



Tuina for chronic non-specific low back pain: A systematic review and meta-analysis of randomized controlled trials

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ABSTRACT

Chronic non-specific low back pain (cNLBP) is a pervasive and debilitating condition with significant personal, societal, and economic burdens. Despite its prevalence, effective and sustainable non-pharmacological treatment options remain limited. Here, we compared the efficacy of Tuina versus non-Tuina interventions in adults with cNLBP. PubMed, EMBASE, Web of Science, Cochrane Library, CNKI, CBM, WanFang, and VIP were searched from inception to April 2025. The Cochrane Risk of Bias tool and the GRADE approach were applied to assess risk of bias and certainty of evidence. Twenty-one trials (1612 participants) were included. Compared with control interventions, Tuina showed greater pain reduction (SMD = -1.06, 95% CI: [-1.37, -0.76], $p < 0.00001$, GRADE: low), better functional improvement (SMD = -1.17, 95% CI: [-1.62, -0.72], $p < 0.00001$, GRADE: low), and superior clinical effectiveness (OR = 3.84, 95% CI: [2.42, 6.11], $p < 0.00001$, GRADE: low). No significant differences were found in muscle fitness (SMD = 1.42, 95% CI: [-0.00, 2.83], $p = 0.05$, GRADE: very low) or incidence of serious adverse events. Tuina effectively treats cNLBP, offering substantial pain relief and functional improvements, though it has no significant impact on muscle fitness. Future work should consider standardized protocols and more rigorously designed trials to support clinical recommendations. This study has been registered with the PROSPERO platform (registration no. CRD420251051014).

1. Introduction

Chronic non-specific low back pain (cNLBP) is a common clinical condition where patients experience low back pain alongside weakness, stiffness, and reduced activity coordination.¹ This stems from abnormal core lumbar muscle biomechanics, leading to muscle wasting, atrophy, and subsequent losses in local strength and spinal stability.² Affecting up to 84% of people during their lifetime, with only around 30% recovering spontaneously, cNLBP ranks among the most prevalent and disabling global diseases.^{3,4} Beyond threatening patients' physical and mental health, it escalates healthcare costs, imposing significant burdens on individuals, families, and society.⁵

Given the high prevalence of cNLBP and its profound clinical impact, identifying safe and effective treatment strategies is critical. Current management options include pharmacotherapy, traditional Chinese medicine, such as Tuina and acupuncture, and rehabilitation exercises. The American College of Physicians guidelines stress that

nonpharmacological interventions should serve as first-line treatment for chronic pain.⁶ Recently, there has been a growing emphasis on nonpharmacological approaches to activate the body's innate defenses and regenerative capacities, promoting long-term physical and mental well-being. Among these, Tuina, characterized by its "even, gentle, sustained, and powerful" manipulative techniques, has gained traction. Tuina involves skilled manual therapy using hands, elbows, knees, or tools to apply specific techniques (e.g., pushing, grasping, pressing, kneading, pinching, tapping) to targeted body surfaces or acupoints. As a nonpharmacological intervention for cNLBP, research on Tuina has expanded, revealing dual mechanisms: it ameliorates muscle atrophy, safeguards spinal cord neurons, and facilitates sciatic nerve repair via suppression of the p38 MAPK inflammatory signaling pathway.⁷ Additionally, in terms of modulating biomechanical structure, its press-extension maneuver facilitates anterior closure of the central nucleus pulposus, augmenting anterior pressure and normalizing intervertebral disc stress—a pivotal factor in pain alleviation.⁸ By addressing

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both inflammation and muscle atrophy,^{9,10} Tuina offers a safe, effective modality increasingly integrated into cNLBP rehabilitation.

While numerous prior studies have explored Tuina for cNLBP, most were limited in informativeness due to small sample sizes and incomplete evidence synthesis. To our knowledge, no research has yet examined the benefits of different Tuina treatment durations for cNLBP patients. This study aims to fill this gap by conducting a systematic review and meta-analysis to comprehensively evaluate the efficacy of Tuina therapy, including varied treatment courses, hoping to provide valuable insights for future research and clinical strategies. We adhered to Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guidelines (PRISMA 2020),¹¹ as detailed in the [Supplementary material 1](#). This study has been registered with the PROSPERO platform (registration no. CRD420251051014).

2. Information and methodology

2.1. Inclusion and exclusion criteria

2.1.1. Inclusion criteria

(1) Study design: Randomized controlled trials (RCTs). (2) Participants: Patients diagnosed with cNLBP, regardless of gender or age. (3) Interventions: Experimental group: Tuina alone or Tuina added to the control intervention. Control group: Conventional non-Tuina rehabilitation, including but not limited to: physical therapy (ultrasound, TENS), conventional exercise therapy (core stability training, McKenzie therapy), health education, non-steroidal anti-inflammatory drugs, and other non-Tuina intervention measures. (4) Outcome measures: Pain (measured by Numerical Rating Scale [NRS] or Visual Analog Scale [VAS]), disability (evaluated using Oswestry Disability Index [ODI] or Roland-Morris Disability Questionnaire [RMDQ]), muscle fitness (assessed via dorsal extensor strength tests or psoas endurance tests), clinical efficacy (assessed via overall efficacy rate), or adverse events (to evaluate Tuina safety).

