 5-30 pounds (about 5-10% of your current weight). You will be instructed to consume a well-established, lower calorie, low fat diet, in which the goal will be to reduce your food intake by about 500 to 1000 Calories per day. In your senior center, you will meet in a

group (~ 10-20 other participants) with an expert in nutrition once per week (~ 45 minutes per session) for 16 weeks who will give you instructions and expert advice on food selection, preparation, and other dietary changes. Weight gain or loss will be monitored weekly, and you will be instructed to keep careful records of your food intake.

Tai Chi Sessions (Weight Loss plus Tai Chi Group)

If you are assigned to the weight loss combined with Tai Chi exercise group, you will also be asked to participate in two (2) supervised exercise sessions per week (40-45 minutes per visit) for the 16-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 assigned room at your local 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 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 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 40-45 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 an effort level that is judged to be appropriate to improve your fitness level. Your blood pressure will also be monitored at 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 five 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.

Control Group

If there is no space available in the intervention group, you understand that you may be asked be in the “waitlist control” group. If you 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 16-week intervention phase. 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 four supervised Tai Chi exercise sessions at your local senior 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 weight loss 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 after the 16 week intervention. All data will be sent and stored with a study number only at the University of Rhode Island and without any personal identifiers (including initials or birth dates). 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. Your local senior 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, 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 subject:

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 all 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, Suite P, room 225). Study records are retained securely for ten years after study end.

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 weight loss and Tai Chi 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 in the study.

Decision to quit at any time:

You understand that 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.

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, or Furong Xu (401) 874-2412 (anonymously, if you choose). In addition, if this study causes you any injury or if you have questions about your rights as a research subject you may contact the office of the Vice President for the Division of Research and Economic Development, 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., a 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 weight loss 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.

Appendix C: Phone Screener
THE UNIVERSITY OF RHODE ISLAND DIETARY EDUCATION AND ACTIVE LIFESTYLE (UR-IDEAL) STUDY – PHASE 5

Data Sheet for Detailed Subject Telephone Interview

o **Brief Explanation of Study**
o **Permission to Conduct Interview?** _____Yes _____No
Comment:_____
_____
How they heard about us?:
_____

o **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:_____
  _____

- **Preference for Senior Center Location**
  S. Kingstown (M/F) 8-9:30____ N. Kingstown (W/F) 8-9:30___ or 10-11:30____
- **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

- **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)

_____
_____
_____
_____

- **Cardiovascular/ 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**

  No Incidents_____

  Fractures as an adult? _____

  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:_____
- **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:_____

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. YES NO
SECTION *A*

Musculoskeletal system:

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

a. Osteoarthritis or degenerative arthritis

b. Rheumatoid arthritis

c. Osteoporosis

d. 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*

YES NO

Respiratory System:

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*

NO

Endocrine system:

Have you ever had any of the following symptoms?

a. Thyroid problems?

b. Adrenal problems?

c. Diabetes mellitus?

If yes, which type? Type 1 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?

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.

Appendix E: Medical Clearance

Medical Clearance to Participate in Dietary Education and Exercise Research Project

It is my understanding that _____ (name of the volunteer), a patient under my care, has volunteered to participate in a dietary weight loss and exercise study entitled "**The University of Rhode Island Dietary Education and Active Lifestyle (UR-IDEAL)** Study." It is strongly recommended that volunteers have the clearance of his or her physician to participate in this study.

The aim of this study is to evaluate the impact of a 16-week Tai Chi exercise program when combined with dietary weight loss (~5-10%) intervention (Dietary Approaches to Stop Hypertension-based diet) in obese (BMI: 30.0-50.0 kg/m^2) older women aged 55-80 years.

Exclusionary criteria for eligibility

___Severe cardiovascular disease, ___Severe stenotic or regurgitant valvular disease, ___Unstable angina Uncontrollable hypertension uncontrolled dysrhythmias, ___ hypertrophic cardiomyopathy, ___Severe COPD or other signs of significant pulmonary dysfunction, ___Musculoskeletal diseases that cause severe joint pain at rest or upon exertion, ___Having any condition that is likely to be aggravated by muscular exertion, ___Major joint, vascular, abdominal or thoracic surgery in the past three months, ___Being unable to engage safely in mild to moderate exercise, such as independently walking up at least one flight of stairs or walking 1/4 mile on level ground, ___Not within age range for study (55-80 years)

