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Effect of Tai Chi Exercise on Cognitive Function during Weight Loss in Obese Older Women

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EFFECT OF TAI CHI EXERCISE ON COGNITIVE FUNCTION DURING WEIGHT LOSS IN OBESE OLDER WOMEN

Alice Marolla
May 1, 2012
OVERVIEW

- Introduction
  - Previous research
  - Statement of problem
- Aims and hypotheses
- Methodology
  - Study Design
  - Participants
  - Measures and Interventions
  - Statistical analysis
- Results
- Discussion
- Conclusion
OBESITY

Growing health problem worldwide
- 5th leading cause of global death
- In 2011, 35.7% of US population obese (Center of Disease Control, 2011)

Defined as having a BMI of ≥ 30 kg/m²

Result of energy imbalance
- Consuming too many calories and not expending enough through physical activity

Women have higher obesity prevalence than men in older adulthood (Carroll, 2007)
OBESITY MANAGEMENT

- Pharmacotherapy
- Surgery (in severe cases)
- Lifestyle intervention (Villareal, 2009)
  - Diet
  - Physical activity
  - Behavioral modifications
OBESITY

- Consequences of obesity include:
  - Coronary heart disease
  - Osteoarthritis
  - Type 2 Diabetes
  - Some cancers (endometrial, breast, colon)
  - Dyslipidemia
  - Liver and gallbladder disease
  - Sleep apnea/respiratory problems
  - Cognitive functioning declines?
    - Some evidence shows cognitive function declines with increased BMI
    - Other research shows obesity may have protective qualities against cognitive decline
COGNITIVE FUNCTION

Comprised of several domains:
- Executive functioning
- Memory
- Attention
- Perception
- Psychomotor skills
- Language

Cognitive function can be measured by:
- MRI scans
- Mini Mental State Examination
- Isaac Set Test
- Benton Visual Retention Test
- Digit Symbol Substitution Test (Amieva et al 2006)

CUTPOINT

Risk factors for cognitive function decline
- Aging
- Gender
- Genetic mutations (Park, 2011)
- Higher education
- Hyperlipidemia
- Diabetes
- Hypertension (Teri et al, 1995)

NORMS
COGNITIVE FUNCTION

- Cognitive functioning declines with aging (Glisky, 2007)
- Dementia is one of the largest growing diseases known
- Alzheimer’s Disease is 7th leading cause of death in US
- Cognitive function declines increase with sedentary lifestyle
COGNITIVE FUNCTION AND PHYSICAL ACTIVITY

- Inactivity and obesity in women have been shown to accelerate cognitive decline (Katz et al, 2012)
- Aerobic fitness shown to help healthy, older adults improve executive control processes (Colcombe & Kramer, 2003)
- Aerobic physical activity also shown to improve motor function, processing speed, and auditory and visual attention in adults aged 55 and older (Angaveren et al, 2008)
- Long time physical activity, such as walking, proven to decrease cognitive decline in older women (Weuve et al, 2004)
- Leisure-time physical activity at midlife also linked to decreased risk of developing Alzheimer’s Disease later in life (Petrovitch & White, 2005)
- More research needs to be done to test the effects of all exercise modes on cognitive function
PHYSICAL ACTIVITY AND COGNITIVE FUNCTION DECLINE

% Decline in mMSE Score

- Lowest
- Second Quartile of Blocks Walked
- Third
- Highest
TAI CHI

- Safe alternative for physical activity for older women based on traditional Chinese martial arts
  - Slow, controlled movements emphasizing postural alignment, weight shifting, and meditation (Yeh et al. 2004)
  - Integration of body and mind in specific sequencing of movements
  - Yin and yang

- Development of whole person, promotes physical and mental health
  (Taggart, 2001)
BENEFITS OF TAI CHI

- Improves balance, flexibility, aerobic capacity, strength (Reid-Ardt et. Al, 2011)
- Improved self-assessed health and self-esteem (Taggart, 2001)
- Promotes gains in neuropsychological functioning and physical functioning
- Osteoarthritis management
- Shown to improve cognitive functioning (Reid-Ardt et. Al, 2011)
- Some evidence for improving body composition and strength when combined with weigh loss (Benson, Katkowski, 2012)
PURPOSE OF STUDY

- **Primary Aim**
  - To determine the additive effect of Tai Chi during dietary weight loss on cognitive function in obese, postmenopausal women.