2.1.2. Exclusion criteria

Exclusion criteria were as follow: (1) Non-randomized studies (e.g., literature reviews, animal experiments, case reports, retrospective/observational clinical studies, conference abstracts, editorials, protocols). (2) Studies lacking a non-Tuina control group (e.g., comparisons of Tuina + core stabilization training vs. Tuina alone do not qualify as non-Tuina controls). (3) Duplicate publications. (4) Studies that did not report or allow extraction of data on pain, disability, and muscle function relevant to this review, or those with unavailable full text. (5) Studies involving participants with low back pain of less than 12 weeks' duration or caused by a specific etiology (including pregnancy, fracture, tumor, infection, or radiculopathy).

2.2. Search strategy

Relevant studies were identified through systematic searches of international and Chinese databases. International databases included PubMed, EMBASE, Web of Science, and the Cochrane Library, while Chinese databases comprised China National Knowledge Infrastructure (CNKI), China Biomedical Literature Database (C BM), WanFang Data, and VIP. Search strategies combined MeSH terms and free-text keywords, including "tuina", "Chinese massage", "manipulation", "low back pain", "chronic non-specific low back pain", "chronic pain", "randomized controlled trial", and "clinical trial". No language restrictions were imposed to minimize selection bias, allowing inclusion of studies in all languages. Reference lists of included studies were manually screened to identify additional relevant trials. The primary search formula was: ((massage) OR (tuina) OR (manipulation)) AND ((low back pain) OR (chronic non-specific low back pain))

2.3. Literature screening

Two researchers (HB, XHH) independently assessed eligibility of studies. For studies published in Chinese, both reviewers were native Chinese speakers fluent in English and with expertise in medical terminology. They independently translated the relevant information into English before extraction. Initial screening was conducted using EndNote 21 software, based on titles and abstracts; full texts of potentially relevant studies were then reviewed to determine inclusion, strictly following the predefined criteria. After screening, the two reviewers cross-checked results. Disagreements were resolved by a third researcher (DMM) through arbitration. This process ensured the accuracy and consistency of data sourced from non-English publications.

2.4. Data extraction

Extracted data included: authors, year of publication, patient age, sample sizes (experimental vs. control groups), intervention details, intervention duration, and outcome measures. Outcomes for analysis were pain, disability, muscle function, clinical efficacy, and adverse events in cNLBP patients. Considering the possibility of substantial clinical and methodological heterogeneity among the included studies, we conducted pre-specified subgroup analyses to explore potential sources of heterogeneity. For the outcomes of pain, disability, and muscle fitness, subgroup analyses were stratified based on the following clinical characteristics: (1) treatment duration (2–4 weeks, 6–8 weeks, and 12 weeks); (2) intervention regimen (Tuina alone versus non-Tuina controls, and Tuina as an add-on therapy versus the active treatment alone); and (3) type of control intervention, categorized as exercise therapy, physical passive therapy, acupuncture, or NSAIDs. For the outcome of overall effectiveness rate, subgroup analyses were conducted according to the different assessment criteria used across studies. Outcome data (event counts/total cases or raw data as mean $\pm$ standard deviation) were extracted and synthesized to statistically analyze Tuina's effects on these outcomes. Non-normally distributed data [median (Q1, Q3)] were converted using the method described by McGrath et al. via the tool available at <https://smcgrath.shinyapps.io/estmeansd/>, ensuring data uniformity across included studies. Besides, two included studies were three-arm randomized controlled trials. To avoid unit-of-analysis errors (double-counting of control group participants), we followed the methods described by Liu¹² and recommended by the *Cochrane Handbook*¹³ to handle these multi-arm trials: (1) For multiple experimental arms with similar interventions (Tuina alone and Tuina as add-on), we combined them into a single experimental group before comparing with the control group. (2) For subgroup analyses by intervention regimen that required separate comparisons of each experimental arm (Ning, 2016), we split the shared control group into two approximately equal groups. The sample size of the control group was divided evenly, while its means and standard deviations were kept unchanged, to ensure the independence of each comparison. Primary outcomes are pain and disability, and secondary outcomes are muscle fitness, clinical efficacy and adverse events.

2.5. Risk of Bias assessment

Methodological quality was independently evaluated and cross-checked by two researchers (MPP, CYM) using the Cochrane Risk of Bias tool (Version 5.1.0) from the *Cochrane Handbook*.¹⁴ Assessments included: random sequence generation, allocation concealment, blinding (of participants, investigators, and outcome assessors), completeness of outcome indicators, selective reporting, and other biases. Disagreements between the two reviewers were resolved by consulting a third researcher (DMM) until consensus was reached.

2.6. Assessment of evidence quality

Evidence quality for each outcome measure was rated using GRADE pro Guideline Development Tool (GDT). Since included studies were RCTs, their initial evidence quality was rated as high. However, evidence quality was downgraded based on the included studies' risk of bias, inconsistency, indirectness, imprecision, and publication bias, with final ratings categorized as "high," "moderate," "low," or "very low".¹⁵

2.7. Statistical analysis

Analyses were performed using Review Manager 5.4 (<https://www.cochranelibrary.com>), a Cochrane Collaboration tool. Post-treatment scores (means and standard deviations) of the Tuina and control groups as the primary effect size for the meta-analysis. A fixed-effects model was applied where heterogeneity was small to moderate ($p > 0.1$ and $I^2 \leq 50\%$); a random-effects model was used for substantial heterogeneity ($p \leq 0.1$ and $I^2 > 50\%$). For substantial heterogeneity, sensitivity or subgroup analyses were conducted to identify its source. Sensitivity analyses (leave-one-out) were performed using Stata 18 (<https://www.stata.com/stata18/>), and Egger's test was used to further assess small-study effects. Count data were synthesized using odds ratio (OR), while continuous variables were synthesized using standardized mean difference (SMD) as effect sizes due to variations in assessment tools and units, with their 95% confidence interval (CI) calculated. A significance level of $\alpha = 0.05$ was applied, with 95% CI computed for all outcomes.

