Perceptions of the Eight Active Ingredients of Tai Chi Exercise among Older Adults

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Abstract

Background

In the United States, Tai Chi has been endorsed as a safe form of exercise among older adults by several national non-profit organizations, and scientific research sponsored by various branches of the federal government. Tai Chi is associated with physical, cognitive, and psychological benefits among older adults. The distinct components, interactions, and complexities of Tai Chi exercise distinguish it from traditional forms of aerobic exercise. Eight 'active ingredients' of Tai Chi practice are purported, yet the perceptions of these active ingredients among older Tai Chi practitioners have yet to be ascertained.

Methods

Data were collected as part of a cross-sectional study exploring the association between Tai Chi exercise and automobile driving among older adults. Perceptions of the Eight Active Ingredients of Tai Chi: 1) awareness, 2) intention, 3) structural integration, 4) active relaxation, 5) strengthening and flexibility, 6) natural, freer breathing, 7) social support, and 8) embodied spirituality were assessed using a self-reported measure. This 8-item measure asks an individual about their level of agreement with statements about the active ingredients associated with Tai Chi practice, using a four-point Likert format (1=strongly disagree, 4=strongly agree), with higher scores representing greater agreement (possible range 8-32).

Results

Participants (N=58) were on average 73 years old (range=65-87 years old), mainly retired (72%) Caucasian women (72%), practicing Tai Chi in diverse community classes. This measure had a normal distribution, internal consistency rates were high (Cronbach's alpha=0.81) with all items correlating significantly with the total mean score (r=0.43-0.76, p=0.01). Among the long-term Tai Chi practitioners higher mean scores were reported (27.8±2.6), compared to the intermediate (25.7±2.9) and beginner (24.4±3.2) groups. Statistically significant differences were found in the mean scores between the long-term Tai Chi practitioners and the intermediate group (mean difference=2.1, SE=0.8, 95% CI=0.16-3.99, p=0.05), as well as the mean scores between the long-term Tai Chi practitioners and the beginner group (mean difference=3.3, SE=1.2, 95% CI=0.55-6.14, p=0.05); providing initial evidence of known-groups validity.

Conclusions

The *Perceptions of the Eight Active Ingredients of Tai Chi* measure is an initial step to understand the perceptions of the active ingredients of Tai Chi exercise. This measure had a normal distribution, high internal consistency and known-groups validity. Assessing and defining the active ingredients of Tai Chi exercise are important for: understanding the mechanisms of action, bridging the gaps between Eastern and Western ways of knowing, developing a common language and framework for researchers to compare study results, and tailoring Tai Chi interventions to fit specific populations.

Keywords

perceptions, psychometrics, questionnaire, reliability, Tai Chi, validity

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Introduction

In the United States (US), Tai Chi and yoga are two popular forms of mind-body exercise.[1] As of 2017, there were approximately four million adults in the US practicing Tai Chi, compared to 35 million adults practicing yoga.[2,3] Tai Chi and yoga share several similar components: yoga has poses, breathwork and meditation, while Tai Chi has movements, natural, freer breathing, and meditation; however, these two forms of mind-body exercise are distinct and unique.

Tai Chi is an ancient Chinese martial art which has become popular in Western societies as a form of gentle physical exercise. Tai Chi practice includes multiple elements such as choreographed postures, intentional movement, attention to balance, integrated breathing, and meditative components. Tai Chi's health benefits include improvements in physical, cognitive, and psychological domains such as better balance and aerobic endurance, fewer falls, better mental concentration, and less depression.[4] In the US, Tai Chi classes are becoming widely available through community-based organizations, private studios and in retirement communities. Tai Chi exercise is endorsed by several US public health organizations for its health benefits.[5-7]

Yoga is an ancient spiritual practice that originated in India.[1] Results of yoga research studies reveal that nearly two-thirds of adults report that they were motivated to exercise more regularly due to yoga, and 4 in 10 reported they were motivated to eat healthier.[8] Adults practicing yoga were more likely to affirm feeling better emotionally, than users of dietary supplements or spinal manipulation. While more than 85 percent of US adults who practice yoga reported less stress.[8] Further, several questionnaires measuring yoga participant's perceptions, beliefs, and outcome expectations of their practice have been developed,[9-12] such as the Beliefs About Yoga Scale,[9] the Essential Properties of Yoga Questionnaire,[10] the Outcome Expectations for Yoga Scale[11] and the Yoga Self-Efficacy Scale.[12] These scales were designed to assist yoga teachers, practitioners and researchers articulate yoga's benefits, expectations and outcomes.

