Efficacy and evidence certainty of traditional Chinese exercises for musculoskeletal disorders: an umbrella review of meta-analyses

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ABSTRACT

Objectives To comprehensively evaluate the efficacy and exercise prescription parameters of traditional Chinese exercises (TCEs) on health outcomes in patients with musculoskeletal disorders (MSDs) and rigorously assess the certainty of the evidence.

Design Umbrella review.

Data sources PubMed, Embase, Cochrane Library, Scopus, Web of Science, PEDro, Ovid Medline, CINAHL and SPORTDiscus databases were searched from inception to 6 March 2026.

Eligibility criteria for study selection Systematic reviews with meta-analyses of randomised controlled trials (RCTs) that investigated TCE interventions for individuals with MSDs.

Results 92 meta-analyses, comprising data from 1744 primary RCTs, were included, yielding 547 unique outcome associations. TCE modalities included mixed/unspecified TCEs (37.3%), Tai Chi (41.5%), Baduanjin (11.0%), Yijinjing (4.2%), Qigong (3.8%), Wuqinxi (1.8%) and Daoyin (0.4%). Targeted MSDs spanned 10 categories, most commonly arthritis (38.8%). Methodological quality was high for 65 (70.7%) meta-analyses (A Measurement Tool to Assess Systematic Reviews). Applying the Grading of Recommendations, Assessment, Development and Evaluations framework, 23 associations (4.2%) were supported by high-certainty evidence and 179 (32.7%) by moderate-certainty evidence. High-certainty evidence demonstrated that TCEs significantly improved physical function in knee osteoarthritis, enhanced mental health in patients with knee osteoarthritis and neck pain and improved sleep quality in fibromyalgia. Tai Chi significantly alleviated chronic MSD-related pain and stiffness while increasing bone mineral density (BMD) in participants with osteopenia/osteoporosis. Subgroup analyses indicated that interventions with longer duration, higher frequency and moderate-to-high weekly volume were associated with greater clinical gains for knee osteoarthritis and osteoporosis.

Conclusions This umbrella review consolidates high-quality evidence demonstrating that TCEs, especially Tai Chi, provide multidimensional benefits for MSDs, improving function, pain, mental health, sleep and BMD with sustained practice.

PROSPERO registration number CRD420251080573.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Prior evidence indicates that traditional Chinese exercises (TCEs) are associated with beneficial health outcomes in musculoskeletal disorders. However, the existing synthesised evidence is fragmented and methodologically heterogeneous, leading to substantial inconsistencies regarding the comparative efficacy of specific exercise modalities and the optimal prescription parameters, such as duration, frequency and volume.

WHAT THIS STUDY ADDS

⇒ This umbrella review synthesises 547 unique associations from randomised controlled trial-based meta-analyses, establishing a comprehensive evidence map across the musculoskeletal spectrum.

⇒ It establishes high-certainty evidence for the efficacy of TCEs, particularly Tai Chi, in improving core outcomes such as physical function in knee osteoarthritis, mental health in neck pain and sleep quality in fibromyalgia. Furthermore, it identifies that optimal clinical benefits are achieved with sustained interventions characterised by longer duration (≥6 months), higher frequency (≥3 times/week) and moderate-to-high weekly volume (≥150 min).

⇒ It is clinically recommended that TCEs represent a safe, accessible and multidimensional therapeutic strategy that can complement conventional therapies and promote patient self-management.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study supports guideline-informed integration of TCEs into musculoskeletal rehabilitation and informs dose optimisation and implementation strategies.

INTRODUCTION

Musculoskeletal disorders (MSDs), encompassing a broad spectrum of conditions affecting bones, joints, muscles and connective tissues, represent a paramount global health challenge.[1] As the foremost contributor to chronic pain and disability worldwide, MSDs affected over 1.69 billion individuals in 2021 and account for a dominant share of years lived with disability.[2] This heterogeneous group, as classified by the Global Burden of Disease study, includes prevalent conditions such as osteoarthritis, low back and neck pain, rheumatoid arthritis and osteoporosis.[3] The chronic and often progressive nature of MSDs results in persistent pain, substantial physical impairment, reduced quality of life and increased risks of comorbidities such as anxiety, depression and social isolation, posing a heavy burden on individuals, healthcare systems and societies.[4 5] Therefore, confronting this burden requires a critical focus on identifying, validating and implementing effective, safe and scalable non-pharmacological management strategies.

Exercise therapy is a cornerstone of non-pharmacological management for MSDs, widely recommended for its efficacy in alleviating pain, improving physical function and enhancing overall well-being.[6 7] Within this therapeutic domain, traditional Chinese exercises (TCEs), such as Tai Chi, Qigong, Baduanjin, Wuqinxi and Yijinjing, have emerged as particularly promising mind-body modalities. Rooted in holistic traditional Chinese medicine (TCM) principles, TCEs uniquely integrate moderate physical activity, mindful breath regulation and meditative focus, positing a synergistic mechanism that may address both physical and psychological facets of MSDs.[8 9] Driven by this rationale and preliminary positive findings, a rapidly expanding corpus of systematic reviews and meta-analyses (SRMAs) has sought to consolidate evidence on TCEs for various MSDs, leading to their inclusion in several international clinical guidelines.[10–13]

However, this proliferation of synthesised evidence has revealed significant inconsistencies and methodological limitations, ultimately obscuring clear clinical guidance. Crucially, the existing body of reviews is fragmented by specific MSD conditions and outcomes, lacking a unified, high-level appraisal across the musculoskeletal spectrum. Substantial controversies persist regarding the comparative effectiveness of different TCE types (eg, Tai Chi vs Baduanjin) and the optimal dosage parameters such as session frequency, programme duration and total volume.[14] For example, findings on the most beneficial TCE modality for knee osteoarthritis are contradictory, with some meta-analyses favouring Baduanjin for overall improvement and others reporting broader efficacy for Tai Chi.[15 16] Similar controversies exist regarding the effects of TCEs on osteoporosis, neck pain and low back pain.[17–19] These discrepancies are compounded by variable methodological rigour and inconsistent grading of evidence certainty across reviews, leaving clinicians, patients and health policymakers without a definitive, authoritative evidence synthesis.

An umbrella review (UR), which systematically synthesises evidence from multiple SRMAs, represents the highest level of evidence synthesis and is ideally suited to address these challenges.[20–22] It can provide a comprehensive overview of the evidence landscape, reconcile conflicting findings, assess the overall strength and quality of the evidence and identify precise gaps for future research. To our knowledge, no UR has comprehensively and critically evaluated the totality of evidence for TCEs across the entire spectrum of MSDs while formally assessing the certainty of that evidence and analytically exploring the impact of exercise prescription variables.

Therefore, to address this critical evidence gap and provide definitive guidance, we conducted this UR of SRMAs of randomised controlled trials (RCTs). Our study aims to: (1) systematically map and synthesise the evidence on the efficacy of TCEs for a wide range of health outcomes across various MSDs; (2) rigorously evaluate the certainty of this synthesised evidence using the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework; (3) empirically analyse the influence of exercise prescription parameters (duration, frequency and volume) through subgroup analyses and (4) identify and articulate key gaps in the current evidence base. We anticipate that this work will yield a consolidated, authoritative evidence assessment to directly inform clinical practice guidelines, health policy decisions and the strategic direction of future research, thereby facilitating the effective and evidence-based integration of TCEs into musculoskeletal healthcare.

METHODS

Protocol registration

This UR was conducted in strict accordance with the reporting standards outlined in the Preferred Reporting Items for Overviews of Reviews guidelines for reporting healthcare interventions.[23] To ensure transparency and minimise bias, the study protocol was prospectively registered within the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD420251080573. This UR strictly adhered to the registered protocol, with no deviations from the prespecified methodology.

