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The effects of Tai Chi intervention on fall prevention in community-dwelling older adults: A systematic review and meta-analysis of randomized controlled trials

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Data analysis.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 2 February 2026 and was last updated on 2 February 2026.

INTRODUCTION

Review question / Objective The objective of this study is to systematically evaluate the effects of Tai Chi intervention on fall prevention and physical functional performance among community-dwelling older adults. The review question is structured using the PICOS framework:

Population (P): Community-dwelling older adults with a mean or median age of 60 years or older. Participants with specific chronic diseases are eligible, but those living in institutionalized settings (e.g., nursing homes or hospitals) are excluded.

Intervention (I): Tai Chi exercise of any style (e.g., Yang, Chen, or TJQMBB) with an intervention duration of at least 8 weeks. Multi-component programs are included only if Tai Chi is the primary component or its effects are separable. Pure Qigong or Baduanjin are excluded.

Comparator (C): Passive controls (e.g., usual care, health education, waitlist) or active controls (e.g., stretching, balance, strength, or aerobic exercises).

Outcomes (O): The primary outcome is the occurrence of actual fall events with a follow-up period of at least 3 months (prioritizing 6–12 months). Key metrics include the proportion of fallers (RR), fall rate (IRR), or time to first fall (HR). Secondary outcomes include functional and balance indicators such as Timed Up and Go (TUG), Berg Balance Scale (BBS), Single Leg Stance (SLS), Falls Efficacy Scale-International (FES-I), and gait speed.

Study design (S): Randomized controlled trials (RCTs), including individual, cluster, or pragmatic RCTs.

Rationale The Global Burden of Falls:

Falls among older adults represent a significant public health challenge, often leading to severe injuries, loss of independence, and increased mortality. As the global population ages, identifying effective, low-cost, and accessible interventions to improve balance and prevent falls is crucial.

The Role of Tai Chi:

Tai Chi, a traditional mind-body exercise, has gained recognition for its potential to enhance postural control, muscular strength, and cognitive focus. However, while numerous studies have explored its benefits, there remains a lack of consensus regarding the optimal intervention duration and the longevity of its effects.

The Knowledge Gap:

Many existing systematic reviews include studies with highly heterogeneous protocols. Specifically, there is a need to synthesize recent high-quality Randomized Controlled Trials (RCTs) that focus on a structured 8-week intervention period to determine if this specific timeframe is sufficient for clinical improvement. Furthermore, the sustained impact of such interventions at a 3-month follow-up remains under-explored in current meta-analyses.

Objective of This Review:

This systematic review and meta-analysis aim to provide an updated evidence-based evaluation of Tai Chi's efficacy on balance, gait speed, and fall rates in older adults. By focusing on specific intervention and follow-up durations, this study will offer clearer clinical guidance for geriatric rehabilitation and fall prevention programs.

Condition being studied Falls among older adults represent a significant global public health challenge. In the population aged 60 and older, approximately one-third of individuals experience at least one fall annually. For community-dwelling older adults—those who live independently in the community—falls are a leading cause of accidental injury, disability, and mortality.

The consequences of falls are multifaceted:

Physical Impact: Falls often lead to severe injuries such as hip fractures, head trauma, and soft tissue damage, which can result in long-term hospitalization and loss of mobility.

Psychological Impact: Many seniors develop a “fear of falling,” leading to self-imposed activity restrictions, social isolation, and a subsequent decline in physical function and quality of life.

Economic Burden: Falls impose a heavy financial burden on both families and healthcare systems. This review focuses on the prevention of actual fall events (the health condition of interest) through Tai Chi exercise. Unlike institutionalized populations, community-dwelling older adults require sustainable, low-cost, and effective interventions to maintain their independence and prevent the transition from functional decline to injurious falls.

METHODS

Participant or population The study population focuses on community-dwelling older adults with a mean or median age of 60 years or older. Participants who live independently in the community are eligible, including those with specific stable chronic diseases. However, individuals living in institutionalized settings, such as nursing homes, residential care facilities, or hospitals, are excluded. In cases of mixed-age populations, the study will only be included if the reported mean or median age of the participants is 60 years or older.

Intervention The intervention involves Tai Chi exercise of any style, including traditional styles (such as Yang, Chen, Sun, or Wu), simplified versions (e.g., 24-form), or specific protocols like Tai Ji Quan: Moving for Better Balance (TJQMBB). To ensure sufficient physiological impact, the intervention must have a duration of at least 8 weeks. Multi-component programs will be included only if Tai Chi is the primary intervention or if the specific effects of the Tai Chi component can be statistically isolated. Interventions consisting exclusively of Qigong, Baduanjin, or other non-Tai Chi exercises, as well as Tai Chi programs lasting less than 8 weeks, are excluded.

Comparator The comparator includes both passive and active control groups. Passive controls consist of usual care, health education, waitlist controls, or no intervention. Active controls include other types of exercise or physical activities, such as stretching, balance training, strength training, or aerobic exercises, to evaluate the specific efficacy of Tai Chi compared to other active interventions.