3. Results

3.1. Literature search results

Database searches identified 2338 Chinese records and 1103 English records, totaling 3441 records. After removing duplicates using EndNote 21, 2460 records remained. Preliminary screening of titles and abstracts narrowed this to 202 records, and full-text review ultimately resulted in the inclusion of 21 studies (19 Chinese, 2 non-Chinese). The screening process is depicted in Fig. 1.

3.2. Baseline characteristics of included studies

A total of 21 studies, encompassing 1612 patients, were included, with publication years spanning 2012–2024. Treatment durations ranged from 2 to 12 weeks. All studies employed a randomized controlled trial design: 19 publications used a two-arm parallel group design, and the remaining 2^{16,17} used a three-arm parallel group design. 5 publications^{16–20} included follow-up assessments at 1–3 months. The baseline characteristics of the included publications are summarized in Table 1.

3.3. Quality assessment results of included studies

All 21 included studies used random number tables for randomization. 7 studies^{18–21,24,27,34} employed opaque envelopes for allocation concealment; the remaining 14 did not describe allocation concealment methods. Regarding blinding: 2 studies^{27,34} did not blind participants or intervention personnel; the remaining 19 did not describe participant or personnel blinding. 2 studies^{18,36} blinded outcome assessors. 12 studies^{16–22,24,27,33–35} had complete outcome data. All studies showed no selective reporting (low risk). 19 studies^{16–21,23–34,36} had unclear risk of

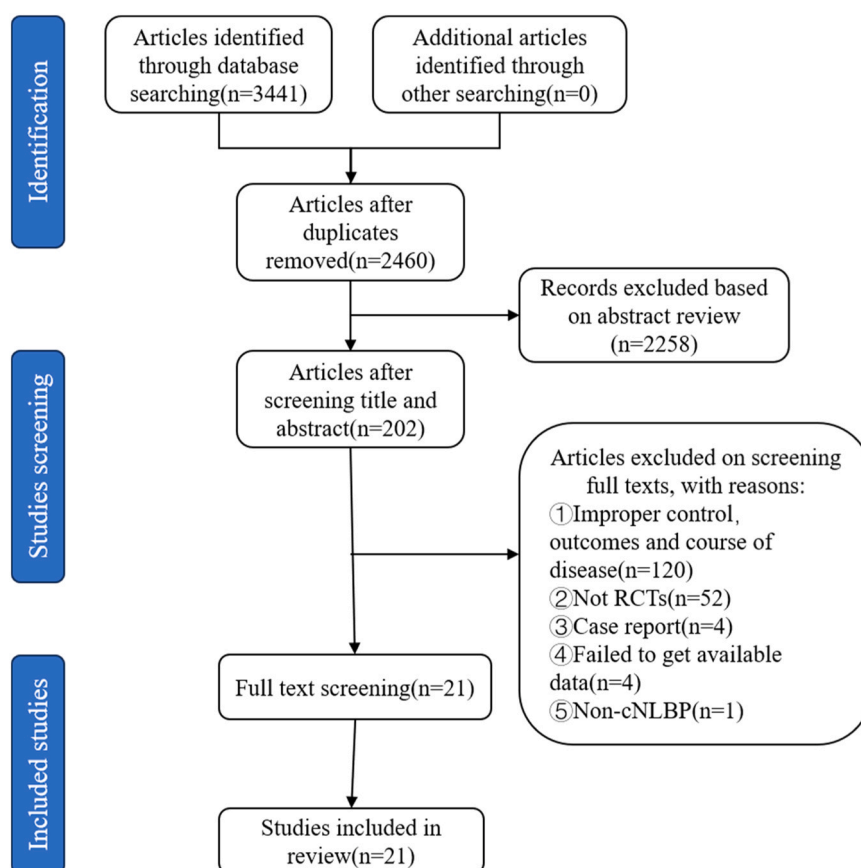


Fig. 1. Literature screening flowchart.

Table 1
Characteristics of the included studies.