Research has shown that Tai Chi has similar benefits to those of yoga,[5] yet only one Tai Chi-specific questionnaire has been published which assessed *Tai Chi Exercise Self-Efficacy* among ethnic Chinese with coronary heart disease risk factors.[13-16] Less is known about the perceptions and beliefs of adults who practice Tai Chi, although findings from qualitative studies have provided some insight. Qualitative studies examining the perceptions of Tai Chi among adults with/without chronic conditions, have reported improvements in physical abilities (e.g., better balance, flexibility, energy), cognitive abilities (e.g., better concentration), psychological benefits (more confidence, improved mood/hope, less stress), greater social support/friendships, more mindfulness, self-awareness, and enjoyment. [17-21] Given the broad health benefits and the growing popularity of Tai Chi practice, perceptions of Tai Chi exercise were recently explored as part of a cross-sectional study that examined the association between Tai Chi exercise with cognitive and physical measures related to automobile driving among adults aged 65 and older.[22]

An understanding of an individual's perceptions of Tai Chi is needed to help bridge the gap between Eastern and Western ways of knowing, provide a common language and framework for researchers to compare study results, and allow for tailored Tai Chi exercise interventions to fit specific populations for health promotion. According to the Harvard Medical School Guide to Tai Chi,[23] there are eight interdependent active ingredients-- awareness, intention, structural integration, active relaxation, strengthening and flexibility, natural/freer breathing, social support, and embodied spirituality. These active ingredients are thought to promote health and well-being in physical, cognitive, and psychological domains.[23-26]

1. Awareness: Since Tai Chi draws an individual's attention to the present moment, this aids in developing awareness, mindfulness, openness and acceptance.[23] Unlike other mind-body exercise with meditative movements (e.g., yoga), Tai Chi employs an active-focused meditation through practical body-centered exercise.[23]
2. Intention: This active ingredient is key, as imagery and visualization, sometimes referred to as "mental practice", are used during Tai Chi to guide an individual toward certain kinesthetic, emotion, and energetic states (e.g., "wave hands like clouds").[27]
3. Structural integration: Since body posture can reveal an individual's internal sense of well-being, this active ingredient is important.[28] Tai Chi fosters balanced, open and relaxed postures, through proper body alignment. Recent research reports that correct body posture plays a key role in helping individuals improve physical and emotional well-being.[29,30]
4. Active relaxation: During Tai Chi practice, the physical effort of the postures is balanced with active relaxation, allowing an individual's body to release tension/stress, and improve emotional well-being.[23]
5. Strengthening and flexibility: This active ingredient is evident during Tai Chi practice and results in less strain, greater power with less effort, and better balance. The slow movements, shifting of body weight to one-leg, and slightly flexed stances load leg muscles and bones leading to better strength, while flexibility is enhanced through dynamic stretching due to the slow relaxed repetitive movements during Tai Chi practice, promoting physical well-being.[30,31]

6. Natural/freer breathing: When this active ingredient is employed during Tai Chi along with the correct body posture, it helps to promote physical and emotional well-being.[23] Unlike other types of exercise, practicing Tai Chi leads to a calming, para-sympathetic state, leading to higher heart rate variability, less oxidative stress and better sleep.[32-34]
7. Social support: This active ingredient occurs during group-based Tai Chi classes, creates a sense of belonging, and promotes emotional well-being.[18,35,36]
8. Embodied spirituality: This active ingredient leads to more holistic living that spills over into how an individual maintains their health and well-being. Tai Chi fosters self-awareness and discovery, as it requires an individual to slow down, which fosters health and well-being.[23,27]