Study designs to be included This review will include randomized controlled trials (RCTs) exclusively. This encompasses individual RCTs, cluster RCTs, and pragmatic RCTs. Only studies with a fall-related follow-up period of at least 3 months will be considered. Non-randomized trials, quasi-experimental studies, case reports, and reviews will be excluded.

Eligibility criteria Beyond the PICOS framework, studies must meet the following criteria: (1) Full-text must be available in English or Chinese; (2) The study must report original data on actual fall events; (3) In cases of multiple publications from the same trial, only the most comprehensive report or the one with the longest follow-up will be included. Studies will be excluded if they have insufficient information regarding the randomization process, if the Tai Chi intervention is

less than 8 weeks, or if the population is primarily in an acute medical phase.

Information sources We will conduct a comprehensive search across several electronic databases from their inception to the present. English databases include PubMed, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), and Web of Science. Chinese databases include China National Knowledge Infrastructure (CNKI), Wanfang Data, and the Chinese Scientific Journal Database (VIP). Additionally, we will manually screen the reference lists of included studies and relevant systematic reviews to identify any additional eligible trials.

Main outcome(s) The primary outcome is the occurrence of actual fall events during a follow-up period of at least 3 months, with a priority given to data from 6 to 12 months. Fall events must be recorded through prospective monitoring (e.g., fall diaries or monthly calls). The principal effect measures will be the proportion of participants experiencing one or more falls (expressed as Relative Risk, RR), the rate of falling (expressed as Incidence Rate Ratio, IRR), or the time to the first fall (expressed as Hazard Ratio, HR). For studies reporting multiple time points, we will extract data closest to the 12-month follow-up.

Quality assessment / Risk of bias analysis The methodological quality of the included randomized controlled trials (RCTs) will be assessed using the Cochrane Risk of Bias 2 (RoB 2) tool. Two reviewers will independently evaluate five domains: (1) bias arising from the randomization process; (2) bias due to deviations from intended interventions; (3) bias due to missing outcome data; (4) bias in measurement of the outcome; and (5) bias in selection of the reported result. Each domain will be rated as “low risk,” “some concerns,” or “high risk.” Any disagreements between reviewers will be resolved through discussion.

Strategy of data synthesis Statistical analysis will be conducted using RevMan 5.4 or Stata software. For dichotomous outcomes (proportion of fallers), Relative Risk (RR) with 95% confidence intervals (CI) will be calculated. For continuous outcomes (TUG, BBS, etc.), Mean Difference (MD) or Standardized Mean Difference (SMD) with 95% CI will be used. Heterogeneity will be assessed using the I^2 statistic. A fixed-effects model will be used if $I^2 < 50\%$. If $I^2 \geq 50\%$, a random-effects model will be applied after exploring potential sources of heterogeneity. If quantitative synthesis is not feasible, a narrative synthesis will be provided.

Subgroup analysis If sufficient data are available, subgroup analyses will be performed to explore sources of heterogeneity. Potential subgrouping criteria include: (1) Type of Tai Chi style (e.g., Yang style vs. TJQMBB); (2) Intervention duration (e.g., 8–12 weeks vs. >12 weeks); (3) Type of control group (passive vs. active control); and (4) Participant age groups (e.g., 60–75 years vs. >75 years).

Sensitivity analysis To evaluate the robustness of the primary findings, sensitivity analyses will be conducted by: (1) excluding studies with a high risk of bias; (2) using the “leave-one-out” method to assess the influence of each individual study on the overall effect size; and (3) comparing results obtained from fixed-effects versus random-effects models.

Country(ies) involved China.

Keywords Tai Chi; Older adults; Aged; Accidental falls; Balance; Systematic review; Meta-analysis; Physical functional performance.

Contributions of each author

Author 1 - HOU YUAN - Author 1 was responsible for the conceptualization and design of the study protocol. They will lead the literature search, independent screening of titles and abstracts, full-text review, and data extraction. Furthermore, Author 1 will perform the statistical analysis and lead the drafting of the final manuscript.

Author 2 - ZHANG MING - Author 2 will participate in the design of the search strategy. They will serve as the second independent reviewer for study selection, data extraction, and quality assessment using the RoB 2 tool. Author 2 will also contribute to the interpretation of the results and the critical revision of the manuscript.

Author 3 - DU Weiping - Author 3 will provide methodological guidance and clinical expertise throughout the study. They will act as the third reviewer to resolve any discrepancies between Author 1 and Author 2 during the screening and data extraction processes. Author 3 will also perform the final review and approval of the manuscript.

Author 4 - SUN Taiwei - Author 4 will be responsible for the development and refinement of the search strategy across all electronic databases. They will also provide oversight on the data analysis process and contribute to the interpretation of clinical outcomes and the critical revision of the manuscript.