Search strategy and study selection

A comprehensive and systematic literature search was performed to identify all relevant SRMAs of RCTs investigating the effects of TCEs on health outcomes in individuals with MSDs. Two independent investigators (W-XC and Y-ZL) executed searches across the following nine electronic databases from inception to 6 March 2026: PubMed, Embase, Cochrane Library, Scopus, Web of Science, PEDro, Ovid Medline, CINAHL and SPORTDiscus. The search strategy was developed with the assistance of a medical librarian and employed a combination of Medical Subject Headings terms and free-text keywords related to TCEs, MSDs and study design (eg, meta-analysis). The detailed search syntax for each database is provided in online supplemental table 1. Furthermore, to ensure literature saturation, we manually screened the reference lists of all included SRMAs and relevant review articles. Any discrepancies during the search and screening process were resolved through consultation with a third senior investigator (Q-JW).

Eligibility criteria

Two independent investigators (W-XC and Y-ZL) performed a dual-review process, screening titles/abstracts and subsequently assessing the full texts of potentially eligible records against the predefined criteria. Any discrepancies arising during the screening process were resolved through consultation with the third investigator (Q-JW). Study selection was guided by the Population, Intervention, Comparison, Outcome, Study design framework. The inclusion criteria were as follows—(1) population: adults or older adults diagnosed with MSDs (eg, arthritis, rheumatoid arthritis, osteoarthritis (knee, hip), axial spondyloarthritis or scoliosis, chronic ankle instability, fibromyalgia, low back pain, neck pain, osteopenia or osteoporosis, sarcopenia and frailty, etc)[3]; (2) intervention: any TCEs (eg, Tai Chi, Qigong, Yijinjing, Baduanjin, Wuqinxi, Liuzijue, Daoyin, etc); (3) comparison: any control intervention, including no exercise/usual care, Chinese medicine, health education, attention control, individual communication, group meetings, other exercise (eg, cycling, resistance training, hydrotherapy, physical therapy and home-exercise, health education and exercise) or both of above comparator groups; (4) outcomes: five major categories of

Inclusion criteria	Exclusion criteria
Population - all individuals diagnosed with musculoskeletal disorders†	***Analytical method***- systematic reviews without quantitative analysis
Intervention- traditional Chinese exercises (eg., Tai Chi, Qigong, Yijinjing, Baduanjin, Wuqinxi, Liuzijue, Daoyin, etc.). No specific limitations were imposed on the type, duration, frequency, or volume of traditional Chinese exercise. Co-interventions were allowed.	***Study quantity*** - systematic reviews with meta-analyses that included fewer than three primary studies
Comparison- non-exercise (i.e. usual care, Chinese medicine, health education, attention control, individual communication, group meetings), other exercise (i.e. cycling, resistance training, hydrotherapy, physical therapy and home-exercise, health education and exercise), or both (non-exercise and other exercise)	***Data integrity*** - systematic reviews with meta-analyses that did not provide a relevant exposure or specific data for re-analysis (eg., standardized mean difference, mean difference, 95% confidence intervals and the number of participants)
Outcomes- Five major categories of health outcomes were included: (1) Pain; (2) Physical function; (3) Quality of life, mental and psychological health; (4) Body composition and biomarkers; (5) Effective and safety	***Language*** - studies published in non-English
Study design- systematic reviews and meta-analyses of randomized controlled trials that provided specific data for re-analysis, including effect sizes with 95% confidence intervals, the mumber of cases, and the total population	***Study design*** - conducting systematic reviews and meta-analyses of trials that are not randomized controlled trials, animal studies, genetic polymorphisms, conference abstracts, and laboratory research

Figure 1 The list of inclusion and exclusion criteria of the umbrella review. Musculoskeletal disorders including—(a) arthritis: arthritis, rheumatoid arthritis, osteoarthritis, osteoarthritis (hip and knee) and knee osteoarthritis; (b) axial spondyloarthritis or scoliosis; (c) chronic ankle instability; (d) fibromyalgia; (e) low back pain: low back pain, lumbar disc herniation; (f) neck pain; (g) osteopenia or osteoporosis: osteopenia; osteoporosis, osteopenia or osteoporosis (perimenopausal/postmenopausal women), osteoporosis (senile), osteoporotic fractures; (h) sarcopenia and frailty: sarcopenia and frailty, sarcopenia.

health outcomes: pain, physical function, quality of life, mental and psychological health, body composition and biomarkers, and effectiveness and safety; (5) study design: SRMAs of RCTs that provided specific data for re-analysis (figure 1).

Exclusion criteria included: (1) systematic reviews without quantitative analyses; (2) SRMAs that included fewer than three primary studies[24]; (3) SRMAs that included non-RCT designs (eg, observational studies) in the primary pooled estimate without providing a separate analysis for RCTs[20]; (4) protocols, conference abstracts, narrative reviews or animal studies. Additionally, to clarify the independent efficacy of TCEs as a primary conservative strategy, TCE intervention on MSDs after the surgical procedures is needed which was beyond the scope of this UR.

Data extraction

A standardised, pilot-tested data extraction form was used to ensure consistency. From each eligible SRMA, the following data were extracted independently by two reviewers from a team of eight trained investigators (working in four pairs): first author's name, year of publication, study design, number of cases, total sample size, intervention measures, comparison groups, health-related outcomes, mean (SD) and effect sizes (eg, standardised mean difference (SMD), OR, risk ratio, weighted MD (WMD), MD, Hedge's g) along with measures of heterogeneity (eg, Cochran's Q) and their corresponding 95% CIs. Crucially, for all primary outcomes of interest, we extracted the raw data (means, SD and sample sizes) from the primary RCTs as reported within the SRMAs to facilitate an independent re-analysis. Discrepancies in extracted data were adjudicated by a senior investigator (Q-JW).

Methodological quality assessment of included SRMAs

The methodological quality of the included SRMAs was evaluated using the 11-item A Measurement Tool to Assess Systematic Reviews (AMSTAR) checklist.[25] Each item was rated as 'Yes' (score 1), 'No' (score 0), or 'Can't answer/Not applicable' (score 0). Total scores were categorised as high quality (8–11 points), moderate quality (4–7 points) and low quality (0–3 points).[25] The assessment was performed independently by four investigators (W-XC, Y-ZL, L-DK and X-FJ), with disagreements resolved by consensus or consultation with the senior investigator (Q-JW).

Assessment of overlap of primary studies

To address the issue of double-counting evidence from the same primary RCTs across multiple SRMAs, we quantified the degree of overlap by constructing a citation matrix of all primary RCTs included in the eligible SRMAs.[26] The corrected covered area (CCA) was calculated.[27] A CCA value of <5% was considered negligible, 5–10% moderate, 11–15% high and >15% very high overlap.[26] This analysis informed the interpretation of the evidence synthesis, indicating where conclusions might be driven by repeated analysis of the same trials.

Data re-analysis and synthesis

To ensure a comprehensive evaluation of the evidence regarding the reported associations, we systematically re-analysed the original study data extracted from all included primary studies within each eligible SRMA.[28] For each unique association identified in the eligible SRMAs, we recalculated the pooled effect size with its 95% CI using a random-effects model. A p value <0.05 was considered statistically significant. Heterogeneity was quantified using the I^2 statistic, with values >50% and >75% representing substantial and considerable heterogeneity, respectively.[29] For SMD analyses, effect size magnitudes were interpreted using Cohen's d criteria: an SMD of 0.2 represented a small effect, 0.5 as a medium effect and 0.8 as a large effect.[30]

Evaluation of certainty of evidence

The overall strength of evidence for each unique association was evaluated using the GRADE framework.[31] For each outcome, eight independent investigators assessed and graded the evidence as 'High', 'Moderate', 'Low' or 'Very Low', considering the following domains: risk of bias, inconsistency, indirectness, imprecision and publication bias.[32] The process was overseen by the senior epidemiologist and methodologist on the team, with disagreements resolved by consensus.

Subgroup and sensitivity analyses

Pre-specified subgroup analyses were conducted to investigate potential sources of heterogeneity, particularly regarding exercise prescription: (1) exercise duration: short-term (≤3 months), medium-term (3–6 months) and long-term (>6 months)[33]; (2) exercise frequency: low (1–2 sessions/week), moderate (3–4 sessions/week) and high (≥5 sessions/week)[34]; (3) exercise volume: low (<150 min/week), moderate (150–300 min/week) and high (>300 min/week).[14]

To test the robustness of the primary findings, we performed the following sensitivity analyses: (1) excluding small-sized studies (defined as those with a sample size below the 25th percentile of all studies in that meta-analysis)[35]; (2) excluding primary RCTs judged to have a 'high risk of bias' based on the Cochrane Risk of Bias tool,[36] which we applied to re-assess primary studies when the original SRMAs did not provide adequate detail; (3) summarising findings from SRMAs that lacked a quantitative synthesis to further consider any unique outcomes and assess whether their conclusions aligned with the main analysis.[37,38] Publication bias was assessed visually using funnel plots and statistically using Egger's regression test for meta-analyses containing 10 or more studies.[38] For meta-analyses where quality assessment data were unavailable or lacked explicit methods and scores, we re-evaluated the primary studies included in the original meta-analyses using the Cochrane criteria.[39]

All statistical analyses were conducted using STATA V.18.

Equity, diversity and inclusion statement

Our study examined the impact of TCEs on health outcomes among individuals with MSDs, across all genders, socioeconomic levels and marginalised communities. The author team, comprising 18 women and five men from various disciplines (orthopaedics, obstetrics, gynaecology, epidemiology, clinical research and clinical laboratories), included scholars at different stages of their careers. Data collection followed a standardised method, ensuring research integrity across diverse MSD populations. Our methodology remained consistent, regardless of regional, educational or socioeconomic differences.

RESULTS

Literature review and study selection

A total of 2182 records were identified through systematic searches of nine databases. After removing duplicates, 928 unique records underwent title and abstract screening. Subsequent full-text assessment of 278 articles against the eligibility criteria led to the inclusion of 92 SRMAs in this UR. The detailed study selection process is illustrated in the flow diagram (online supplemental figure 1). The list of articles excluded during full-text screening, along with reasons for exclusion, is provided in online supplemental table 3. The two investigators had highly consistent agreement on both the selection of studies (98.8% for title/abstract screening, 99.5% for full-text assessment) and data extraction (98.6%), with kappa values of 0.957 and 0.948, respectively. Minor discrepancies were resolved through consensus or consultation with a third senior investigator.

Characteristics of included meta-analyses and associations

The 92 included SRMAs, published between 2011 and 2026, encompassed data from 1744 primary RCTs, evaluating 547 unique TCE-outcome associations across the spectrum of MSDs. The characteristics of each included SRMA are summarised in online supplemental table 4).

The TCE interventions investigated were: Tai Chi (n=227 associations, 41.5%), mixed/unspecified TCEs (n=204, 37.3%), Baduanjin (n=60, 11.0%), Yijinjing (n=23, 4.2%), Qigong (n=21, 3.8%), Wuqinxi (n=10, 1.8%) and Daoyin (n=2, 0.4%). The target MSD populations spanned 10 categories: arthritis (n=212 associations, 38.8%), low back pain (n=79, 14.4%), osteopenia or osteoporosis (n=77, 14.1%), sarcopenia (n=59, 10.8%), fibromyalgia (n=48, 8.8%), total MSDs (n=23, 4.2%), neck pain (n=22, 4.0%), chronic ankle instability (n=17, 3.1%) and axial spondyloarthritis/scoliosis (n=10, 1.8%) (figure 2). The assessed health outcomes covered core domains of MSD management, including physical function (balance, disability, Western Ontario and McMaster Universities scale (WOMAC) and 36-Item Short Form Health Survey (SF-36), pain, quality of life, mental health (depression and anxiety), sleep quality, bone mineral density (BMD) and other disease-specific clinical measures (online supplemental tables 2 and 4).

Based on our de novo re-analysis using a random-effects model, 394 (72.0%) of the 547 unique associations demonstrated a statistically significant benefit of TCEs ($p<0.05$), with 295 (53.9%) remaining significant at a threshold of $p<0.001$. Heterogeneity was considerable, with 206 associations (37.7%) showing high heterogeneity ($I^2 > 75\%$), 122 (22.3%) showing moderate heterogeneity (I^2: 50–75%) and 219 (40.0%) showing low heterogeneity ($I^2 < 50\%$) (online supplemental table 5).

Methodological quality and evidence certainty

Using the AMSTAR tool, 65 SRMAs (70.7%) were rated as high quality, 27 (29.3%) as moderate quality and none as low quality (online supplemental figure 2). Applying the GRADE framework to the 547 associations revealed a distribution of evidence certainty: 23 associations (4.2%) were supported by high-certainty evidence, 179 (32.7%) by moderate-certainty evidence, 218 (39.9%) by low-certainty evidence and 127 (23.2%) by very low-certainty evidence (figure 2 and online supplemental table 6).

Assessment of overlap

Primary study overlap was quantified using a citation matrix and the CCA. With 1000 total citations (N), 443 unique studies (r) and 92 SRMAs (c), the calculated CCA was 0.0138 (1.38%). The CCA indicates negligible overlap of primary RCTs across the included SRMAs, ensuring the robustness of our synthesis and minimal evidence redundancy. More details of overlapping citations are provided in online supplemental figure 3.

Effects of TCEs on health outcomes across MSDs

The synthesised evidence for all associations, organised by MSD category, is presented below. Forest plots for key outcomes are shown in figures 3 and 4 and online supplemental figure 4–10, with complete data in online supplemental table 5.

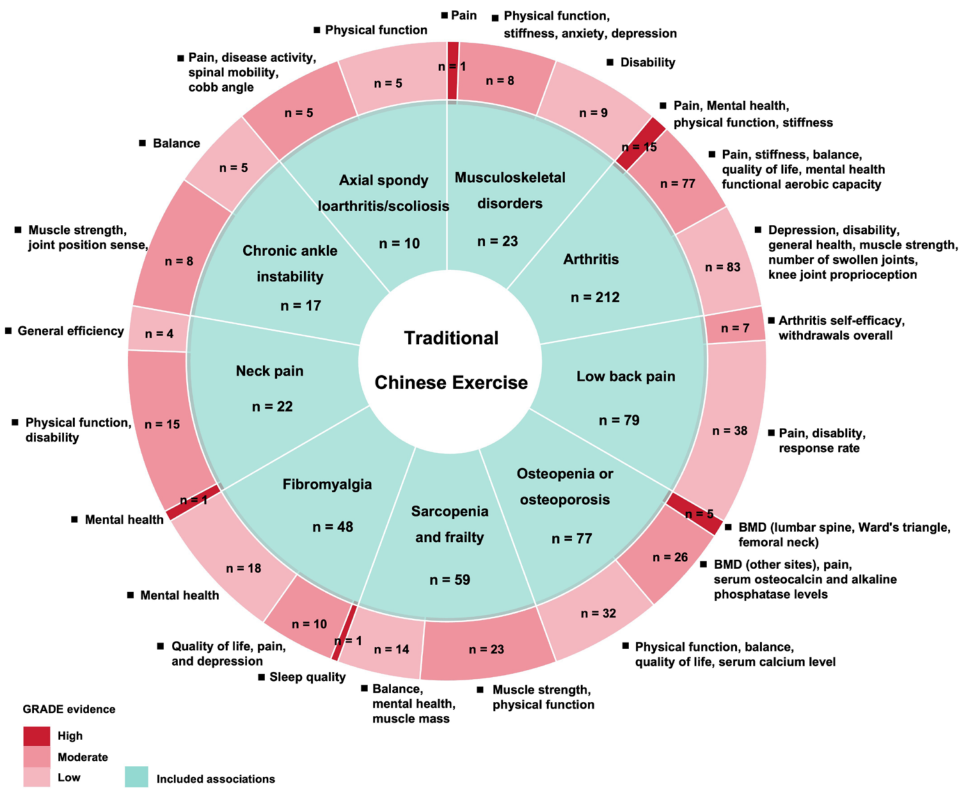


Figure 2 The numbers of the levels of evidence and corresponding outcomes. Other sites include calcaneus, femoral neck, femur, proximal femur trochanter and Ward's triangle. BMD, bone mineral density.

MSDs (general)

Among 23 associations for general MSDs, one (0.2%) was supported by high-certainty evidence and eight (1.5%) by moderate-certainty evidence (figure 3 and figure 5; online supplemental table 6).

High-certainty evidence showed that Tai Chi significantly reduced pain compared with no exercise (SMD=−0.65, 95% CI −0.82 to −0.48).[40] Moderate-certainty evidence indicated that Tai Chi improved disability (SMD=−0.65, 95% CI −0.82 to −0.48),[41] and that TCEs reduced pain (SMD=−0.50, 95% CI −0.75 to −0.25) and improved physical function (SMD=−0.57, 95% CI −0.82 to −0.32) in patients with musculoskeletal pain.[42]

Arthritis

A total of 212 associations (38.8%) were identified for arthritis populations, with the majority focusing on knee osteoarthritis (n=170, 31.8%). Among these, 15 associations (2.7%) exhibited high-certainty level, while 74 associations (13.5%) had a moderate level of evidence (figures 4 and 5; online supplemental table 6).

Osteoarthritis (general)

Moderate-certainty evidence supported that Tai Chi alleviated disability (SMD=−0.66, 95% CI −0.85 to −0.46),[41] improved functional aerobic capacity (SMD=0.66, 95% CI 0.23 to 1.09),[43] reduced pain (SMD=−0.57, 95% CI −0.86 to −0.27)[40] and improved WOMAC sub-scores for pain (SMD=−0.45, 95% CI −0.70 to −0.20),[44] stiffness (SMD=−0.73, 95% CI −1.17 to −0.30)[44] and physical function (SMD=−0.74, 95% CI −1.09 to −0.40),[44] as well as quality of life (SMD=0.38, 95% CI 0.01 to 0.75).[45]

Knee osteoarthritis

15 associations were rated as high-certainty of evidence. Specifically, TCEs improved physical function on the WOMAC (SMD=−0.85, 95% CI −1.04 to −0.65) and SF-36 (SMD=2.85,

Population	Outcomes	Intervention	Type of effect metric	Random effects (95% CI)	Random effects (95% CI)	I2	Quality for GRADE
Musculoskeletal Disorders							
	Pain	Tai Chi	SMD		-0.65 (-0.82, -0.48)	36	High
	Anxiety	TCEs	SMD		-0.43 (-0.73, -0.12)	44	Moderate
	Depression	TCEs	SMD		-0.41 (-0.65, -0.16)	39	Moderate
	Disability (WOMAC/RMIQ)	Tai Chi	SMD		-0.65 (-0.82, -0.48)	0	Moderate
	Pain	TCEs	Hedge's g		0.49 (0.27, 0.72)	25.6	Moderate
	Pain	Tai Chi	Hedge's g		0.63 (0.31, 0.95)	7.3	Moderate
	Pain (WOMAC change)	TCEs	SMD		-0.50 (-0.75, -0.25)	66	Moderate
	Physical function (WOMAC change)	TCEs	SMD		-0.57 (-0.82, -0.32)	64	Moderate
	Stiffness (WOMAC change)	TCEs	SMD		-0.37 (-0.75, 0.00)	78	Moderate

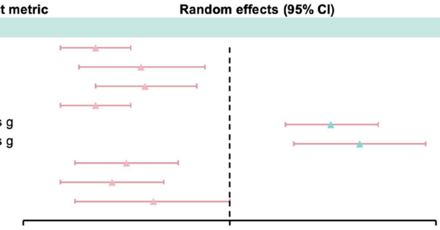
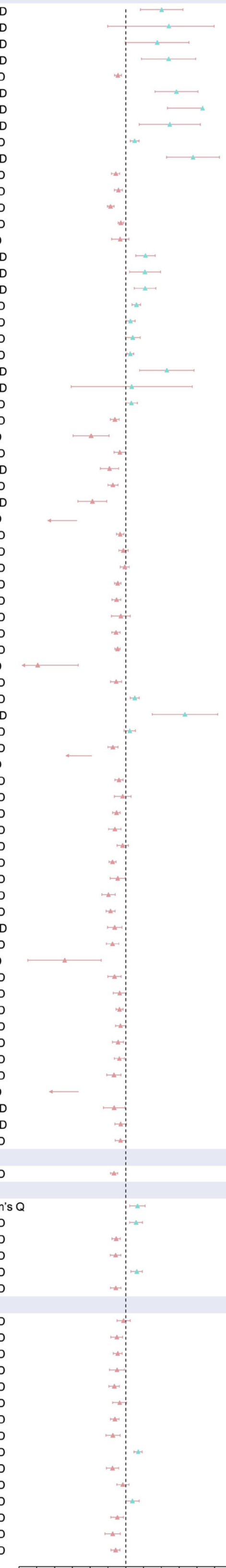


Figure 3 High-to-moderate-certainty evidence on the effect of traditional Chinese exercise interventions on health outcomes in individuals with total musculoskeletal disorders. GRADE, Grading of Recommendations Assessment, Development and Evaluation; RMIQ, Roland Morris Disability Questionnaire; SMD, standard mean difference; TCEs, traditional Chinese exercises; WOMAC, the Western Ontario and McMaster Universities scale.



Population	Outcomes	Type of intervention	Type of effect metric	Random effects (95% CI)	I2	Quality for GRADE
Arthritis						
Knee osteoarthritis						
	Mental health (SF-36)	TCEs	WMD	2.02 (0.83, 3.22)	0.5	High
	Mental health (SF-36)	TCEs (≤12 weeks)	WMD	2.42 (-1.02, 4.97)	39.3	High
	Mental health (SF-36)	TCEs (>12 weeks)	WMD	1.77 (-0.02, 3.55)	0	High
	Mental health (SF-36)	Tai Chi	WMD	2.41 (0.89, 3.93)	19	High
	Pain (WOMAC)	Tai Chi	SMD	-0.44 (-0.63, -0.24)	24	High
	Physical function (SF-36)	TCEs	WMD	2.85 (1.65, 4.06)	7.4	High
	Physical function (SF-36)	TCEs (≤12 weeks)	WMD	4.32 (2.34, 6.29)	26.1	High
	Physical function (SF-36)	TCEs (>12 weeks)	WMD	2.474 (0.75, 4.19)	0	High
	Physical function (SF-36)	Tai Chi	SMD	0.50 (0.26, 0.74)	14	High
	Physical function (SF-36)	Tai Chi	WMD	3.78 (2.30, 5.27)	22.6	High
	Physical function (WOMAC)	Tai Chi	SMD	-0.56 (-0.80, -0.33)	43	High
	Physical function (WOMAC)	TCEs (≤12 weeks)	SMD	-0.41 (-0.64, -0.18)	33	High
	Physical function (WOMAC/KOOS change)	TCEs	SMD	-0.85 (-1.04, -0.65)	0	High
	Stiffness (WOMAC)	Tai Chi	SMD	-0.27 (-0.43, -0.11)	0	High
	Stiffness (WOMAC)	TCEs	MD	-0.31 (-0.79, 0.17)	27	High
	Bablance (Berg balance scale)	TCEs	WMD	1.11 (0.56, 1.66)	0	Moderate
	Bablance (Berg balance scale)	TCEs (≤12 weeks)	WMD	1.08 (0.22, 1.95)	0	Moderate
	Bablance (Berg balance scale)	Tai Chi	WMD	1.09 (0.48, 1.69)	0	Moderate
	Bablance (Berg balance scale)	TCEs	SMD	0.60 (0.36, 0.84)	4	Moderate
	Mental health (SF-36 change)	TCEs	SMD	0.27 (0.02, 0.53)	9.8	Moderate
	Mental health (SF-36)	Tai Chi	SMD	0.40 (-0.01, 0.82)	67	Moderate
	Mental health (SF-36)	Tai Chi	SMD	0.26 (0.06, 0.45)	0	Moderate
	Mental health (SF-36)	Tai Chi	WMD	2.31 (0.78, 3.84)	0	Moderate
	Mental health (SF-36)	Baduanjin	WMD	0.34 (-3.06, 3.74)	0	Moderate
	Mental health (SF-36)	TCEs	SMD	0.32 (-0.00, 0.65)	73	Moderate
	Pain (change)	TCEs	SMD	-0.61 (-0.86, -0.36)	62.7	Moderate
	Pain (VAS change)	TCEs	MD	-1.94 (-2.96, -0.93)	96	Moderate
	Pain (VAS)	Tai Chi	SMD	-0.33 (-0.65, -0.01)	43	Moderate
	Pain (VAS)	Tai Chi	WMD	-0.91 (-1.42, -0.40)	0	Moderate
	Pain (VAS/WOMAC)	Tai Chi (short-term)	SMD	-0.72 (-1.00, -0.44)	0	Moderate
	Pain (WOMAC change)	Tai Chi	WMD	-1.87 (-2.68, -1.07)	33	Moderate
	Pain (WOMAC)	Wuqinxi	MD	-17.00 (-21.41, -12.58)	0	Moderate
	Pain (WOMAC)	TCEs	SMD	-0.31 (-0.52, -0.10)	63.6	Moderate
	Pain (WOMAC)	Baduanjin	SMD	-0.13 (-0.39, 0.13)	0	Moderate
	Pain (WOMAC)	Yijinjing and Wuqinxi	SMD	-0.05 (-0.30, 0.20)	27.3	Moderate
	Pain (WOMAC)	TCEs	SMD	-0.45 (-0.63, -0.26)	70.3	Moderate
	Pain (WOMAC)	TCEs (>12 weeks)	SMD	-0.52 (-0.77, -0.27)	73.8	Moderate
	Pain (WOMAC)	Wuqinxi	SMD	-0.27 (-0.80, 0.26)	89.9	Moderate
	Pain (WOMAC)	Tai Chi	SMD	-0.55 (-0.78, -0.31)	63.1	Moderate
	Pain (WOMAC)	TCEs	SMD	-0.46 (-0.61, -0.31)	47	Moderate
	Pain (WOMAC)	Tai Chi	MD	-4.94 (-7.22, -2.66)	48.3	Moderate
	Pain (WOMAC/KOOS change)	TCEs (12 weeks)	SMD	-0.54 (-0.85, -0.23)	69	Moderate
	Physical function (SF-36 change)	Tai Chi	SMD	0.51 (0.26, 0.75)	23.7	Moderate
	Physical function (SF-36 change)	Tai Chi	WMD	3.33 (1.50, 5.17)	19.2	Moderate
	Physical function (SF-36)	TCEs	SMD	0.23 (-0.09, 0.55)	73	Moderate
	Physical function (WOMAC)	Tai Chi (short-term)	SMD	-0.72 (-1.00, -0.44)	0	Moderate
	Physical function (WOMAC)	Wuqinxi	MD	-33.45 (-48.74, -18.17)	0	Moderate
	Physical function (WOMAC)	TCEs	SMD	-0.38 (-0.61, -0.15)	69.5	Moderate
	Physical function (WOMAC)	Yijinjing and Wuqinxi	SMD	-0.17 (-0.64, 0.31)	77.5	Moderate
	Physical function (WOMAC)	TCEs	SMD	-0.52 (-0.73, -0.31)	64.1	Moderate
	Physical function (WOMAC)	TCEs (>12 weeks)	SMD	-0.61 (-0.96, -0.26)	76.7	Moderate
	Physical function (WOMAC)	Baduanjin	SMD	-0.17 (-0.49, 0.15)	13.5	Moderate
	Physical function (WOMAC/KOOS change)	TCEs	SMD	-0.74 (-0.93, -0.55)	33.7	Moderate
	Physical function (WOMAC/KOOS change)	Tai Chi	SMD	-0.45 (-0.87, -0.02)	83.8	Moderate
	Physical function (WOMAC/KOOS change)	Baduanjin	SMD	-0.97 (-1.34, -0.59)	0	Moderate
	Physical function (WOMAC/KOOS change)	TCEs	SMD	-0.85 (-1.11, -0.60)	63.5	Moderate
	Stiffness (WOMAC change)	Tai Chi	WMD	-0.62 (-1.03, -0.21)	39.1	Moderate
	Stiffness (WOMAC change)	TCEs	SMD	-0.74 (-1.09, -0.39)	81.3	Moderate
	Stiffness (WOMAC)	Wuqinxi	MD	-3.43 (-5.50, -1.37)	0	Moderate
	Stiffness (WOMAC)	TCEs	SMD	-0.63 (-1.01, -0.25)	85	Moderate
	Stiffness (WOMAC)	Yijinjing and Wuqinxi	SMD	-0.34 (-0.70, 0.03)	61.6	Moderate
	Stiffness (WOMAC)	TCEs	SMD	-0.35 (-0.55, -0.15)	70.1	Moderate
	Stiffness (WOMAC)	TCEs (>12 weeks)	SMD	-0.29 (-0.57, -0.00)	65.7	Moderate
	Stiffness (WOMAC)	TCEs (>12 weeks)	SMD	-0.43 (-0.74, -0.12)	76.1	Moderate
	Stiffness (WOMAC)	Wuqinxi	SMD	-0.36 (-0.64, -0.08)	64.4	Moderate
	Stiffness (WOMAC/KOOS change)	TCEs (12 weeks)	SMD	-0.66 (-1.07, -0.26)	77.1	Moderate
	6-minute walk test	TCEs	MD	-11.81 (-13.77, -9.85)	0	Moderate
	Timed Up and Go Test	TCEs	WMD	-0.65 (-1.25, -0.04)	87.1	Moderate
	Timed Up and Go Test	TCEs (>12 weeks)	WMD	-0.28 (-0.61, 0.04)	17.1	Moderate
	Timed Up and Go Test	TCEs	SMD	-0.29 (-0.59, 0.01)	55	Moderate
Arthritis						
	Disability (WOMAC)	Tai Chi	SMD	-0.66 (-0.85, -0.46)	0	Moderate
Osteoarthritis						
	Functional aerobic capacity	Tai Chi	Cochran's Q	0.66 (0.23, 1.09)	0	Moderate
	Mental health (SF-36)	TCEs	SMD	0.58 (0.22, 0.95)	68	Moderate
	Pain	Tai Chi	SMD	-0.54 (-0.77, -0.30)	14.5	Moderate
	Pain	Tai Chi (>10 weeks)	SMD	-0.57 (-0.86, -0.27)	36.3	Moderate
	Physical function (SF-36)	TCEs	SMD	0.62 (0.30, 0.94)	57	Moderate
	stiffness (WOMAC)	TCEs	SMD	-0.56 (-0.85, -0.26)	82	Moderate
Osteoarthritis (Hip and knee)						
	Pain	Tai Chi (≤ 5 weeks)	SMD	-0.12 (-0.49, 0.26)	0	Moderate
	Pain	Tai Chi (6-10 weeks)	SMD	-0.50 (-0.83, -0.17)	0	Moderate
	Pain (WOMAC change)	Tai Chi	SMD	-0.45 (-0.70, -0.20)	20.7	Moderate
	Pain (WOMAC change)	Tai Chi (<12 weeks)	SMD	-0.49 (-0.90, -0.08)	0	Moderate
	Pain (WOMAC/KOOS)	Tai Chi	SMD	-0.64 (-0.94, -0.35)	64.4	Moderate
	Pain (WOMAC/KOOS)	Tai Chi	SMD	-0.34 (-0.73, 0.05)	74.8	Moderate
	Physical function (WOMAC change)	Tai Chi	SMD	-0.61 (-0.85, -0.37)	0	Moderate
	Physical function (WOMAC change)	Tai Chi (12 weeks)	SMD	-0.72 (-1.12, -0.31)	36.5	Moderate
	Physical function (WOMAC)	Tai Chi	SMD	0.70 (0.47, 0.93)	0	Moderate
	Physical function (WOMAC/KOOS)	Tai Chi	SMD	-0.74 (-1.09, -0.40)	73.2	Moderate
	Physical function (WOMAC/KOOS)	Tai Chi	SMD	-0.16 (-0.50, 0.18)	66.5	Moderate
	Quality of life (SF-36)	Tai Chi	SMD	0.38 (0.01, 0.75)	29.8	Moderate
	Stiffness (WOMAC change)	Tai Chi (12 weeks)	SMD	-0.47 (-0.83, -0.12)	0	Moderate
	Stiffness (WOMAC stiffness or KOOS symptoms)	Tai Chi	SMD	-0.73 (-1.17, -0.30)	79.6	Moderate
	Timed Up and Go Test	Tai Chi	SMD	-0.57 (-0.82, -0.32)	20.9	Moderate