Although we are unaware of any cardiac complications that have resulted from Tai Chi, 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 in this study will either participate in 1) a 16-week dietary weight loss program plus Tai Chi (a low-impact martial art) 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, Ph.D., M.P.H., Department of Kinesiology, 25 West Independence Way, Room 214, University of Rhode Island, Kingston, RI 02881, Ph: (401) 874-5440, Ingrid E Lofgren, PhD., M.P.H., R.D., Department of Nutrition and Food Sciences, 106 Ranger Hall, University of Rhode Island, Kingston RI 02881, Ph: (401)874-5706, and Furong Xu, Ph.D., Department of Kinesiology, 25 West Independence Way, Room 214, University of Rhode Island, Kingston, RI 02881, Ph: (401) 874-2412

Physicians Name_____
Physicians Signature_____ Date_____

Appendix F: Education Survey

Name _____ **Date:** _____ **Study ID#:** _____

EDUCATION

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) _____

Appendix G:YALE PHYSICAL ACTIVITY SCALE

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

Work: (Number of hours per week)

1. _____Shopping (e.g., grocery, clothes)

2. _____Stair climbing while carrying a load

3. _____Laundry (time loading, unloading, hanging, folding only)

4. _____Light housework: tidying, dusting, sweeping; collecting trash in home; polishing; indoor gardening; ironing

1. _____Heavy housework: vacuuming, mopping; scrubbing floors and walls; moving furniture, boxes, or garbage cans

6. _____Food preparation (10+ minutes in duration): chopping, stirring, moving about to get food items, pans

7. _____Food service (10+ minutes in duration):setting table; carrying food; serving food

8. _____Dish washing (10+ minutes in duration): clearing table; washing/drying dishes, putting dishes away

9. _____Light home repair: small appliance repair; light home maintenance/repair

10. _____Heavy home repair: painting, carpentry, washing/polishing car

11. _____Other: _____

Yard work: (Number of hours per week)

12. _____Gardening: planting, weeding, digging, hoeing

13. _____Lawn mowing (walking only)

14. _____Clearing walks/driveway: sweeping, shoveling, raking

15. _____Other

Appendix H: Data Collection Sheet

SPPB

BALANCE SCORING:

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

- **B. Semi-Tandem Stand**
  - Held for 10 sec ❒ 1 point
  - Not held for 10 sec ❒ 0 points
  - Number of seconds held if less than 10 sec:____sec
  - Not attempted ❒ 0 points
  - If participant did not attempt test or failed, check why:
  - Participant could not walk unassisted ❒
  - Not attempted, you felt unsafe ❒
  - Not attempted, participant felt unsafe❒
  - Participant unable to understand instructions ❒
  - Other (Specify) ❒
  - Participant refused ❒
  - **If 0 points, end Balance Tests**
- **C. Tandem Stand**
  - Held for 10 sec ❒ 2 points
  - Held for 3 to 9.99 sec ❒ 1 point
  - Held for < than 3 sec ❒ 0 points
  - Not attempted ❒ 0 points
  - If participant did not attempt test or failed, check why:
  - Participant could not walk unassisted ❒
  - Not attempted, you felt unsafe ❒
  - Not attempted, participant felt unsafe❒
  - Participant unable to understand instructions ❒
  - Other (Specify) ❒
  - Participant refused ❒

- **D. Total Balance Tests score _____(sum points)**
- Comments:

GAIT SPEED TEST SCORING:

- Length of walk test course: Four meters
- **A. Time for First Gait Speed Test (sec)**
  - Time for 4 meters ____sec
  - If participant did not attempt test or failed, check why:
  - Tried but unable ❒
  - Participant could not walk unassisted ❒
  - Not attempted, you felt unsafe ❒
  - Not attempted, participant felt unsafe❒
  - Participant unable to understand instructions ❒
  - Other (Specify) ❒
  - Participant refused ❒
  - Aids for first walk……None ❒Cane ❒ Other ❒

- **B. Time for Second Gait Speed Test**
  - 1. Time for 4 meters ____sec
  - 2. If participant did not attempt test or failed, check why:
  - Tried but unable ❒
  - Participant could not walk unassisted ❒
  - Not attempted, you felt unsafe ❒
  - Not attempted, participant felt unsafe❒
  - Participant unable to understand instructions ❒
  - Other (Specify) ❒
  - Participant refused ❒
  - Aids for second walk…… None ❒ Cane ❒ Other ❒
  - What is the time for the faster of the two walks? _____sec.
  - If the participant was unable to do the walk: ❒ **0 points**