Given the conceptualization of Tai Chi's active ingredients, we developed statements based on the descriptions for each ingredient, to create the *Perceptions of the Eight Active Ingredients of Tai Chi* measure, as an initial step to understand the perceptions of the active ingredients of Tai Chi exercise among older adults. The purpose of this study was to: 1. Determine the score distributions and measurement properties of the *Perceptions of the Eight Active Ingredients of Tai Chi*, and 2. Examine the internal consistency (reliability) and known groups validity of the *Perceptions of the Eight Active Ingredients of Tai Chi*.

Methods

Design

Data were collected as part of a cross-sectional study exploring the association between Tai Chi exercise and automobile driving among older adults,[22] which was previously reported using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[37,38] In this study, cognitive and physical measures related to driving performance were collected during face-to-face study appointments from community-dwelling Tai Chi practitioners aged 65 years and older (N=58). Self-reported driving habits, Tai Chi practice, non-Tai Chi exercise habits, dispositional mindfulness, overall well-being, and the exploratory Perceptions of the Eight Active Ingredients of Tai Chi were collected. All measures were compared to normative reference values, except for the Perceptions of the Eight Active Ingredients of Tai Chi scale reported in this article. Statistically significant correlations were found between several study measures and participants performed better on several cognitive and physical measures. Participants also scored higher on dispositional mindfulness and overall well-being when compared to normative reference values.

Study Participants

Community-dwelling older Tai Chi practitioners (aged 65 years and older) living in the middle Tennessee area in the US were recruited.[22] All participants spoke English and received formal instruction in Tai Chi (any style of Tai Chi), had been practicing Tai Chi for at least 3 months, and were currently practicing Tai Chi for at least 30 minutes each week, at the time of study enrollment. Recruitment, enrollment, and data collection occurred between September 2014 and June 2015. Written informed consent was obtained from each participant. Participants were assured that their results would be aggregated and that individual results would remain confidential. The study was approved by the Institutional Review Boards at The University of Arizona and Vanderbilt University.

Study Procedures

Participants that enrolled in the study were scheduled for a study appointment. Study appointments were held at convenient locations that provided privacy and a quiet, non-distracting environment. Study measures were reviewed for completeness to decrease the chance of missing self-report data and to clarify participant's questions. Access to restrooms, bottled water, and stretch breaks were provided to increase participant comfort. Once all study measures were collected the participant received their personal results and incentive materials including their driving self-assessment results, an older driver safety booklet and a list of area Tai Chi classes.

Study Measure: Perceptions of the Eight Active Ingredients of Tai Chi

Based on the conceptualization of Tai Chi's active ingredients described in the Harvard Medical School Guide to Tai Chi,[23] statements were developed by distilling the major concepts from the description provided for each active ingredient (Table 1). Each statement contains four different response options (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree), with possible scores ranging from 8 to 32. A high score indicates greater agreement with the statements.

Table 1: Perceptions of the Eight Active Ingredients of Tai Chi

Active Ingredient	Statement
Awareness	Because of my Tai Chi practice, I feel I am more aware, mindful, and have better focus.
Intention	During Tai Chi my movement begins with intention and then moves my body.
Structural Integration	Tai Chi integrates my breathing, posture, and movement.
Active Relaxation	During Tai Chi practice I am both active and relaxed in my mind and my body.
Strengthening and Flexibility	Tai Chi is an aerobic exercise that strengthens my muscles and

	bones, and increases my flexibility.
Natural, Freer Breathing	As a result of my Tai Chi practice my breathing is more natural and free.
Social Support	The social interaction as part of a Tai Chi community is important to me.
Embodied Spirituality	The spirituality, philosophy, and rituals of Tai Chi are important to me.

Data Analysis

Data were entered into SPSS (IBM-SPSS, version 22) with each file double-checked for completeness and accuracy. A random check of 15% of the data files resulted in no errors in the entered data. Parametric tests were used for normally distributed data and non-parametric tests were used for non-normally distributed data. All significance levels were set at $p < 0.05$.

Descriptive statistics of the *Perceptions of the Eight Active Ingredients of Tai Chi* were calculated to examine the measures of central tendency, distribution, dispersion and percentile values. We assessed the mean, standard deviation, standard error of the mean, median, skewness, kurtosis, observed range of scores, floor & ceiling effects, and the inter-quartile percentage values. This information on variability helps determine if the scale is detecting important differences in the concept at each end of the continuum. Further, the degree of variability in scores can affect the internal consistency (reliability) of the study measure.[39] Skewness and kurtosis scores closer to zero, but $< \pm 2$, represent a more normal distribution.[39]

Internal consistency was assessed using Cronbach's alpha, and reflects the extent to which all items in the scale measure the same concept. Internal consistency scores of at least 0.70 were considered acceptable.[39] Item analysis is another method of checking reliability of a tool, thus the item-total correlations of the measure were calculated using Pearson's r.[39,40] Evidence of homogeneity of the *Perceptions of the Eight Active Ingredients of Tai Chi* measure was defined as correlations higher than 0.40.[39]

Known-groups validity, a type of construct validity was examined. Known-groups validity tests for mean differences among groups, known to differ on the concept being measured. We conducted a one-way ANOVA with Tukey's post-hoc tests to determine differences in mean scores among groups. We hypothesized that mean scores among beginner (less than 1 year), intermediate (1-3 years) and long-term (greater than 3 years) Tai Chi practitioners would differ significantly, and that the mean score of the long-term Tai Chi practitioners would be significantly higher than the beginner and intermediate groups. Validity is supported if results obtained confirm the *a priori* hypothesis.[39]

Results

Study Participants

Fifty-eight participants completed the study (Table 2). Participants were on average 73 (SD=5.9) years old (range=65-87 years old). The majority were college educated (91%), Caucasian (90%), retired (74%) women (72%). The most frequent self-reported health conditions were hypertension/heart disease (57%), arthritis/degenerative joint disease (41%) and eye conditions (29%).

Table 2: Participant Demographics, N=58

	n (%)
Women, n (%)	42 (72.4)
Married/domestic partner, n (%)	26 (44.8)
Caucasian, n (%)	52 (89.7)
Tertiary education (13+ years), n (%)	53 (91.4)
Retired/Unemployed, n (%)	43 (74.1)
Self-reported health problems, n (%)	
Hypertension/Heart disease	33 (56.9)
Arthritis/Degenerative joint disease	24 (41.4)
Eye conditions (e.g., cataracts, glaucoma)	17 (29.3)
Cancer	8 (13.8)
Diabetes	7 (12.1)
Respiratory disease	6 (10.3)
Sleep apnea	3 (5.2)
Kidney disease	1 (1.7)

Participants in this study had been practicing Tai Chi for various lengths of time, ranging from 3 months to over 3 years. Beginners in Tai Chi had practiced between three months to less than one year (12%, n=7), those at the intermediate level had practiced between one to three years (35%, n=20), while long-term Tai Chi practitioners had practiced greater than three years (53%, n=31). The majority of participants (74%, n=43) performed Tai Chi in a group-based class once or twice a week, for 45-60 minutes each class. Several Tai Chi styles were practiced with Yang (41%) and Sun (40%) styles being the most popular forms among these participants.

Descriptive Statistics

Descriptive data of the *Perceptions of the Eight Active Ingredients of Tai Chi* are presented in Table 3. The measure had a normal distribution, without skewness (-0.03) or kurtosis (-0.58) detected. There were no floor effects, though ceiling effects were noted in 5% of the study sample. Overall, participants' perceptions of the essential elements of Tai Chi mainly agreed or strongly agreed with statements related to the eight active ingredients associated with Tai Chi practice (mean=26.66±3.01, median=27.00), with all items performing well. The 'structural integration' active ingredient item had the highest mean score (3.59±0.50, observed range=3-4), while the lowest mean scores

were found for two active ingredient items: 'strengthening and flexibility' (3.14±0.71, observed range=1-4), and 'embodied spirituality' (3.14±0.58, observed range=2-4).

Table 3: Descriptive Statistics of Perceptions of the Eight Active Ingredients of Tai Chi, N=58

Statistic	Value
Number of Items	8
Mean	26.66
SD	3.01
Standard Error of Mean	0.39
Median	27.00
Variance	9.04
Skewness	-0.03
Kurtosis	-0.58
Possible range	8-32
Observed Range	19-32
Floor effects % (n)	0% (0)
Ceiling Effects % (n)	5% (3)
Inter-quartile percentage values	
25%	24.00
50%	27.00
75%	29.00
Meaning of High Score	Higher Agreement with Statements of Active Ingredients of Tai Chi

Reliability

The internal consistency estimate in this study sample was high (Cronbach's alpha=0.81). Internal consistency is a function of the number of items, the average correlation among items and the variability of the items in the study sample. Item analysis was conducted using Pearson's r between the mean scores for the 8-items in the *Perceptions of the Eight Active Ingredients of Tai Chi* measure with the total mean score. All items correlated significantly with the total mean score (r=0.43-0.76, p=0.01), supporting internal consistency of the measure.[39,40]

Validity

Among the long-term Tai Chi practitioners higher mean scores were reported (27.8±2.6), compared to the intermediate (25.7±2.9) and beginner (24.4±3.2) groups. As expected, statistically significant differences were found in the mean scores between the long-term Tai Chi practitioners and the intermediate group (mean difference=2.1, SE=0.8, 95% CI=0.16-3.99, p=0.05), as well as the mean scores between the long-term Tai Chi practitioners and the beginner group (mean difference=3.3, SE=1.2, 95% CI=0.55-6.14, p=0.05). In this study, the long-term Tai Chi practitioners reported higher agreement with the *Perceptions of the Eight Active Ingredients of Tai Chi* statements, providing initial evidence of known-groups validity.

Discussion

To our knowledge, this is the first study to examine perceptions of the active ingredients of Tai Chi exercise among older adults. The purpose of this study was to determine the score distributions and measurement properties, along with the initial reliability and validity of the *Perceptions of the Eight Active Ingredients of Tai Chi*. This measure had a normal distribution, with initial evidence of high reliability and known-groups validity. Internal consistency of this measure was high, likely due to the average correlation among items and the variability of the items. However, measures with high internal consistency may have difficulty discriminating well in studies with repeated measures, when sensitivity to change in a measure is important. Known-groups validity was supported in this study, with the long-term Tai Chi practitioners reporting higher agreement with the *Perceptions of the Eight Active Ingredients of Tai Chi* statements. Further, we found statistically significant differences in the mean scores between the long-term Tai Chi practitioners and those in the intermediate group, and between the long-term Tai Chi practitioners and those in the beginner group. Since validity of a measure accumulates with evidence derived from different samples, further research using this measure is needed.

To date, no other studies have assessed the perceptions of the active ingredients of Tai Chi exercise. However, a questionnaire from a similar but distinctly different mind-body exercise was developed to determine which key ingredients comprise a yoga class, the Essential Properties of Yoga Questionnaire.[10] The *Perceptions of the Eight Active Ingredients of Tai Chi* and the Essential Properties of Yoga Questionnaire have several similar 'ingredients', such as awareness/mindfulness, postures, meditation, breathing, and spirituality/philosophy.[10] However, there are differences in terms of the 'active ingredients' representing intention, structural integration, and social support. In addition, the Essential Properties of Yoga Questionnaire identified 14 "ingredients" or subscales. Each subscale contains between 3-8 items for a total of 63 items, which are scored on a 5-point Likert scale. Thus, the Essential Properties of Yoga Questionnaire has a much high participant and researcher burden, when compared to the *Perceptions of the Eight Active Ingredients of Tai Chi* measure.

In the US, the popularity of Tai Chi is growing as evidenced by the increasing availability of classes in community settings and along with endorsements by health- and aging-related agencies. This study revealed positive perceptions of the eight active ingredients of Tai Chi among older adults, despite these adults having diverse Tai Chi exercise habits. Finding methods to engage adults for longer durations of time, and across the lifespan could potentially enhance the perceived and actual benefits of Tai Chi exercise. Analyzing aggregate responses to individual scale items could assist Tai Chi

teachers to tailor classes to specific populations. Understanding the perceptions of Tai Chi exercise will help researchers articulate expected physical, cognitive and psychological benefits and refine research questions while bridging Eastern and Western perspectives on the wide range of benefits of Tai Chi exercise.

The *Perceptions of the Eight Active Ingredients of Tai Chi* measure was collected during an observational study exploring the association of Tai Chi exercise and cognitive and physical measures related to automobile driving among adults 65 and older.[22] Tai Chi exercise is associated with improvements in physical, cognitive, and psychological domains. These positive aspects are supported by our findings of higher scores in dispositional mindfulness and overall well-being when compared to normative reference values. Exploring perceptions of Tai Chi exercise can potentially lead to further improvements in these health-related domains by increasing engagement with Tai Chi exercise through individualization of classes and personalized instruction.

The *Perceptions of the Eight Active Ingredients of Tai Chi* study measure is an initial step to assess and understand perceptions of the active ingredients of Tai Chi exercise. The *Perceptions of the Eight Active Ingredients of Tai Chi* measure can used to facilitate comparisons across diverse Tai Chi studies, regardless of the style of Tai Chi used, by characterizing the key active ingredients. In addition, this measure has the potential to determine which active ingredients have a greater effect on a given outcome for a specific population, and to identify the mechanisms of these effects. Finally, this measure may be helpful in developing targeted Tai Chi interventions for specific health conditions.

Study Strengths and Limitations

Strengths of this study include the diverse community settings of the Tai Chi programs from which participants were recruited, representing various styles of practice, teaching styles and engagement with Tai Chi. In addition, the varying lengths of time these participants had practiced Tai Chi, i.e., beginner, intermediate and long-term practitioners, provided insights on the differences among participants' *Perceptions of the Eight Active Ingredients of Tai Chi.* Study limitations include the study sample with the majority being female, Caucasian and well-educated, and living in one geographical area in the US, limiting generalizability.

Future Research

Future research of the *Perceptions of the Eight Active Ingredients of Tai Chi* is recommended, to refine the statements developed, aimed at expressing the major concepts for each active ingredient. For example, the 'strengthening and flexibility' active ingredient currently is a single-item statement. This statement could be expanded to three separate statements focused on aerobic exercise, strength, and flexibility to yield a greater distinction among the components in this active ingredient. In addition, qualitative research is recommended using focus group to provide further understanding of participants' perceptions of the active ingredients of Tai Chi. Finally, recruitment of a larger study sample with ethnically- and gender-diverse younger, middle-aged and older adults will provide more depth and breadth for understanding the perceptions of Tai Chi.

Conclusion

Assessing and defining the active ingredients of Tai Chi exercise is important. Potential benefits of using the *Perceptions of the Eight Active Ingredients of Tai Chi* measure include: 1) understanding the mechanisms of action, 2) bridging gaps between Eastern and Western ways of knowing, 3) developing a common language and framework for researchers to compare study results, and 4) tailoring Tai Chi interventions to fit specific populations. This study adds to the growing body of scientific knowledge regarding the perceived benefits of Tai Chi exercise, provides insight into methods to engage individuals in Tai Chi exercise, and can enhance personalized Tai Chi interventions.

Appendix

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Authors' contributions
Sally Miller conceived, designed and collected data for the study. Ruth Taylor-Piliae consulted on study design and data analysis and interpretation. Both authors prepared, reviewed, and approved the final manuscript.

Ethics approval and consent to participate
The study was approved by the Institutional Review Boards at The University of Arizona and Vanderbilt University.

Availability of data and materials
The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests
The authors declare that they have no competing interest.

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