Study	Sample number	Groups	n	Age	Duration	Outcomes	Follow-up interval
Zheng et al., 2012 ²¹	60	Exp: Tuina + lumbar traction Con: Lumbar traction	Exp: 30 Con: 30	Exp: 43 ± 15 Con: 42 ± 15	20 min, twice/week, 3 weeks	1)VAS	NM
Cheng, 2023 ²²	57	Exp: Tuina Con: Extracorporeal shock wave therapy	Exp: 29 Con: 28	Exp: 40.00 ± 2.45 Con: 39.55 ± 2.34	once/3 days, 5 times	1)VAS; 2)RMDQ; 3)Clinical efficacy	NM
Fan, 2022 ²³	80	Exp: Tuina + acupuncture Con: Acupuncture	Exp: 40 Con: 40	Exp: 48.34 ± 2.37 Con: 48.37 ± 2.35	30 min, 5 times/week, 4 weeks	1)VAS; 3)ODI	NM
Feng, 2020 ²⁴	57	Exp: Tuina + core stability training Con: Core stability training	Exp: 29 Con: 28	Exp: 38.31 ± 11.41 Con: 37.51 ± 11.06	5 times/week, 2 weeks	1)VAS; 2)RMDQ; 3)Clinical efficacy	NM
Jia et al., 2020 ¹⁸	60	Exp: Tuina Con: Acupuncture + infrared radiation	Exp: 30 Con: 30	Exp: 50.15 ± 10.35 Con: 52.34 ± 11.63	6 times within 4-week period	1)NRS; 2)ODI	1 month
Li et al., 2022 ²⁵	126	Exp: Tuina Con: Swiss ball	Exp: 63 Con: 63	Exp: 38.95 ± 6.21 Con: 39.10 ± 6.18	once/day, 6 weeks	1)VAS; 2)ODI; 3)Clinical efficacy	NM
Li, 2023 ²⁶	60	Exp: Tuina + acupuncture Con: Naproxen	Exp: 30 Con: 30	Exp: 44.51 ± 3.65 Con: 44.02 ± 3.43	Exp: 6 times/week, 3 weeks Con: 3 times/day, 3 weeks	1) VAS; 2)ODI	NM
Jia, 2023 ²⁷	67	Exp: Tuina Con: Rehabilitation	Exp: 34 Con: 33	Exp: 51.76 ± 4.53 Con: 51.00 ± 3.60	once every other day, 3 times/session, 2 sessions	1)VAS; 2)ODI; 3)Clinical efficacy	NM
Lin, 2020 ²⁸	120	Exp: Tuina Con: Routine exercise	Exp: 60 Con: 60	Exp: 42.43 ± 17.54 Con: 42.34 ± 16.35	30 min, once/day, 1 month	1)Clinical efficacy	NM
Lin et al., 2022 ²⁹	90	Exp: Tuina + acupuncture Con: Acupuncture	Exp: 45 Con: 45	Exp: 51.67 ± 8.36 Con: 50.56 ± 7.90	5 times/week, 3 weeks	1)VAS; 2)ODI; 3)Clinical efficacy	NM
Liu et al., 2018 ³⁰	80	Exp: Tuina + acupuncture Con: Acupuncture	Exp: 40 Con: 40	Exp: 45.6 ± 3.80 Con: 45.9 ± 3.40	20 min, once/day, 3 months	1)VAS; 2)ODI; 3)Back Extensor Strength Test	NM
Xu et al., 2022 ²⁰	80	Exp: Tuina + breathing training Con: Routine rehabilitation	Exp: 40 Con: 40	Exp: 49.10 ± 8.03 Con: 48.81 ± 7.94	5 times/week, 3 weeks	1)VAS	3 months
Ning, 2016 ¹⁶	60	Exp1: Tuina Exp2: Tuina + core stability training Con: Core stability training	Exp1: 20 Exp2: 20 Con: 20	Exp1: 40.81 ± 7.51 Exp2: 41.05 ± 6.98 Con: 40.93 ± 7.62	3 times/week, 12 weeks	1)VAS; 2)ODI; 3)Lumbar Muscular Endurance; 4)Clinical efficacy	3 months
Sun et al., 2015 ¹⁹	92	Exp: Tuina + sling training Con: Celebrex	Exp: 44 Con: 48	Exp: 41.21 ± 6.49 Con: 39.43 ± 6.49	Exp: twice/week, 4 weeks Con: once/day, 4 weeks	1)VAS; 2)ODI	3 months
Wang, 2018 ³¹	60	Exp: Tuina Con: TDP + acupuncture	Exp: 30 Con: 30	Exp: 38.80 ± 13.73 Con: 41.23 ± 12.02	once every other day, 7 times/session, 2 sessions	1)VAS; 2)ODI; 3)Clinical efficacy	NM
Wang et al., 2020 ³²	64	Exp: Tuina Con: Acupuncture	Exp: 32 Con: 32	Exp: 44.23 ± 4.12 Con: 42.62 ± 3.24	5 times/week, 2 weeks	1)VAS; 2)Clinical efficacy	NM
Wang et al., 2022 ³³	92	Exp: Tuina + Fu's Subcutaneous Needling Con: Diclofenac Sodium Sustained Release Tablets	Exp: 46 Con: 46	Exp: 50.83 ± 7.14 Con: 50.16 ± 7.39	Exp: twice/week, 4 weeks Con: once/day, 4 weeks	1)VAS; 2)Clinical efficacy	NM

(continued on next page)

Table 1 (continued)

Study	Sample number	Groups	n	Age	Duration	Outcomes	Follow-up interval
Yao, 2023 ³⁴	65	Exp: Tuina + ultramicro acupotomy Con: Exercise therapy + fascia knife	Exp: 33 Con: 32	Exp: 38.24 ± 7.69 Con: 35.09 ± 8.58	once every other day, 3 times/session, 2 sessions	1)VAS; 2)RMDQ	NM
Yao et al., 2020 ³⁵	61	Exp: Tuina + exercise Con: Medium-frequency electrotherapy + exercise	Exp: 31 Con: 30	Exp: 33.80 ± 9.40 Con: 33.40 ± 6.70	Exp: Tuina: once every other day, 7 times. Exercise: once/day, 14 days Con: once/day, 14 days	1)VAS; 2)ODI; 3)Lumbar Muscle Endurance; 4)Clinical efficacy	NM
Yu, 2019 ¹⁷	81	Con: Exercise Exp1: Tuina + acupuncture Exp2: Exercise + Tuina + acupuncture	Con: 27 Exp1: 27 Exp2: 27	Con: 32.74 ± 6.55 Exp1: 33.48 ± 6.11 Exp2: 32.70 ± 6.83	3 times/week, 4 weeks	1)VAS; 2)ODI; 3)Back Extensor Strength Test	3 months
Liu et al., 2024 ³⁶	100	Exp: Tuina Con: Routine rehabilitation	Exp: 50 Con: 50	Exp: 41.03 ± 2.33 Con: 41.21 ± 2.45	twice/week, 8 weeks	1)VAS; 2)NRS; 3)RMDQ; 4)ODI; 5) Back Extension Strength; 6)Clinical efficacy	NM

Note: Exp: experimental group. Con: control group. TDP: Thermal Design Power. VAS: Visual Analog Scale. NRS: Numerical Rating Scale. ODI: Oswestry Disability Index. RMDQ: Roland Morris Disability Questionnaire. NM: not mentioned.

other biases due to unreported conflicts of interest. Detailed risk of bias assessment results for included studies is presented in Fig. 2.

3.4. Meta-analysis

3.4.1. Pain

20 studies evaluated Tuina’s effect on pain levels in cNLBP patients: 18 used the VAS,^{16,18–27,29–35} 1 used the NRS,¹⁸ and 1 used both measures.³⁶ Effect sizes were pooled using SMD. Heterogeneity was high ($I^2 = 87\%$, $p < 0.00001$), so a random-effects model was applied. The result (Fig. 3) showed that Tuina was more effective than non-Tuina control interventions in reducing pain [SMD = -1.06, 95% CI (-1.37, -0.76), $p < 0.00001$].

Subgroups were categorized by treatment duration, intervention regimen and control types. The subgroup analysis based on treatment duration (Fig. 4) revealed that pain relief efficacy increased with longer treatment, suggesting a stable cumulative effect that may enhance clinical value in extended regimens. Nevertheless, only long-term treatment [SMD = -2.64, 95% CI (-3.89, -1.39), $p < 0.0001$] approached the minimal clinically important difference (MCID) threshold of 2.5.^{37,38} Besides, the test for subgroup differences indicated that neither intervention regimen nor control types significantly influenced the pooled effect size (subgroup differences of intervention regimen: $p = 0.78$; control types: $p = 0.39$), suggesting that these variables were not the primary sources of heterogeneity (Supplementary material 2).

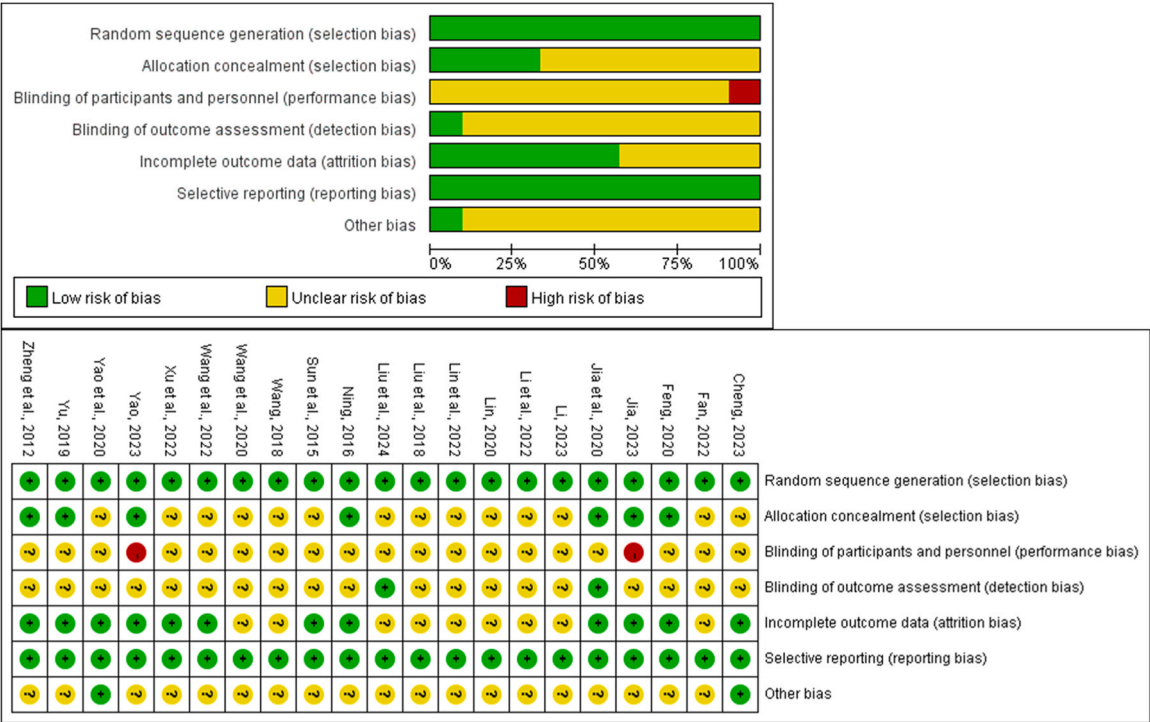


Fig. 2. Risk-of-bias graph and summary.

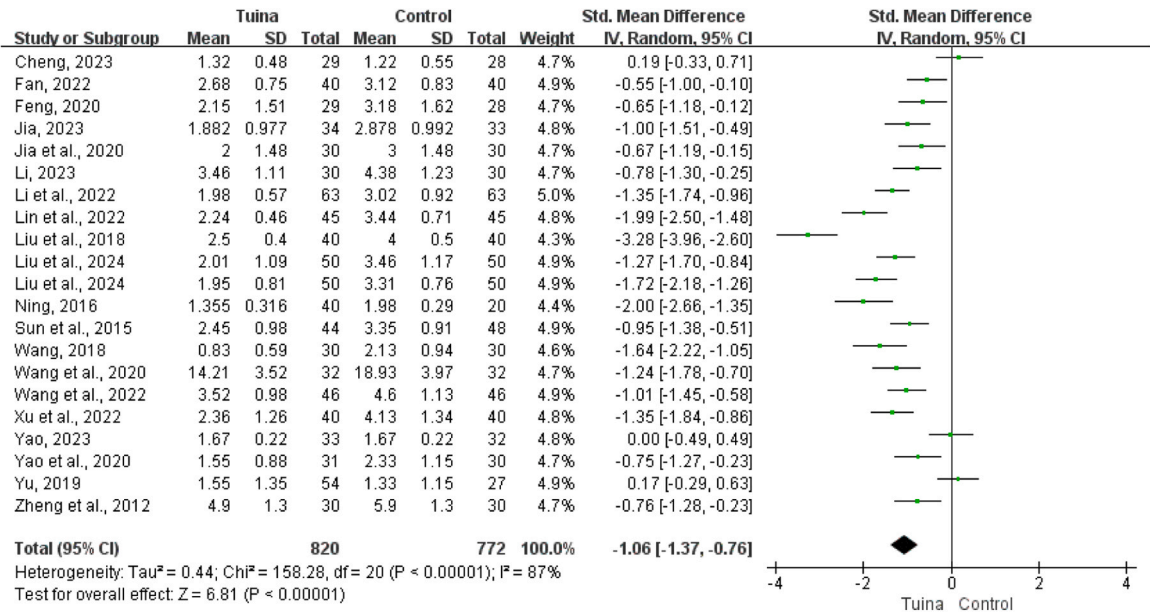


Fig. 3. Forest plot for outcome pain.

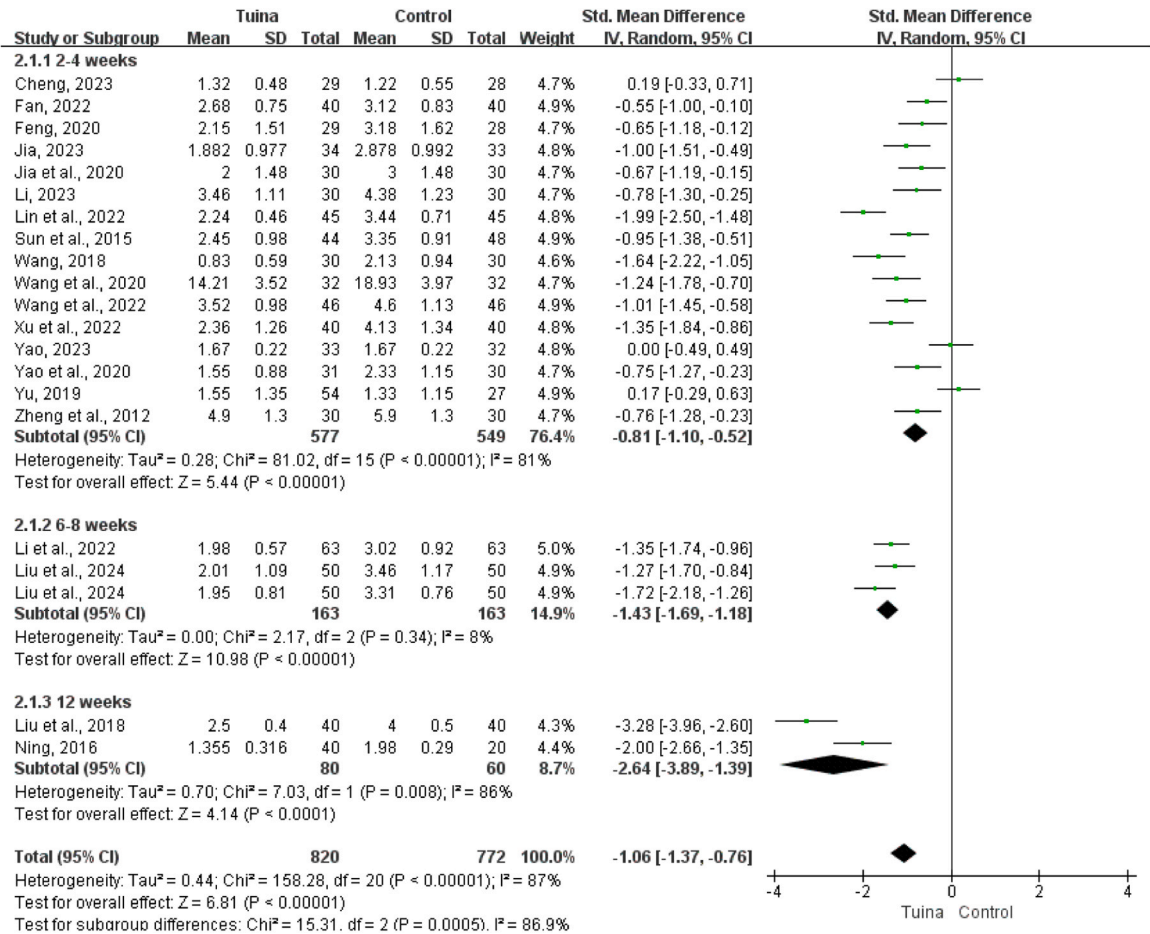


Fig. 4. Forest plot for outcome pain—subgroup of treatment duration.

3.4.2. Disability

16 studies evaluated the effect of Tuina on disability in patients with cNLBP. Among these, 12 studies^{16–19,23,25–27,29–31,35} used the ODI, 3 studies^{22,24,34} recorded changes via the RMDQ, and 1 study³⁶ employed

both measures. SMD was used as the effect size metric for pooling results. Heterogeneity testing revealed substantial variability across studies ($I^2 = 92\%$, $p < 0.00001$), prompting the use of a random-effects model (Fig. 5). Meta-analysis results demonstrated that Tuina

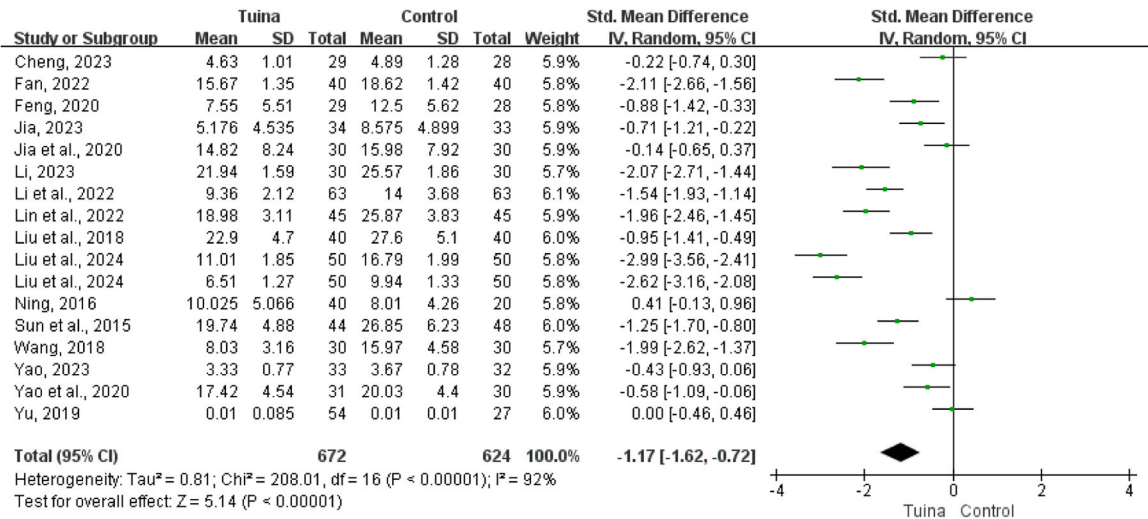


Fig. 5. Forest plot for outcome disability.

significantly improved disability compared with conventional treatment [$SMD = -1.17$, 95% CI $(-1.62, -0.72)$, $p < 0.00001$].

To delve deeper into the origins of heterogeneity, we carried out subgroup analyses for the disability outcome, taking into account factors such as treatment duration, intervention regimen, and control types. The subgroup analyses stratified by treatment duration (Fig. 6) showed that short- and medium-term Tuina significantly reduced disability scores, whereas long-term Tuina did not differ significantly from conventional treatment [$SMD = -0.28$, 95% CI $(-1.61, 1.06)$, $p = 0.69$]. Neither group reached the MCID threshold of 10.^{38–40} Regarding intervention regimen, the test for subgroup differences revealed no significant effect

($p = 0.76$), indicating that the type of regimen was not a major contributor to heterogeneity. However, control type appeared to be a possible source of heterogeneity (p for subgroup differences = 0.04; $I^2 = 62.8\%$). Among these comparisons, the Tuina versus physical passive therapy subgroup exhibited the largest effect size ($SMD = 1.94$). Nevertheless, this finding should be interpreted with caution, as it was derived from only two studies (Supplementary material 2).

3.4.3. Lumbar muscle fitness

5 studies assessed lumbar muscle fitness in cNLBP patients after Tuina therapy: three^{17,30,36} reported dorsal extensor strength test