- **For 4-Meter Walk:**
  - If time is more than 8.70 sec: ❒ **1 point**
  - If time is 6.21 to 8.70 sec: ❒ **2 points**
  - If time is 4.82 to 6.20 sec: ❒ **3 points**
  - If time is less than 4.82 sec: ❒ **4 points**

CHAIR SCORING:

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

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

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

- **Scoring for Complete Short Physical Performance Battery**
- **Total Balance Test score _____ points**
- **Gait Speed Test score _____ points**
- **Chair Stand Test score _____ points**

- **Total Score _____ points (sum of points above)**

Timed Up and Go

A. Time for first TUG test (sec)
Time:_____sec

If participant did not attempt test of failed, check why:
Tried but unable___
Participant could not walk unassisted____
Not attempted, you felt unsafe____
Not attempted, participant felt unsafe____
Participant unable to understand instructions_____
Other (specify)_____
Participant refused_____

Aids for first walk…….None____ Cane_____ Other_____

B. Time for second TUG test (sec)
Time:_____sec

If participant did not attempt test of failed, check why:
Tried but unable___
Participant could not walk unassisted____
Not attempted, you felt unsafe____
Not attempted, participant felt unsafe____
Participant unable to understand instructions_____
Other (specify)_____
Participant refused_____

Aids for second walk…….None____ Cane_____ Other_____

Chair Sit and Reach Test

Practice	cm
Trial 1	cm
Trial 2	cm

Comments:

Grip Strength: Arm: L / R

Trial 1	kg
Trial 2	kg
Trial 3	kg

Comments:

Leg Strength: Leg: L / R

Trial	Kilograms	Pain/ Discomfort
Practice		
1		
2		

Comments:

Appendix I: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 <u>IS NOT</u> 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 J: DASH Education Session Outline

WEEK 1
Topic: Common food beliefs.
Hand-outs: Common food beliefs questionnaire (to be completed at beginning of class) Nasco Read Food Labels handout.
Interactive component: Food Beliefs questionnaire, icebreaker: ask participants what they believe are common food myths. (Undergrads to make note of these for later sessions using Myth Buster handouts and posters for respective topics)
Food: Hidden health foods: Quinoa, complete protein, emphasize its versatility (provide recipe)
Props/Models: portion size models, measuring cups, food models
Participant Assignment: Complete food records and bring in any confusing food labels from home along with Read Food Labels handout.

WEEK 2
Topic: Food label reading
Hand-outs: Nasco Food Labels (from previous week), nutrition label terminology (to be handed out at the beginning of class)
Interactive component: Label reading exercise
Food: Yogurts: lite and full sugar (fruit on bottom or blended) Emphasis on fat and sugar content and subjectivity of serving size in large containers.
Props/Models: Two yogurts

WEEK 3
Topic: Introduction to food guide pyramid/serving size
Hand-outs: Mypyramid for older adults (print in color), "Nasco handy portions" and portion distortion handouts. Nasco portion puzzle handout
Interactive component: Use of computer for on line tutorial of MyPyramid.gov (use conference room overhead and personal laptop) – use actual food such as All Bran Cereal, coffee bread, pasta – have ppts dish out what they normally would and guess their portion size.
Food: some type of 100 cal pack (Quaker rice cakes, other).
Props/Models: serving size models/measuring cups
Free Item: Equal Easy Everyday Carb Counting Guide

WEEK 4
Topic: Introduction to the DASH Diet
Hand-outs: DASH diet eating plan sample serving sizes, nutrition to go: eating healthy the DASH way, ADA DASH nutrition fact sheet, Nasco sodium content of foods brochure.
Interactive component: Designing a DASH diet using food models based off "DASH diet eating plan" handout
Food: Breakfast items: low fat grain cereals, whole grain bagels, bran muffins
Props/Models: Food models (could be used to design dash diet)

WEEK 5

Topic: Heart healthy food/Know your fats
Hand-outs: nutrition to go: Trans fat, heart friendly fats, counting down cholesterol Nasco Busting the Myth – MUFAs, PUFAS, SF, and TF handouts, Common Fats and Oils handouts, Fat Facts handouts, Nasco Fat and Cholesterol Content of Foods Brochure
Interactive component: AHA bad fats videos on overhead, fat myths (review Nasco poster)
Food: Dark chocolate/nuts /avocado
Props/Models: TAG model, (2) Artery Death Models, Fat lipo visual model (tubes), fat model (Deb Riebe)

