

Modulation of Brain Resting-State Functional Connectivity by Traditional Chinese Exercise: An Activation Likelihood Estimation Meta-Analysis of Seed-Based Studies

INPLASY2026100096

doi: 10.37766/inplasy2026.10.0096

Received: 22 October 2026

Published: 22 October 2026

Li, HR; Zhao, HP; Wang, M.

Corresponding author:

Meng Wang

wangmengsy@gmail.com

Author Affiliation:

College of Sports Science,
Shenyang Normal University,
Shenyang, China.

ADMINISTRATIVE INFORMATION**Support** - No support.**Review Stage at time of this submission** - Data analysis.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY2026100096

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 October 2026 and was last updated on 22 October 2026.

INTRODUCTION

Review question / Objective This review aims to identify spatially convergent differences in resting-state functional connectivity associated with traditional Chinese exercise (TCE) using coordinate-based activation likelihood estimation (ALE) meta-analysis. P: Participants receiving Tai Chi or Qigong interventions, including Baduanjin, and long-term practitioners. I: Tai Chi, Qigong, or Baduanjin practice or interventions. C: Eligible control groups, including non-exercise controls. O: Peak coordinates of between-group functional connectivity differences identified using seed-to-whole-brain voxelwise analyses, with increased and decreased connectivity analyzed separately. S: Controlled intervention studies and cross-sectional studies comparing long-term practitioners with controls.

Condition being studied This review focuses on differences in resting-state brain functional connectivity associated with traditional Chinese

exercise, including Tai Chi and Qigong (including Baduanjin). Functional connectivity describes statistical associations between activity in different brain regions at rest. The review is not restricted to a single disease and encompasses general populations and participants with cognitive impairment, cognitive frailty, or subjective cognitive decline. Analyses excluding these cognitive-related populations will examine the influence of population characteristics on the findings.

METHODS

Participant or population Eligible participants include individuals receiving Tai Chi or Qigong interventions, including Baduanjin, long-term practitioners, and corresponding control participants. Participants must have undergone resting-state functional magnetic resonance imaging, and studies must report eligible between-group functional connectivity comparisons. The review encompasses general populations and participants with cognitive impairment, cognitive frailty, or subjective cognitive decline.

Intervention Traditional Chinese exercise practice or interventions, including Tai Chi and Qigong, with Baduanjin classified as a form of Qigong. Both structured interventions and long-term practice will be eligible. Exercise type, practice or intervention protocol, and exercise dose will be extracted.

Comparator Control groups meeting the review's eligibility criteria, including non-exercise controls, will be included. Intervention studies must report post-intervention between-group comparisons or between-group comparisons of pre-to-post changes. Studies of long-term practitioners must report cross-sectional between-group comparisons. Experiments using non-exercise controls will also be analyzed separately.

Study designs to be included Controlled intervention studies of traditional Chinese exercise and cross-sectional studies comparing long-term practitioners with controls will be included. Intervention studies must report post-intervention between-group differences or between-group differences in pre-to-post changes. Studies reporting only within-group comparisons, baseline between-group comparisons, or comparisons without an eligible control group will be excluded.

Eligibility criteria Eligible publications include original research articles published in peer-reviewed journals and master's or doctoral theses in Chinese or English, without restrictions on publication year. Studies must assess resting-state functional connectivity using seed-to-whole-brain voxelwise analyses and report peak coordinates of between-group differences in MNI or Talairach standard space. Studies will be excluded if they do not report relevant functional connectivity results, use only non-connectivity measures, or restrict connectivity analyses to predefined target regions without conducting seed-to-whole-brain voxelwise analyses. Studies with missing peak coordinates will also be excluded if these cannot be obtained from supplementary materials or by contacting the authors.

Information sources PubMed, Cochrane Library, Web of Science, MEDLINE, APA PsycINFO and ERIC via EBSCO, Embase, ProQuest, CNKI, and Wanfang were searched from inception to October 5, 2026. PubMed, Cochrane Library, Web of Science, MEDLINE, APA PsycINFO and ERIC via EBSCO, Embase, ProQuest, CNKI, and Wanfang were searched from inception to October 5, 2026. PubMed, Cochrane Library, Web of Science, MEDLINE, APA PsycINFO and ERIC via EBSCO, Embase, ProQuest, CNKI, and Wanfang will be searched from inception to October 5, 2026.

Reference lists of systematic reviews published in the preceding ten years on traditional Chinese exercise and brain functional magnetic resonance imaging will be screened. Grey literature will be searched manually.

Main outcome(s) The primary outcome is the spatial convergence of between-group differences in resting-state functional connectivity across the whole brain. Increased and decreased connectivity in the traditional Chinese exercise group relative to controls will be analyzed separately. Significant cluster locations, peak coordinates, ALE values, and cluster volumes will be reported. Intervention studies will contribute post-intervention comparisons or comparisons of pre-to-post changes; cross-sectional studies will contribute comparisons at scanning. Significance will be defined as cluster-level FWE-corrected $p < 0.05$. Conventional effect sizes will not be pooled.

Quality assessment / Risk of bias analysis Two authors will assess reporting completeness using a 10-item checklist covering participant characteristics, image acquisition and analysis, and reporting of results and conclusions. Items will be scored as 0, 0.5, or 1 for not met or not explicitly reported, partially met, or fully met, respectively. Scores describe reporting completeness and study characteristics rather than overall methodological quality or formal risk of bias. Fail-Safe N (FSN) analyses will assess the influence of null findings and potential publication bias on significant clusters.

Strategy of data synthesis Coordinate-based ALE meta-analyses will be conducted using GingerALE 3.0.2. Peak coordinates of functional connectivity differences between traditional Chinese exercise and control groups will be extracted. Talairach coordinates will be converted to MNI space using the built-in Convert Foci tool. Increased ($TCE > CG$) and decreased ($CG > TCE$) connectivity will be analyzed separately to identify spatial convergence across studies. An uncorrected voxel-level threshold of $p < 0.001$ will be used for cluster formation, with significance determined at cluster-level FWE-corrected $p < 0.05$. The minimum significant cluster volume will be determined using 1,000 permutations.

Subgroup analysis Subgroup analyses will be conducted by exercise type, separately examining Tai Chi and Qigong, including Baduanjin. Experiments using non-exercise controls will also be analyzed separately. Each analysis will examine increased and decreased functional connectivity in the traditional Chinese exercise group relative to

controls separately, using the same statistical thresholds as the primary analyses.

Sensitivity analysis Jackknife sensitivity analyses will be performed by excluding one experiment at a time and repeating the ALE meta-analysis with the remaining data. These analyses will assess the persistence of significant clusters and the influence of individual experiments. Additional analyses will exclude experiments involving participants with cognitive impairment, cognitive frailty, or subjective cognitive decline to examine the influence of population composition. Increased and decreased connectivity will be analyzed separately using the same statistical thresholds as the primary analyses.

Language restriction Only studies published in Chinese or English will be included.

Country(ies) involved China.

Keywords Traditional Chinese exercise; Tai Chi; Qigong; Baduanjin; Resting-state functional connectivity; Activation likelihood estimation.

Contributions of each author

Author 1 - Hanru Li.

Email: lhracs@qq.com

Author 2 - Hongpeng Zhao.

Author 3 - Meng Wang.

Email: wangmengsy@gmail.com