Figure 4 High-to-moderate-certainty evidence on the effect of traditional Chinese exercise interventions on health outcomes in individuals with arthritis. GRADE, Grading of Recommendations Assessment, Development and Evaluation; KOOS, the Knee injury and Osteoarthritis Outcome Score; MD, mean difference; SF-36, 36-Item Short Form Health Survey; SMD, standard mean difference; TCE, traditional Chinese exercises; VAS, Visual Analogue Scale; WMD, weight mean difference; WOMAC, the Western Ontario and McMaster Universities scale.

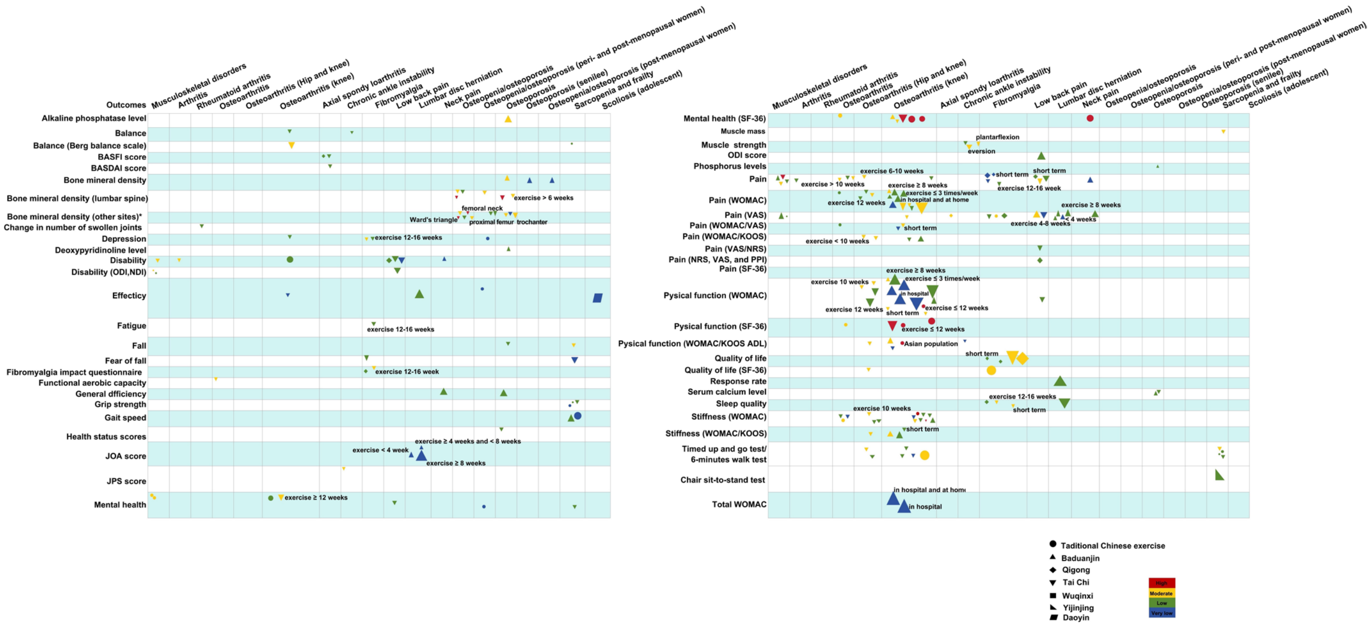


Figure 5 The strength of included meta-analyses evaluating the effect of traditional Chinese exercise interventions on health outcomes in individuals with various musculoskeletal disorders. The size of the circle reflects the magnitude of the random effect sizes with statistically significant results. *Other sites: calcaneus, femoral neck, femur, proximal femur trochanter and Ward's triangle. ADL, activities of daily living; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; BASFI, Bath Ankylosing Spondylitis Functional Index; BASMI, Bath Ankylosing Spondylitis Metrology Index; JOA, Japanese Orthopaedic Association; JPS, joint position sense; KOOS, the Knee injury and Osteoarthritis Outcome Score; NDI, Neck Disability Index; NRS, Numerical Rating Scale; ODI, Oswestry Disability Index; PPI, Present Pain Intensity; SF-36, 36-Item Short Form Health Survey; VAS, Visual Analogue Scale; WOMAC, the Western Ontario and McMaster Universities scale.

95% CI 1.65 to 4.06) scales,[46 47] and mental health on the SF-36 (SMD=2.02, 95% CI 0.83 to 3.22).[47] Tai Chi specifically improved physical function (WOMAC: SMD=−0.56, 95% CI −0.80 to −0.33; SF-36: SMD=3.78, 95% CI 2.30 to 5.27), WOMAC pain (SMD=−0.44, 95% CI −0.63 to −0.24), stiffness (SMD=−0.27, 95% CI −0.43 to −0.11) and mental health (SMD=2.41, 95% CI 0.89 to 3.93).[47 48] Moderate-certainty evidence indicated that TCEs, including Tai Chi and Wuqinxi,[49 50] reduced WOMAC pain and stiffness scores.[46 47 51]

Axial spondyloarthritis

Eight associations were evaluated. Three associations (0.55%) supported by moderate-certainty evidence indicated that TCEs[52] reduced disease activity (MD=−0.72, 95% CI −1.11 to −0.34) and improved spinal mobility (MD=−0.51, 95% CI −0.84 to −0.18), and Qigong provided significant benefits in pain relief (MD=−0.71, 95% CI −0.91 to −0.51) (figure 5; online supplemental figure 4 and online supplemental table 6).

Scoliosis

Only two associations assessed the effect of TCE interventions in adolescents with scoliosis. Moderate-certainty evidence revealed that Daoyin significantly reduced the Cobb angle compared with the control condition (MD=−4.43, 95% CI −5.51 to −3.34) (figure 5; online supplemental figure 4 and online supplemental table 6).

Chronic ankle instability

Of 17 associations, eight (1.5%) were supported by moderate-certainty evidence. This evidence revealed that Tai Chi[53] improved joint position sense in plantarflexion (SMD=−0.60, 95% CI −1.08 to −0.12) and balance (SMD=0.79, 95% CI 0.40 to 1.17) and increased muscle strength in plantarflexion (SMD=0.82, 95% CI 0.34 to 1.29) and eversion (SMD=1.04, 95% CI 0.62 to 1.46) (figure 5; online supplemental figure 5 and online supplemental table 6).

Fibromyalgia

Among 48 associations, one (0.2%) was supported by high-certainty and 10 (1.8%) by moderate-certainty evidence (figure 5; online supplemental figure 6 and online supplemental table 6).

High-certainty evidence demonstrated that TCEs improved sleep quality (MD=−2.23, 95% CI −2.88 to −1.58) in fibromyalgia.[54] The same high-certainty evidence also showed a significant reduction in pain (MD=−2.17, 95% CI −2.73 to −1.61). Moreover, moderate-certainty evidence showed that Tai Chi reduced anxiety/depression symptoms (SMD=−0.25, 95% CI −0.47 to −0.02) and improved quality of life (SMD=−0.61, 95% CI −0.90 to −0.31) and sleep quality (SMD=−0.57, 95% CI −0.86 to −0.28).[55 56] Furthermore, TCEs yielded consistent pain relief (MD=−1.26, 95% CI −1.77 to −0.75), while Qigong specifically showed a marked improvement in quality of life (MD=−9.79, 95% CI −12.89 to −6.68).[57]

Low back pain

79 associations were examined. Seven associations (1.3%) with moderate-certainty evidence indicated that TCEs (SMD=−1.13, 95% CI −1.52 to −0.74),[42] including Tai Chi and Baduanjin,[40 58] effectively reduced pain, improved disability (SMD=−0.77, 95% CI −1.39 to −0.15)[59] and increased treatment response rates in older patients[60] (OR=4.92, 95% CI 2.89 to 8.39) (figure 5; online supplemental figure 7 and online supplemental table 6).

Neck pain

Of 22 associations, one (0.2%) was supported by high-certainty and 15 (2.7%) by moderate-certainty evidence. High-certainty evidence substantiated that TCEs improved mental health (MD=3.37, 95% CI 0.50 to 6.24).[61] Moderate-certainty evidence supported that TCEs[62] reduced pain (SMD=0.81, 95% CI 0.50 to 1.13) with sustained effects at follow-up (SMD=0.69, 95% CI 0.39 to 1.00) (figure 5; online supplemental figure 8 and online supplemental table 6).

Osteopenia or osteoporosis

77 associations were assessed. High-certainty associations demonstrated that Tai Chi significantly enhanced BMD at multiple weight-bearing sites. These clinical benefits were observed in Ward's triangle (MD=0.04 g/cm², 95% CI 0.02 to 0.06) and the femoral neck (MD=0.02 g/cm², 95% CI 0.00 to 0.04),[63] alongside consistent gains in lumbar spine BMD in post-menopausal women (MD=0.04 g/cm², 95% CI 0.02 to 0.06).[64] 20 moderate-certainty associations[42 65 66] (3.7%) further indicated benefits on femoral neck and trochanter BMD, lumbar spine BMD in perimenopausal women and pain relief (figure 5; online supplemental figure 9 and online supplemental table 6).

Sarcopenia and frailty

59 associations (10.8%) were identified, with 23 (4.2%) supported by moderate-certainty evidence (figure 5; online supplemental figure 10 and online supplemental table 6). This evidence confirmed that TCEs, particularly Yijinjing, improved physical performance (6 min walk test: WMD=0.31, 95% CI 0.28 to 0.33; squatting-to-standing test: WMD=2.58, 95% CI 2.12 to 3.05),[67] enhanced grip strength (Hedges'g=0.32, 95% CI 0 to 0.64) and knee muscle strength[68] and reduced fall rates (MD=−0.41, 95% CI −0.64 to −0.17) in older adults with sarcopenia or frailty.[69]

Subgroup analyses

Pre-specified subgroup analyses by exercise duration, frequency and volume revealed consistent patterns (online supplemental tables 7–9, online supplemental figures 11–13).

For knee osteoarthritis, both TCEs and Tai Chi produced large improvements in physical function and pain relief (SMD frequently ≥0.8), particularly when implemented with long-duration intervention (>6 months) or delivered at higher frequency (≥3 sessions/week). Even short-term interventions (≤3 months) and low-frequency (1–2 sessions/week) or low-volume (< 150 min/week) prescriptions consistently yielded significant, clinically meaningful effects (SMD: 0.27–0.50), reaffirming that TCEs can improve symptoms rapidly when appropriately prescribed. Medium-to-high exercise volume further enhanced joint mobility and reduced pain, with improvements suggesting potentially clinically meaningful benefits on WOMAC and SF-36.

For osteopenia and osteoporosis, Tai Chi exhibited small-to-moderate increases in bolstering lumbar-spine and femoral neck BMD, supported by high certainty according to GRADE. Although absolute changes were modest, benefits were more pronounced with regular, moderate-to-high volume and sustained exercise, consistent with the physiological time course of bone remodelling.

In neck pain and fibromyalgia, TCEs and Tai Chi produced moderate-to-large improvements in mental health and sleep quality (SMD: 0.5–0.8), again with high-certainty evidence, even over shorter intervention periods. Large effects (SMD: −0.93) were observed even over shorter intervention periods for spinal pain, while higher-frequency exercise amplified psychological benefits, suggesting rapid responsiveness of mental and sleep-related outcomes to TCE-based interventions.

Overall, these findings demonstrated that while TCEs are beneficial across a range of conditions and programme formats, greater clinical gains generally occur with adequate frequency (≥3 sessions/week) and moderate-to-high exercise volume (≥150 min/week), with long-duration interventions providing the most sustained improvements.

Sensitivity analyses

Sensitivity analyses confirmed the robustness of the primary findings (online supplemental tables 10–12). Excluding small-sized studies or those with a high risk of bias did not materially change the effect estimates or GRADE ratings for the majority of associations. The stability of results under these alternative assumptions strengthens confidence in the main conclusions.

DISCUSSION

This UR, synthesising evidence from 92 meta-analyses encompassing 547 unique associations, provides the highest-level evidence to date regarding the efficacy of TCEs for MSDs. Our findings robustly demonstrate that TCEs are supported by high-certainty or moderate-certainty evidence for improving a constellation of patient-centred outcomes across specific MSDs. Notably, we established high-certainty evidence for significant improvements in physical function and mental health in knee osteoarthritis, enhanced sleep quality in fibromyalgia and mental health benefits in neck pain. Furthermore, Tai Chi specifically confers high-certainty benefits for increasing BMD in osteopenia/osteoporosis and provides effective relief for pain and stiffness across multiple conditions, including knee osteoarthritis. These results advocate for a nuanced, evidence-based prescription strategy: shorter-term/lower-volume TCE programmes can establish a low entry threshold for rapid symptomatic relief and foster initial adherence, while sustained, adequately dosed interventions are paramount for optimising long-term functional recovery, musculoskeletal integrity and psychological well-being.

TCEs are philosophically grounded in the holistic principles of TCM, which emphasise harmonising body and mind, regulating the flow of Qi and enhancing intrinsic resilience.[70] This theoretical framework aims to harmonise movement with stillness, regulate physiological function and enhance the body's innate resilience.[71] Our findings lend robust, contemporary scientific support to these historical principles. For instance, Chinese clinical guidelines already endorse TCEs for knee osteoarthritis management,[72] and our UR provides high-certainty evidence confirming their efficacy for improving physical function (WOMAC and SF-36) in this condition. The observed benefits likely arise from a multimechanistic synergy: the slow, controlled movements enhance lower-limb strength, balance and proprioception through neuromuscular adaptation[73 74]; concurrently, the meditative and breathing components may attenuate systemic inflammation (eg, reducing TNF-α, IL-6) and modulate stress responses, contributing to pain reduction and functional improvement.[75 76]

TCEs confer significant psychosocial benefits, which observational studies attribute to reduced social isolation in community settings.[77 78] This UR advances the field by providing high-certainty evidence that these benefits extend to clinical populations, demonstrating improved mental health in knee osteoarthritis and neck pain and enhanced sleep quality in fibromyalgia. Robust RCTs confirm that specific modalities, including Tai Chi, Baduanjin and Yijinjing, alleviate stress, anxiety and depressive symptoms.[79] These psychological gains are synergistic with concurrent improvements in physical self-awareness and control, such as enhanced proprioception and postural stability-key targets in degenerative joint disease.[80 81] The mechanistic basis for this dual benefit lies in the integrated mind-body framework of TCEs, which regulates the autonomic nervous system to promote relaxation and reduce stress hormones,[82] while meditative components may strengthen emotional regulation.[83] For sleep, TCEs are hypothesised to modulate sleep-wake neural circuits,[84 85] with studies confirming improvements in both subjective and objective sleep parameters.[86 87] Fibromyalgia exemplifies the clinical value of this holistic action, as guidelines recommend TCEs like Tai Chi for sleep improvement, leveraging their gentle, sustainable nature to promote long-term adherence.[88 89] Future research should define optimal prescription parameters for such conditions.

Tai Chi exemplifies the strengths of TCEs, combining safety, adaptability and accessibility for older adults and chronic patients.[71 90] Our high-certainty evidence validates its strong guideline recommendations for knee osteoarthritis and fibromyalgia,[91 92] confirming substantial benefits for pain relief across MSDs and for improving BMD in osteopenia/osteoporosis. Its clinical value is enhanced by practical advantages: compared with education, it offers quicker pain relief and higher adherence in knee osteoarthritis; compared with aerobic exercise, it provides superior symptom improvement in fibromyalgia.[93 94] Its efficacy in chronic low back pain is also guideline-aligned.[95] Mechanistically, Tai Chi promotes anabolic bone metabolism, evidenced by increased BMD and favourable changes in bone turnover markers,[96] underpinning its endorsement in endocrinology guidelines.[97] Critically, our subgroup analyses indicate its maximal functional and skeletal benefits are dose-dependent, requiring sustained practice for optimal outcomes.

TCEs represent a widely practised yet underused component of global healthcare, with integration often hindered by uncertainties regarding their efficacy and safety.[98 99] This UR provides high-level evidence confirming the scientific validity and multidimensional benefits of TCEs for MSDs. Unlike conventional exercise, TCEs simultaneously improve physical function, pain, mental health and sleep quality in chronic MSDs. The demonstrated moderate-to-large effects support the integration of TCEs into standard management to complement rehabilitation, reduce pharmacological reliance and promote self-management. Their safety and adaptability make them particularly suitable for osteoarthritis and osteoporosis, while their psychological benefits extend utility to complex conditions like fibromyalgia. From a public health perspective, TCEs are scalable, cost-effective interventions. Their cultural acceptability, minimal resource needs and suitability for community delivery position them as strategic tools for healthy ageing initiatives and chronic disease prevention in diverse populations. In summary, this synthesis provides the evidence base for healthcare systems and policymakers to recognise TCEs as evidence-based, multimodal therapies. The next step is developing implementation strategies—including training, certification and financing—to translate this evidence into accessible, routine care.

To our knowledge, this UR is the first to summarise and present the existing evidence of the effect of TCEs across a wide spectrum of health-related outcomes in patients with MSDs from RCTs. It also systematically and thoroughly identifies the gaps and uncertainties in the current evidence base. Rigorous criteria were applied to assess the methodological quality and GRADE level of the included meta-analyses. Furthermore, sensitivity analyses of excluded meta-analyses on the same topic indicated that most evidence hierarchies remained consistent. By comprehensively integrating a broad range of published studies, this UR provided a robust foundation for clinicians and public health policymakers to develop improved strategies and policies.

Despite the robust evidence, several limitations and research gaps persist. First, our UR is inherently limited by the scope and quality of the underlying meta-analyses. While the inclusion of the most recent evidence was sought, it is possible that some newly published primary RCTs were not captured in the included SRMAs. However, our assessment of duplicate meta-analyses focusing on similar associations indicated that this is unlikely to significantly impact our overall findings (online supplemental table 12). Second, while we assessed methodological quality (AMSTAR) and evidence certainty (GRADE), substantial heterogeneity was observed in many associations, likely stemming from variations in participant characteristics, intervention protocols (type, dose and duration) and outcome measures. Third, our ability to perform detailed subgroup analyses by factors such as disease severity, ethnicity or sex was constrained by the lack of reported data in the original meta-analyses. This limits nuanced clinical guidance for specific patient subpopulations. Fourth, although the overall body of evidence is large, some associations were informed by a small number of studies, potentially limiting the power to detect publication bias or small-study effects. Furthermore, many of the primary RCTs included in these meta-analyses had small sample sizes and only observed patients over a short-term follow-up period. To robustly validate and extend the effects of TCEs, future research should prioritise large-scale, multicentre RCTs with long-term follow-up. Head-to-head trials comparing different TCE modalities, standardised dose-response studies and investigations in diverse global populations are also needed to strengthen the evidence base and support broader implementation.

CONCLUSION

In conclusion, this comprehensive UR provides a definitive, high-level evidence synthesis supporting TCEs as effective interventions for a range of MSDs. The evidence, particularly for Tai Chi, reaches high certainty for improving key outcomes such as physical function in knee osteoarthritis, mental health in neck pain, sleep in fibromyalgia and bone density in osteopenia/osteoporosis. These findings argue for their formal inclusion in clinical guidelines and rehabilitation programmes worldwide. TCEs represent a safe, accessible and cost-effective strategy that can complement conventional therapies, reduce pharmacological reliance and empower patients in self-management. For healthcare systems and policymakers, promoting the adoption of TCEs, particularly in community and primary care settings, could be a strategic component of public health initiatives aimed at healthy ageing and chronic disease prevention. Future research should focus on addressing the identified evidence gaps, particularly regarding optimal prescription parameters and long-term sustainability of benefits.

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Author note The authors affirm that the manuscript is an honest, accurate and transparent account of the study being reported, that no important aspects of the study have been omitted and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

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