- **Hypothesis**
  - The addition of Tai Chi to a dietary weight loss intervention will result in a significant increase in cognitive function score compared to a weight loss only group.

- **Exploratory Aims**
  - To determine the additive effect of Tai Chi during dietary weight loss on weight, body composition, waist circumference, and BMI.
STUDY DESIGN

- 16 week randomized trial
- Weight Loss only group (WL) vs. Tai Chi + Weight Loss group (TCWL)
- 32 participants overall
- Pre- and post-intervention measures
  - Baseline testing
  - Intervention
  - Post-intervention testing
PARTICIPANTS

INCLUSION:

- Women, aged 55-79 years
- BMI $\geq 30-50$ kg/m$^2$
- Weight-stable (within 5%) over last 3 months
- Currently not engaged in regular physical activity program within last 6 months
- Post-menopausal (by self-report)
- Signed informed consent form and received medical clearance from physician
- Able to safely engage in moderate exercise

EXCLUSION:

- Significant cognitive impairment; defined as known diagnosed dementia
- Hearing loss, speech disorder, language barrier or visual impairment
- Progressive, degenerative neurologic disease
- Terminal illness with life expectancy of $<12$ months, as determined by a physician
- Severe pulmonary disease, uncontrolled diabetes or blood pressure, or anemia
- Medications not taken for $>3$ weeks; lipid lowering medication for at least 6 months
- Joint, vascular, abdominal, thoracic surgery within the past year or significant CVD
- Unable to safely engage in moderate exercise
PARTICIPANT RECRUITMENT

- Newspaper and television advertisement, flyers sent out to local residents and University staff, word of mouth
- Phone interview
- Orientation
  - Explained methods and procedures
  - Participants ask questions
  - Completed full medical history and read/signed informed consent
  - Assessed height and weight
OUTCOME MEASURES

- Primary Outcome:
- Cognitive functioning
  - DIGIT SYMBOL SUBSTITUTION TEST (DSST)
  - Valid for testing learning procedures like memory assessment and visual scanning efficiency (Fein et al., 2003)
  - Valid for assessing changes in cognition among subjects with medium-high level cognition level
  - Predictive of cognition declines with aging (Salthouse 1992)
  - 90 second timed test
  - Match numbers to corresponding symbol
  - Scored by adding up the correct number of boxes completed from 0-90
OUTCOME MEASURES
EXPLORATORY OUTCOMES

- Body Composition
  - Dual Energy X-Ray Absorptiometry (DXA)
  - Total body fat free mass, fat mass, and percent fat
  - Fasted state, wearing medical scrubs
EXPLORATORY OUTCOMES

DXA

- Measures bone mineral density (BMD) with high and low level x-ray beams
- Determines absorption of each beam by bone to calculate BMD
- Typically used to diagnose osteoporosis
EXPLORATORY OUTCOMES

- Anthropometrics
  - Weight measured on balance beam scale
  - Height measured by wall mounted stadiometer
  - Waist circumference measured by non-stretch tape measure with a tensiometer
  - BMI calculated as body weight (kg)/height² (m²)
EXPLORATORY OUTCOMES

- **Physical Activity**
  - Measured by Yale Physical Activity Scale (YPAS)
  - Total kcal/week, total hours of activity/week, adjusted for season

- **Dietary Intakes**
  - Fred Hutchinson Food Frequency Questionnaire
    - Self-reported food consumption over 1 month time span
    - Total caloric intake per day and macronutrient intake as percentage of the diet per day
    - 2 parts: Food preparation and frequency of intake
RANDOMIZATION

- Occurred following pre-testing
- WL only or TCWL
- Random Allocation Software (Isfahan University of Medical Sciences, Isfahan, Iran)
INTERVENTIONS

Behaviorally-Based Dietary Weight Loss Intervention

- Administered to both groups
- 45 minute session once/week for 16 weeks
- Supervised by registered dietician
- Modified, behaviorally based Dietary Approaches to Stop Hypertension (DASH) diet
  - Low sodium
  - Low saturated fat
  - Moderate total fat
  - High fruits and vegetables, whole grains
  - Lean dairy and meats
- Weight loss goal of 5-10% total body mass
INTERVENTIONS

Tai Chi

- Administered to TCWL group
- Modified 24 form Yang Style
- Yang style has shown intensity not exceeding 50% of participants’ maximum oxygen intake \( (\text{Reid-Ardt et al., 2011}) \)
- 3 non-consecutive days/week for 16 weeks
- Instructed by experienced Tai Chi instructor and study staff
- 2-4 movements taught per week progressively
  - Emphasis on breathing
- Included pre/post exercise blood pressure, warm up, and cool down
Interested Subjects, n = 142

Phone Screened, n = 89

Qualified, n = 47

Attended orientation, n = 38

Attended pre-testing, n = 33

Completed pre-testing, n = 32

Randomized WL, n = 16

Randomized TCWL, n = 16

Completed intervention, n = 13

Completed intervention, n = 14

Withdrew, n = 3

Withdrew, n = 2

Could not contact, n = 53

Not qualified, n = 37

Signed informed consent, did not attend pre-testing, n = 5

Did not complete pre-testing, n = 1
RESULTS

- Final analytic sample, n=27
  - WL (n=13, BMI = 34.8 kg/m²)
  - TCWL (n=14, BMI = 34.4 kg/m²)

- Adherence to DASH education
  - WL group- 86.5%
  - TCWL group- 78.1%
  - Adhere to Tai Chi sessions -73.1%
## BASELINE CHARACTERISTICS

<table>
<thead>
<tr>
<th>Variable</th>
<th>WL (n=13)</th>
<th>TCWL (n=14)</th>
<th>p between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>62.7±6.0</td>
<td>60.4±5.9</td>
<td>0.334</td>
</tr>
<tr>
<td>WT (kg)</td>
<td>90.1±9.0</td>
<td>89.8±14.4</td>
<td>0.956</td>
</tr>
<tr>
<td>HT (cm)</td>
<td>160.9±3.6</td>
<td>162.0±6.7</td>
<td>0.610</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>34.8±2.9</td>
<td>34.3±5.1</td>
<td>0.725</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>107.1±9.1</td>
<td>106.8±9.8</td>
<td>0.929</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>44.2±7.0</td>
<td>43.0±9.4</td>
<td>0.721</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>44.9±3.1</td>
<td>46.1±5.9</td>
<td>0.530</td>
</tr>
<tr>
<td>% Body Fat</td>
<td>50.7±3.2</td>
<td>49.2±4.1</td>
<td>0.318</td>
</tr>
<tr>
<td>Physical Activity (kcal/wk)</td>
<td>10,294±8,070</td>
<td>8,661±6,157</td>
<td>0.558</td>
</tr>
<tr>
<td>Kcal Intake (kcal/day)</td>
<td>1,883±611</td>
<td>2,113±1,610</td>
<td>0.663</td>
</tr>
<tr>
<td>CHO Intake (%)</td>
<td>46.3±7.8</td>
<td>47.0±7.2</td>
<td>0.808</td>
</tr>
<tr>
<td>FAT Intake (%)</td>
<td>33.5±6.7</td>
<td>34.9±4.6</td>
<td>0.530</td>
</tr>
<tr>
<td>PRO Intake (%)</td>
<td>18.9±3.4</td>
<td>18.0±3.1</td>
<td>0.512</td>
</tr>
</tbody>
</table>
## Anthropometric Changes