WEEK 6
Topic: Fruits and Vegetables (emphasis on DASH) *{Potassium,vitamin C}
Hand-outs: Nutrition on the go: The power of produce and Fantastic fruits, SNAP recipes ADA vegetable and potassium fact sheet.? Nasco Busting the Myth – Vitamins, Minerals, and Antioxidants handouts
Interactive component: Busting F&V Myths poster
Foods: variety of fruits and vegetables – raisins, craisins (portioned out), any other dried fruit, carrots, celery, some sort of DIP.
Props/models: Fruit and vegetable food models
Free Item: Sunkist Orange Peeler, "SNAP-ed squeeze fruit"
Participant Assignment: Bring in labels from grain products from home they believe may be whole grain.
Guest Speaker: Nivindra or BPS Grad student

WEEK 7
Topic: Grains/Carbohydrate *{fiber, folate}
Hand-outs: Whole grains made easy, whole grain handouts, strategies for increasing dietary fiber intake, SNAP recipes, CHO and Fiber content of foods brochure, COMPLEX VS SIMPLE CARBS myths HANDOUTS
Interactive component: Identifying whole grains based on food labels they bring in, provide examples, categorizing food items as either whole grain or refined, food myths poster.
Foods: variety of whole grain crackers, breads, white bread with whole grains.
Props/models: food models, Nasco fiber lipo visuals

WEEK 8
Topic: Protein *{B12}
Hand-outs: ADA fact sheets, SNAP recipes, Nutrition to go: Eggs, Nasco Busting the Myth – Protein and Veg Protein handouts, Nasco Protein Content of Foods Brochure (ordered)
Interactive component: Nasco myth poster: Veggie vs. Animal protein
Foods: Hummus, low fat string cheese
Props/Models: food models

WEEK 9
Topic: Dairy and dairy alternatives (osteoporosis and calcium)*{vitamin D}
Hand-outs: Nutrition to go: Got Calcium? Lactose intolerance, SNAP recipe

Interactive component: match food items with proper calcium content or a game in which ppts guess which food model contains the most amount of calcium. (I have a list of calcium rich foods I can match up with our food models).
Also, a true and false fact sheet about Vitamin D (Noereem)
Foods: alternative calcium sources: fortified soy and rice milks,
Props/Models: food models with calcium contents

WEEK 10
Topic: Healthy dining out and eating during social gatherings
Hand outs: Nutrition on the go: Dining out healthy, Eat out eat healthy, eating out healthy tip sheet, Sensible eating during the holidays.
Interactive component: analyzing local restaurant menus for healthy choices (Newport Creamery, Chellos, Chillis, Friendlys, Applebees, Dennys, McDs, etc.)
Foods:
Props/models: local restaurant menus

WEEK 11
Topic: Cutting calories and healthy substitutions
Hand-outs: Tip sheets: lowering calories on the DASH plan, healthy food substitutions
Interactive components:
Foods:
Props/Models: healthy alternative products used in cooking. (applesauce, prune puree, beans, yogurt etc.)
FREE ITEM: Pure Via samples

WEEK 12
Topic: healthy beverage choices/alcohol
Handouts: ADA fact sheet alcoholic beverages, Think Your Drink Handouts, Sizing up your beverages.
Interactive component:
Foods: assorted beverages (fruit juices)
Props/models: "giant soda" model (Linda), food props

WEEK 13
Topic: Food Safety and high risk foods
Hand-outs: High risk food fact sheet
Interactive component: Indentifying food risk in kitchen, Food Safety Toss Up Ball
Foods:
Props/models: examples of high germ conduits.
Free Item: SNAP-ed Fridge thermometer

WEEK 14
Topic: Healthy home cooking and the tools that make it easier.
Hand-outs: UR-IDEAL recipe book
Interactive component: Cooking demonstration/easy recipe
Foods: SNAP recipe: "Brocolli Bean and Pasta Salad"

Props models: Portion size gadgets for home cooking.

WEEK 15
Topic: Eating on a budget/healthy supermarket shopping /eating in season
Hand-outs:
Interactive component
Foods: SNAP recipe
Props/Models: cost comparisons of prepared food vs. ingredients.

WEEK 16
Topic: Common food beliefs feed-back and overall review of topics
Hand-outs: Redistribute common food beliefs questionnaire
Interactive component: food beliefs feedback
Foods:
Props models: