

CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

For a 73 year old female with slow walking speed following right sided MCA stroke, is Tai Chi training more effective than strength training for reducing falls risk?

AUTHOR

Prepared by	Alan Levinson	Date	11/21/2017
Email address	alan_levinson@med.unc.edu		

CLINICAL SCENARIO

73 year old female following right sided MCA stroke with decreased strength and motor control of left upper and lower extremity and decreased balance, coordination, and gait speed. Some left side neglect observed in ambulation with rolling walker, requiring repeated cues to attend left and maintain straight path secondary to right veering tendency. Forward head posture, and decreased step length, occasional scissors gait and insufficient left toe clearance during swing phase are evident on examination.

Patient is 2 weeks post stroke, and has progressed to using a small base quad cane. Patient exhibits some mild cognitive deficits including decreased ability to follow multi-step instructions and requiring occasional cues for safety.

Older adults with history of stroke often experience decreased mobility. This may result from decreased motor control of lower extremities, weakness in leg muscles, or sensory processing of environmental conditions. When individuals lose fluid control of motion, they become at greater risk for falls and associated complications that result. Cardiovascular and muscular deconditioning will progress if patients avoid walking for fear of falls. General health and quality of life decline as time goes on with decreased physical activity. To counter the resulting health risks associated with decreased mobility, I will compare Tai Chi exercises with strength and conditioning exercises to determine which intervention yields the best improvement in mobility.

SUMMARY OF SEARCH

- 8 Articles were identified in search of 3 databases (PubMed, Embase and Web of Science) including 7 systematic reviews and 1 randomized control trial. 2 systematic reviews with meta-analysis were selected for inclusion in this CAT.
- **(Hu et al., 2016)** compared a variety of Tai Chi interventions against non-Tai Chi control groups for incidence of falls.
- **(Huang et al., 2016)** found that Tai Chi interventions were effective in reducing falls for older adults, and in particular Yang Style Tai Chi implemented for longer than 6 months and at least 3x weekly.
- Future research may include identification of specific methodology and activities that target improved performance on validated functional outcome measures related to falls prevention.

CLINICAL BOTTOM LINE

These reports provide evidence that Tai Chi exercise programs are safe and possibly effective interventions for a 73 year old female post stroke. Considerations for practice may include availability of trained Tai Chi instructors as well as in-patient vs. outpatient environment for delivery of services. Patient education on maintenance of any intervention post PT discharge is also essential as long term success depends on continued practice.

This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor

The above information should fit onto the first page of your CAT

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	Intervention (or Assessment)	Comparison	Outcome(s)
Elder* Older Adults Aged 65 and up slow walking speed mobility deficit* ambulation impair*	Tai chi qi gong chi gung chi kung balance coordination	Strength* resistance condition* Physical Therapy Physiotherapy	walk* gait speed fall* risk

Final search strategy:

Databases and Sites Searched	Number of results	Limits applied, revised number of results (if applicable)
PubMed	20	None
Web of Science	9	None
Embase	15	None
Hand search of references, total from above	12	None

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
Community dwelling older adults age 65 years and older. Comparing Tai Chi OR strengthening/ resistance training interventions. Pre-and post-test evaluation on gait speed OR falls risk.
Exclusion Criteria
Abstracts, pilot studies, case reports, non-published articles, non-peer reviewed articles.

RESULTS OF SEARCH

Author (Year)	Risk of bias (quality score)*	Level of Evidence**	Relevance	Study design
Howe (2011) ¹	AMSTAR = 8/11	1a	Low	Systematic Review (SR) of Randomized Controlled Trials (RCTs)
Hu (2016) ²	AMSTAR = 7/11	1a	Moderate	SR of RCTs and Meta-analysis (MA)
Huang (2016) ³	AMSTAR = 7/11	1a	Moderate	SR of RCTs with MA

Leung (2011) ⁴	AMSTAR = 5/11	1a	Moderate	SR of RCTs with MA
Liu (2010) ⁵	AMSTAR = 3/11	1b (not all articles were RCTs)	Low	SR of RCTs and Quasi-experimental pre/ post test
Schleicher (2012) ⁶	AMSTAR = 2/11	1c (includes 14 RCTs; 5 Cross-sectional reviews; 5 pre/post assessment studies)	Moderate	SR of "recent literature"
Yang (2014) ⁷	AMSTAR = 4/11	1b (All RCTs except 1 non-RCT article)	Moderate	SR with MA
Yildirim (2016) ⁸	PEDro = 7/11	1b	Low	RCT

BEST EVIDENCE

The following 2 studies were identified as the 'best' evidence and selected for critical appraisal. Rationale for selecting these studies were:

- **Hu (2016)** due to high AMSTAR score (low risk of bias), high level of evidence, and moderate relevance to my PICO.
- **Huang (2016)** due to high AMSTAR score (low risk of bias), high level of evidence, and moderate relevance to my PICO.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of Effect of *Tai Chi Exercise on Fall Prevention in Older Adults: Systematic Review and Meta-Analysis of Randomized Controlled Trials* (Yu-Ning Hu, Yu-Ju Chung, Hui-Kung Yu, Yu-Chi Chen, Chien-Tsung Tsai, Gwo-Chi Hu, 2016)

Aim/Objective of the Study/Systematic Review:

To establish the effectiveness of Tai Chi as an intervention for reducing falls risk in elderly adults. Prior systematic reviews had been inconclusive. Falls among elderly can lead to injury, disability, reduced independence, and poor quality of life. Programs that reduce falls risk are therefore worthy of study and determination made as to their effectiveness. This is an updated review including RCTs published in 2012 and 2013.

Study Design

Systematic Review 10 Randomized controlled trials encompassing 2,850 participants were identified.

Search strategy 4 Databases (Medline, PubMed, Embase, and Cochran Library) were searched.

- Inception through June 30, 2013.
- No language restriction.
- Key words searched: Tai Chi, TaiChi, Tai-ji, taichjiquan, and taiji with fall, falls, falling and accidental falls.

Selection criteria ("inclusion details below, no "exclusion" details provided).

- Must be randomized controlled trial.
- Subjects must be older than 65 years of age.
- At least one intervention included must be Tai Chi or variation.
- At least one outcome measure must be related to falls with control group receiving health education or exercise or no intervention at all.
- Wide range of Tai Chi interventions allowed, with variation in style, frequency, duration, and participant variables.

Methods

- 2 Authors independently read potential articles and made judgments on inclusion based on prior established criteria.
- PEDro scores for each randomized controlled trial were determined, and those of fair to good quality (most were 5-7/10) were reviewed.
- Data were obtained and reviewed in relation to study trials and outcome measures, and discrepancies between the authors were resolved through debate and eventual agreement.
- Wide range of interventions included, with no pre-determined inclusion/ exclusion subject requirements, and outcome definitions.
- Details on blinding of subjects within trials was not provided.
- Statistical software utilized was Stata version 11.0.

Statistical analysis

- The primary outcome was falls events. Determination of overall effect size was completed through a random effects model.
- Falls events were analyzed via generating an odds ratio given that falls either occurred or did not. Each trial was evaluated with a 95% confidence interval.
- Heterogeneity and subgroup analysis were also completed using the I^2 statistic. Publication bias was assessed with funnel plot graph and Egger's test.

Additional information

285 potential articles were identified from the initial database search. After removing duplicates, the relevant articles based on title and abstract review totaled 39. Full text review further narrowed the list to 10 articles.

Setting

Outpatient clinics (7 studies) and long-term care facilities (3 studies).

Participants

10 studies (N = 2,850; 1,540 randomized into treatment group 'Tai Chi' and 1,310 subjects randomized to control group). Average age of subjects is between 68 and 84. Study size ranged from 59 to 684 participants divided into control and experimental groups. All studies investigated a unique style or prescription of intervention.

Intervention Investigated*Control*

8 studies made control group comparison to be "non-exercise" while the remaining 2 were "exercise" groups. Description of individual study interventions was not provided or summarized.

Experimental (Tai Chi groups)

Tai Chi was a heterogeneous term, among the studies included in this systematic review there was a variety of styles (Yang, Sun, and "modified" or non-specified) and implementations. For example, duration of intervention was categorized simply as either greater than or less than 6 months.

Outcome Measures

Falls incidence, collected via self-report methods. No information was provided on timing or method of follow up data collection.

Main Findings

Meta-analysis was performed on overall results of the 10 trials included. Further sub-grouping odds ratio analysis was performed by duration of training (<6 months or \geq 6 months). Additional analysis was performed by style of Tai Chi (including Yang, Sun, and Modified styles).

Odds ratios for risk of falls were calculated and I^2 Heterogeneity were provided for the meta-analysis.

Tai Chi v. control overall effect odds ratio: OR / (95% CI, range):

- 0.71 / (0.61, 0.83)

For Tai Chi intervention of less than 6 months, the OR continues to show preference for reducing falls versus control, but less convincingly:

- 0.80 / (0.66, 0.96)

Tai Chi program longer than 6 months showed the strongest effect among trials:

- 0.52 (95% CI, 0.38, 0.71)

Heterogeneity for both groups is presented as $I^2 = 18.8\%$. This suggests that the groups are similar enough to conduct a valid comparison among groups.

When analyzing by style of Tai Chi, a "modified" version showed nearly equal effect as Yang style:

- Yang- 0.62 (95% CI, 0.45, 0.86)
- Modified- 0.68 (95% CI, 0.52, 0.90) both in favor over control group.

Original Authors' Conclusions
Evidence gleaned from the present review indicate that Tai Chi exercise for older adults is effective in reducing falls risk. At this time the prescription for duration, frequency and style remain imprecise, warranting further research..
Critical Appraisal
Validity
<p>This study earned a low risk of bias score (7/11 AMSTAR). However, bias could be introduced in that no report is provided on publication status, individual study characteristics (blinding and randomization methods). Overall quality of the RCTs chosen was absent from this review. Clinical measures for this review is simply number of fallers among subjects. The review lacks information on specific details of frequency, duration, and other information from individual studies, as well as when follow up was conducted. Furthermore there was no detail on how information was validated beyond self-report of falls. This leaves open the question of validity of results. Strengths of the study include that when comparing duration, the tendency for better outcomes was associated with programs lasting 6 months or longer. Likewise, when analyzing styles of Tai Chi, even without specific details, Modified style Tai Chi was slightly more effective in reducing falls than Yang and Sun styles.</p> <p>Internal validity (how subjects were randomized into control v. treatment groups) was not explicitly provided. The higher quality RCTs provide a procedure for randomization and thereby reduce risk for selection bias. True external validity can only be guaranteed when subjects are drawn randomly from a target population. For this study, there may be limited generalizability of results beyond the sample selected, since there is not much information about the pool from which subjects were drawn.</p> <p>With balancing these factors, overall evidence quality is moderate.</p>
Interpretation of Results
<p>Odd ratios (OR) describe the odds that the subject who has received Tai Chi (in whichever form/ duration) intervention will have a fall compared to the odds that a non-Tai Chi subject will fall. The nature of OR is that numbers close to 1.0 represent no change in chance for the outcome in question. Strongest associations are ≤ 0.50, and statistically significant relationships will have a 95% CI that does not include 1.0.</p> <p>While the results of this study are significant for Tai Chi intervention as an effective intervention to reduce falls risk, the associations are not strong. Longer duration (>6 months) and Yang style were shown to have the stronger associations to reduced falls risk.</p> <p>Given the variation of intervention frequency and lack of standardized outcome measurement tool, the results of this systematic review are of questionable value for clinical applicability.</p> <p>The conclusion of the authors to recommend further study on issues of frequency, duration, and style of Tai Chi is certainly appropriate. This author suggests that while there are positive tendencies shown in the results evaluating Tai Chi as an effective program to reduce falls risk, it may be safe to conclude that Tai Chi does not increase risk of falls for elderly adults.</p>
Applicability of Study Results
<p>The review seems to be relevant for my client scenario in that the age and functional status of participants appears to be similar to my 73 year old female patient. No specific information is provided on whether subjects include people recovering from stroke, however. Limited applicability of results, due to limited information beyond age and living circumstances are provided. Does this study include subjects with certain medical conditions that increase falls risk? Would Tai Chi be acceptable and effective in an inpatient rehabilitation or acute care setting? How much training or expertise is required to properly lead a Tai Chi intervention? These issues were not addressed by authors of the review.</p> <p>Furthermore, Tai Chi is a specialized form of exercise, and may require significant study and practice in order to achieve a mastery level suitable for implementation. In the absence of a specifically trained leader, Tai Chi would not be recommended for implementation.</p>

(2) Description and appraisal of *Systematic Review and Meta-Analysis: Tai Chi for Preventing Falls in Older Adults* (Zhi-Guan Huang, Yun-Hui Feng, Yu-He Li, Chang-Sheng Lv, 2016)

Aim/Objective of the Study/Systematic Review:
Study authors state that evidence is not confirmed that Tai Chi is an effective intervention against falls in elderly. The objective of this systematic review is to update the current evidence from trial studies. This review compared Yang and Sun styles of Tai Chi. Additionally, this review investigates relationship among frequency, duration, and follow up characteristics.

Study Design

Systematic review

Search strategy 3 Databases (Cochran Library – Issue 2, 2016; Medline – 1966 through February 1, 2016; and Embase – 1984 through February 1, 2016) were searched.

- No language or publication status restriction.
- Key words searched: Tai Chi, falls, accidents.
- Searches of MetaRegister of Controlled Trials and WHO International Clinical Trials Registry Platform to identify ongoing studies.
- Reference lists of articles hand searched for additional potential article inclusion.

Selection criteria (“inclusion details below, no “exclusion” details provided)

- Must be randomized controlled trial
- Subjects must be older than 60 years of age
- At least one intervention included must be Tai Chi or variation
- At least one outcome measure must be related to falls incidence and rate

Methods

- 18 articles were included in this systematic review, including 3,824 subjects. Meta-analysis was conducted on 15 trials and 3,470 subjects.
- 227 potential articles were initially identified, reduced to 177 after duplicate removal.
- 2 Authors independently excluded articles based on title and abstract review.
- 50 articles remained for full text review by both authors, with 32 being excluded for ineligible interventions (3), irrelevant outcomes (18), non-RCT or multiple report from single study (11).
- Cochrane Collaboration tool was used to determine risk of bias in each article, but results were **not included**.

Statistical analysis

- Primary outcomes evaluated were falls incidence and rate of falls. Trial results were pooled using a random effects model, calculation of relative risk to a 95% confidence interval, and incidence rate ratios.
- Heterogeneity was calculated with I^2 . Values > 50% with a $p < 0.10$ were considered to be moderate level of heterogeneity.
- Subgroup analysis by frequency, total time of intervention (in hours), and follow up, dichotomous falls risk at enrollment (high/ low) and style of Tai Chi.
- Publication bias was assessed with funnel plot graph and Egger’s test, and if asymmetry was discovered, the “trim and fill” method was used to adjust for that bias.

Setting

Location of studies (number): <ul style="list-style-type: none"> - USA (7) - China (3) - Taiwan (2) - Australia (2) - Netherlands (2) - New Zealand (1) - Canada (1) 	Comorbidities not limited in studies except these conditions (number of studies): <ul style="list-style-type: none"> - Frail and pre-frail older adults (3) - Stroke (2) - Parkinson’s Disease (2) - Postmenopausal with osteopenia (1)
---	---

Location details (urban vs. rural) were not included in the review.

All but 1 study recruited community dwelling older adults.

1 study recruited participants from community and hospital.

Participants

18 Studies total were included in this systematic review. A summary of characteristics is provided here.

Intervention/ Control (n)	Tai Chi intensity Selected ranges low to high	Average age range / Male: Female ratio	Follow-up
INTERVENTION Tai Chi (5) Yang (9) Sun (4) /	$N \times$ times per week – (# weeks) [n] 1x (4wks) then... ..2x (16wks) [1] 1x (16wks) [1] 2x (15wks) [1] 2x (48wks) [1]	64.5 - 85.4 years / M:F ratio varies	3 months – [2] 4 months – [2] 6 months – [3] 11 months – [2] 1 year – [5] 2 years – [2] ...continued....
CONTROL Yang (1) Education (2) Stretching (2) Usual care (4) No Tai chi (6) Low intensity exercise (3) Conventional PT (1)	3x (1year) [1] >=3x (2years) [1] 5x (8wks) [1]		

<p>Overall, studies included in this review were considered low risk or unclear risk of bias. Features in favor of low risk include group allocation by random sequence generation, and sealed assignment. Seven studies had adequate blinding of subjects and personnel, and 14 studies used blinded assessors.</p>
<p>Intervention Investigated</p>
<p><i>Control</i></p>
<p>A variety of control group experiences were represented among the studies. Most commonly described is “no Tai Chi”, however, that exclusion still leaves a lot of unknown variables on the table. 6 studies identified this as control, and “usual care” and “low intensity exercises were used in 4 and 3 studies respectively.</p>
<p><i>Experimental (Tai Chi exercises)</i></p>
<p>The Yang style of Tai Chi was most commonly identified among studies, with 9 trials represented. “Tai Chi” without designation was studied in 5 trials, while Sun style was the focus of the remaining 4. In addition to 3 distinct styles of exercise, the frequency and duration varied widely. Frequency ranged from 1x/ week to 5x/ week, and treatments were provided anywhere from 4 weeks to 2 years. No information was provided on session length or precise location/ setting of delivery among individual trials.</p>
<p>Outcome Measures</p>
<p>Number of fallers and rate of falls.</p>
<p>Main Findings</p>
<p>Meta-analysis of 16 trials revealed that risk of falling was reduced for Tai Chi participants versus their control counterparts, with risk ratio of 0.80 (95% CI, 0.72, 0.88).</p> <p>Breaking down styles of Tai Chi for analysis yields the following details:</p> <ul style="list-style-type: none"> - Reduced risk of falls is greatest for Yang style Tai Chi; 0.61 (95% CI, 0.46, 0.80) - Sun style Tai Chi; 0.88 (95% CI, 0.80, 0.98) <ul style="list-style-type: none"> o Both sub groups reached p=0.01 for statistical significance. <p>Frequency of Tai Chi intervention also has a direct relationship to reduced falls risk, for example:</p> <ul style="list-style-type: none"> - 3x weekly sessions are associated with reduced falls risk ratio compared to less frequent sessions, for example, compared to 2x: (95% CI for the following risk ratios) <ul style="list-style-type: none"> o 3x: 0.62 (0.51, 0.75) / 2x: 0.83 (0.76, 0.92) 1x weekly intervention was not statistically significant. See Interpretation section. - All sub group test differences are p=0.57, well above the commonly accepted 0.05 threshold for significance. <p>Time for follow up of intervention also showed differences in risk ratios, with shorter follow up faring better than delayed:</p> <ul style="list-style-type: none"> - 1-3 months: 0.63 (0.44, 0.89) and - 3-6 months: 0.79 (0.65, 0.94) and decreasing again at >6 months. <p>RATE of Falls:</p> <p>Similar to number of fallers, RATE of falls was shown to favor Yang style Tai Chi using incidence rate ratio (IRR), with p=0.001.</p> <ul style="list-style-type: none"> - Rate Yang #falls / IRR, (95% CI): 528 / 0.54 (0.42, 0.70) <p>When comparing frequency, RATE of falls follows the same trend, that is, reducing number with increased frequency, p=0.07 (not statistically significant).</p> <ul style="list-style-type: none"> - 3x weekly: 454 / 0.48 (0.36, 0.64); 2x: 1,641 / 0.73 (0.57, 0.95); 1x weekly not statistically significant.
<p>Original Authors' Conclusions</p>
<p>This systematic review supports using Tai Chi as a falls risk reducing intervention. In particular, Yang style and using at least 3x weekly sessions are shown to provide the most risk reduction of falls. There may be potential bias due to the impossibility of blinding subjects to their treatment, as well as a publication bias that was not addressed.</p>

Critical Appraisal
Validity
<p>Risk of bias for this study is determined to be low, represented by a 7/11 score on the AMSTAR systematic review scale. While the strong score is based on factors like thorough literature search and 2 independent investigators completing data extraction, important details about the RCTs were omitted, such as specific randomization and blinding of subjects, and completion rates. As a result, there is a possible internal validity weakness. While only randomized controlled trials were included in the review, the overall experimental design for each study was not reported. Outcome measures of number of fallers and rate of falls are explained and there is a variety of follow up times, however, these are not standardized and validated measures, relying on memory and accuracy of subject reports.</p> <p>As mentioned for article 1, internal and external validity are not directly observable beyond the community and environments listed above. The authors acknowledge that most trials used a sample of convenience, i.e., the communities in which the research was being conducted. Therefore external validity is in question to a larger target population.</p> <p>A thorough listing of sub-group statistical results are provided, making comparisons and relative effectiveness of style and frequency/ duration of interventions readily available.</p> <p>Overall this systematic review may be considered moderate quality evidence.</p>
Interpretation of Results
<p>Reducing falls risk is a worthy goal for patients, therapists, researchers, and caregivers alike. In pooling data from studies in this systematic review, Tai Chi (with its variations in style and delivery) achieves statistically significant evidence as an effective intervention for falls reduction in limited aspects.</p> <p>Risk ratios (RR) were calculated for style of Tai Chi, frequency, and follow-up interval. Risk ratios represent the proportion of people exposed to Tai Chi intervention who went on to experience a fall or falls relative to the control group of individuals not – exposed to Tai Chi interventions who later had a fall or falls. So, for top line result of Tai Chi versus non-Tai Chi RR 0.80 (95% CI, 0.72, 0.88) would read as follows: The relative risk of a person participating in Tai Chi is 0.80 for falling compared to a person receiving no Tai Chi intervention.</p> <p>Similarly to the OR analysis of the first article, here the RR of .80 is below 1.0 (the point of even chance of falls), but is not considered to be a strong reduction of risk. Also worth noting is the CI (0.72, 0.88) extends even closer to the point of the statistically non-significant value of 1.0. While the evidence improves for Yang style Tai Chi, and increased frequency and duration, there are some important notes to highlight: First, the statistic used for rate of falls is the incidence rate ratio (IRR) is closely aligned with RR. Second, for the Tai Chi interventions, there are several comparisons that do not achieve statistical significance.</p> <p>The following variations are statistically non-significant with CI ranges that include 1.0: For number of fallers, Tai Chi 1x/ weekly, for between 30 and 60 hours of total intervention, and for multiple falls, 1x weekly and fewer than 30 hours of intervention. Selected additional variations and RR / (95% CI) are listed below:</p> <ul style="list-style-type: none"> - 2x weekly Tai Chi – 0.83 / (0.76, 0.92) - >60 hours total Tai Chi – 0.80 / (0.67, 0.94) - Multiple falls; 30 – 60 hours of total Tai Chi – 0.58 (0.35, 0.94) <p>These results show that there is variation in what is effective intervention for reducing falls in elderly adults. However, the authors draw this conclusion without commenting on the subgroup analysis p value = 0.57, which is well in excess of commonly recognized 0.05 threshold for significance.</p>
Applicability of Study Results
<p>Aside from age and gender similarities, there is little applicability of this review to my client upon detailed analysis. Close inspection of the data leaves the clinician little choice but to pursue other intervention options for a 73 year old post stroke woman with increased falls risk.</p> <p>This systemic review appears low in risk bias (7/11 AMSTAR) at face value, but offers little detail to help a clinician reduce falls risk for patients. No intervention methodology is offered besides the named style of Tai Chi (Yang, Sun). Due to the lack of statistical significance (or very low significance) it may only be possible to infer wide generalizations such as “exercise that provides benefits to strength and balance like Tai Chi may provide should be completed 3x or more weekly. Unlike the conclusions of this study, the previous statement is supported by the US Department of Health and Human Services.⁹</p>

SYNTHESIS AND CLINICAL IMPLICATIONS

The 2 studies included in this review had promising abstract summaries about the effectiveness of Tai Chi interventions and their value in reducing falls in older adults. This author reviewed 8 or more articles to find high quality studies to inform if Tai Chi or strength training is more effective in reducing falls for a 73 year old female post-stroke. High quality reviews with multiple validated outcome measures were deemed low relevance for a variety of reasons, including that neurological conditions such as patients with history of stroke and Parkinson's Disease were excluded from their study. The systematic reviews included in this study (Hu, 2016) and (Huang, 2016) both conclude that Tai Chi is effective for reducing falls risk in older adults.

While each review earned a low risk score (7/11 AMSTAR), the weaknesses became apparent in the detailed data analysis. Quality of included studies was not fully detailed, specific randomization procedures for subjects was therefore left unreported. Methodological details about interventions were omitted as well. Many of the articles reviewed cite the objective as being some form of the following statement: "Tai Chi has been a popular activity for older adults as an intervention to reduce falls risk. Falls are associated with weak legs, poor balance and coordination, and are prevalent in the older adult community. Prior studies have been inconclusive on the efficacy of Tai Chi as an intervention, and further research is needed on frequency, duration, and style of intervention."

With all this uncertainty, it is fair to ask: a) Why there is so much uncertainty? And, b) Should researchers pursue other interventions?

This author proposes that the reason for uncertainty is that Tai Chi is a diverse umbrella term for a balance and callisthenic exercise program. Tai Chi is originally from China and many people in the US have adopted its practice for both physical and mental health benefits. The specific methods and prescription for optimal health and specifically for falls prevention goals likely varies by individual, and would require 1:1 personalization and guidance for optimal results.

And, YES, other interventions should be pursued.

This CAT uncovered the same challenges that other studies faced when attempting to quantify the falls risk reduction qualities of Tai Chi: Interventions were not explicitly outlined, and while falls risks were reduced in treatment groups, the results were either not statistically significant, or of weak association. Furthermore, falls risk was assessed in these 2 studies via falls rate incidence or fall events. This data was collected via patient report and could be subject to memory or factual errors.

For PTs interested in evidence based physical therapy practice, this author suggests returning to the original clinical scenario and building an intervention suitable for the individual and based on strength, flexibility, coordination, and balance that are intertwined with falls prevention.

The challenge that PT can meet for these at-risk fallers is to make the activities fun, challenging, and effective. There are balance activities that can be modeled and performed safely at home by patients. Future research could be targeted at establishing a series of "fun" activities that provide balance, strength, and coordination associated with falls prevention, and that could be packaged for safe independent home use or applied in a more restrictive environment.

Additionally, to address the weakness of the studies in this review, it is recommended to develop an outcome measure protocol for increasing validity of assessing quality and effectiveness of any program used. The articles originally reviewed for this CAT included a number of validated assessments, easy to administer, and requiring little equipment or training to use: 6MWT, TUG, SLS, Four Square Step Test, to name a few. Two recent articles introduced additional functional assessment measures.

In 2016, Shui et al. proposed a 360 degree turn test for people with chronic stroke. The test was validated against the TUG, Berg Balance Scale, and 10 m Walk Test. This test is short and easy to administer and provides another option for assessing function.¹⁰

In 2017, Carter et al. propose the 3 m Backwards Walk Test (3MBW) as a tool to assess falls risk. In a retrospective study of older adults with history of falls, the 3MBW was administered to healthy adults living in a retirement community. Cutoff values were established for fallers versus healthy controls. Initial results showed that for 3MBW times, people with history of falls took 4.5s to complete and people completing the trial in less than 3.0s were less likely to have reported a falls history.¹¹

REFERENCES

Bibliography

1. Howe TE, Rochester L, Neil F, Skelton DA, Ballinger C. Exercise for improving balance in older people. *Cochrane Database Syst Rev* 2011;(11):CD004963. doi:10.1002/14651858.CD004963.pub3.
2. Hu Y-N, Chung Y-J, Yu H-K, Chen Y-C, Tsai C-T, Hu G-C. Effect of Tai Chi Exercise on Fall Prevention in Older Adults: Systematic Review and Meta-analysis of Randomized Controlled Trials. *Int J Gerontol* 2016;10(3):131-136. doi:10.1016/j.ijge.2016.06.002.
3. Huang Z-G, Feng Y-H, Li Y-H, Lv C-S. Systematic review and meta-analysis: Tai Chi for preventing falls in older adults. *BMJ Open* 2016;7:1-8.
4. Leung DP, Chan CK, Tsang HW, Tsang WW, Jones AY. Tai Chi as an Intervention to Improve Balance and Reduce Falls in Older Adults: A Systematic Review and Meta-analytical Review. *Altern Ther Health Med* 2011;17(1):40-48.
5. Liu H, Frank A. Tai chi as a balance improvement exercise for older adults: a systematic review. *J Geriatr Phys Ther* 2010;33(3):103-109.
6. Schleicher MM, Wedam L, Wu G. Review of Tai Chi as an effective exercise on falls prevention in elderly. *Res Sports Med* 2012;20(1):37-58. doi:10.1080/15438627.2012.634697.
7. Yang Y, Li X-Y, Gong L, Zhu Y-L, Hao Y-L. Tai Chi for improvement of motor function, balance and gait in Parkinson's disease: a systematic review and meta-analysis. *PLoS ONE* 2014;9(7):e102942. doi:10.1371/journal.pone.0102942.
8. Yildirim P, Ofluoglu D, Aydogan S, Akyuz G. Tai Chi vs. combined exercise prescription: A comparison of their effects on factors related to falls. *J Back Musculoskelet Rehabil* 2016;29(3):493-501. doi:10.3233/BMR-150645.
9. Department of Health and Human Services. *2008 Physical Activity Guidelines for Americans*. Washington, DC: DHHS; 2008.
10. Shiu CH, Ng SS, Kwong PW, Liu T-W, Tam EW, Fong SS. Timed 360° turn test for assessing people with chronic stroke. *Arch Phys Med Rehabil* 2016;97(4):536-544. doi:10.1016/j.apmr.2015.11.010.
11. Carter V, Jain T, James J, Cornwall M, Aldrich A, de Heer HD. The 3-m Backwards Walk and Retrospective Falls: Diagnostic Accuracy of a Novel Clinical Measure. *J Geriatr Phys Ther* 2017. doi:10.1519/JPT.000000000000149.