<table>
<thead>
<tr>
<th>Variable</th>
<th>WL (n = 13)</th>
<th>TCWL (n = 14)</th>
<th>Between-Group $p^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>-3.7 ± 0.9</td>
<td>-2.2 ± 0.9</td>
<td>0.266</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>-1.4 ± 0.4</td>
<td>-0.9 ± 0.3</td>
<td>0.257</td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>-5.2 ±1.2</td>
<td>-3.4 ± 1.1</td>
<td>0.291</td>
</tr>
<tr>
<td>Body Fat Mass (kg)</td>
<td>-2.3 ± 0.7</td>
<td>-2.0 ± 0.7</td>
<td>0.727</td>
</tr>
<tr>
<td>Fat-Free Mass (kg)</td>
<td>-1.2 ± 0.3</td>
<td>-0.2 ± 0.3</td>
<td>0.056</td>
</tr>
<tr>
<td>% Body Fat</td>
<td>-5.5 ± 1.8</td>
<td>-4.8 ± 1.7</td>
<td>0.780</td>
</tr>
<tr>
<td>GROUP</td>
<td>PRE</td>
<td>POST</td>
<td>CHANGE</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>WL</td>
<td>56.1 ± 2.6</td>
<td>56.2 ± 2.3</td>
<td>0.08</td>
</tr>
<tr>
<td>TCWL</td>
<td>57.3 ± 2.7</td>
<td>59.7 ± 2.8</td>
<td>2.6</td>
</tr>
</tbody>
</table>
## COGNITIVE FUNCTION CHANGES BETWEEN WEIGHT LOSERS AND NON-WEIGHT LOSERS

<table>
<thead>
<tr>
<th>Group</th>
<th>Change</th>
<th>Within-group p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Losers (N=)</td>
<td>-0.5 ± 1.8</td>
<td>0.7820</td>
</tr>
<tr>
<td>Non-weight Losers</td>
<td>3.0 ± 1.7</td>
<td>0.0997</td>
</tr>
</tbody>
</table>
### COGNITIVE FUNCTION CHANGES WITHIN WEIGHT LOSS GROUP

<table>
<thead>
<tr>
<th>Group</th>
<th>Change</th>
<th>Within-group $p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight-Losers (n=10)</td>
<td>-1.7 ± 2.7</td>
<td>0.5485</td>
</tr>
<tr>
<td>Non-weight Losers (n=5)</td>
<td>2.9 ± 3.5</td>
<td>0.4205</td>
</tr>
</tbody>
</table>

### TCWL Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Change</th>
<th>Within group $p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Losers (n=8)</td>
<td>3.6 ± 2.0</td>
<td>0.0979</td>
</tr>
<tr>
<td>Non-weight Losers (n=5)</td>
<td>1.8 ± 1.5</td>
<td>0.2507</td>
</tr>
</tbody>
</table>
DISCUSSION

- First study to show effects of Tai Chi in addition to dietary weight loss on cognitive functioning in postmenopausal women
- A significant difference was shown between the cognitive functioning scores between the TCWL and WL groups
  - This supports the previous research which suggests Tai Chi improves cognitive functioning
  - Also supports research that states diet improves cognitive functioning with increased intake of Vitamins B, C, and E (Park, 2011)
- The findings between weight losers and non-weight losers are in support of the research showing protective qualities of obesity on cognitive functioning
DISCUSSION

- **Strengths**
  - Randomized
  - Relatively similar subject sample
  - Weight-loss only control group
  - Objective measures of body composition measures

- **Weaknesses**
  - Small sample size
  - No true control group
  - No follow-up assessed
  - High degree of weight loss variability
CONCLUSION

- Tai Chi, in addition to dietary weight loss may help improve cognitive function in older obese women and decrease their risk of developing Alzheimer’s Disease.
- Although the combination may help attenuate cognitive decline, obesity may have a protective quality against cognitive decline as well.