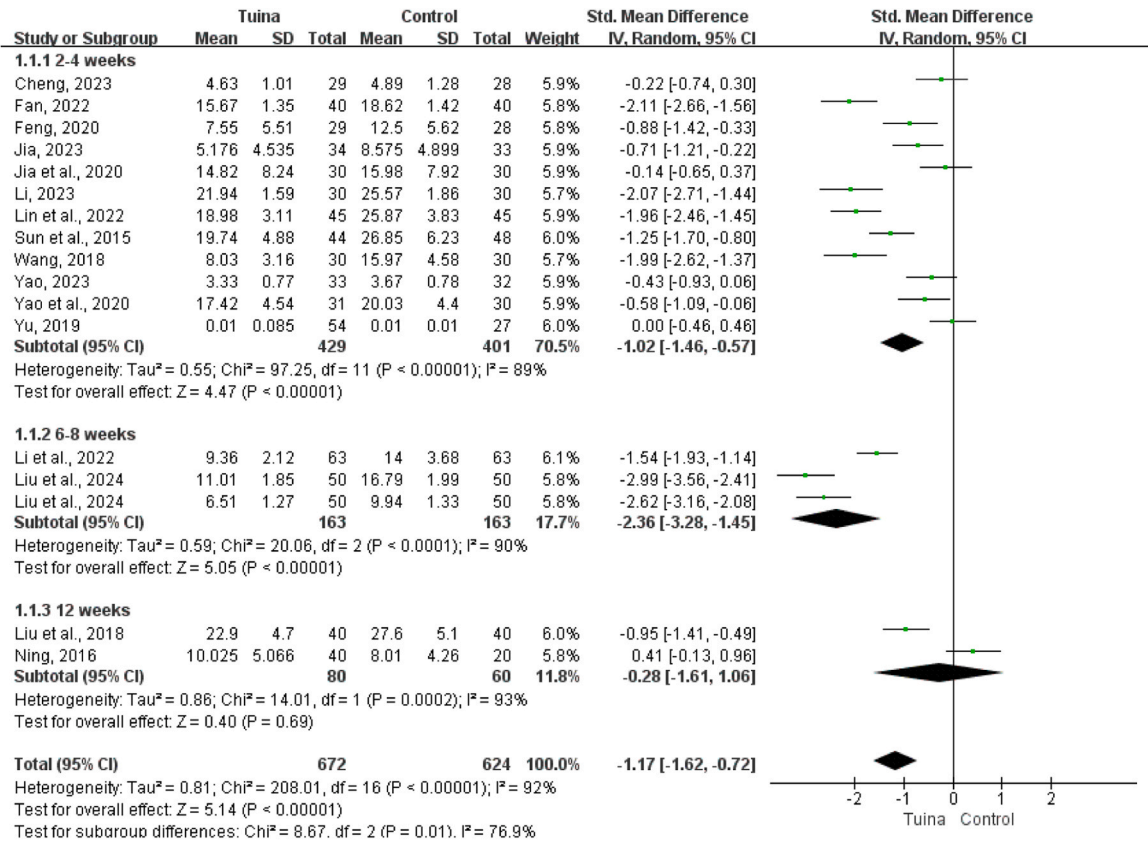


Fig. 6. Forest plot for outcome disability—subgroup of treatment duration.

results, and two^{16,35} used psoas endurance tests. SMD was used for pooling effects.

Heterogeneity was substantial ($I^2 = 97\%$, $p < 0.00001$), so a random-effects model was applied (Fig. 7). Overall, Tuina showed no significant difference from conventional treatment in improving lumbar muscle fitness [SMD = 1.42, 95% CI (-0.00, 2.83), $p = 0.05$].

In the treatment duration subgroup (Fig. 8), a single study assessed that Tuina significantly enhanced lumbar muscle fitness compared to conventional treatment in the medium-term subgroup [SMD = 3.22, 95% CI (2.62, 3.82), $p < 0.00001$]. Although the effect size appears substantial, the evidence is limited by the small number of included studies. Subgroup analysis based on intervention regimen did not identify regimen as a major source of heterogeneity (p for subgroup differences = 0.89). Unlike the subgroup analysis based on intervention regimen, the analysis stratified by control types revealed a significant subgroup difference ($p < 0.00001$), suggesting that the type of control intervention may be a potential source of heterogeneity for muscular fitness outcomes. However, given the limited number of included studies in this analysis ($n = 5$), this finding should be interpreted with caution, and further large-scale studies are warranted to validate these results (Supplementary material 2).

3.4.4. Overall effectiveness assessment

11 studies reported overall effectiveness rates. 7 studies^{16,25,27,29,31,32,34} used the *Diagnostic efficacy of standard TCM Syndrome* to assess clinical efficacy; 2 studies^{28,36} relied on clinician evaluations of symptoms (e.g., pain, lumbar function, straight-leg raise test); one study³³ referenced the *Clinical Guiding Principles for New Chinese Medicines*; and one study²⁴ used VAS score reduction rates.

These 11 studies included 897 patients, with outcomes analyzed as dichotomous variables. In the experimental group, 433 of 460 participants (94.13%) achieved effectiveness; in the control group, 355 of 437 participants (81.24%) did so.

Studies showed good homogeneity ($p = 0.96$, $I^2=0\%$), so a fixed-effects model was used for meta-analysis. Results indicated that Tuina significantly increased the total effectiveness rate compared to the control group, with a statistically significant difference [OR= 3.84, 95% CI (2.42, 6.11)].

The test for subgroup differences (Fig. 9) indicates that there is no statistically significant subgroup effect ($p = 0.87$), suggesting that different efficacy definitions do not modify the effect of Tuina in comparison to non-Tuina. Although the subgroup using the VAS reduction rate showed a non-significant result ($p = 0.07$), this finding was derived from a single study, precluding definitive conclusions and thus does not undermine the robustness of the primary finding that Tuina significantly improves the overall clinical effective rate compared to non-Tuina interventions.

3.4.5. Adverse events

7 studies^{16–18,22,24,29,34} assessed safety. Due to substantial variability in adverse event definitions across studies, data were synthesized descriptively. 5 studies^{17,18,22,29,34} reported no significant adverse events in either group. One study²⁴ noted 1 patient with increased lumbar pain and limited flexion-extension after core stability training,

which resolved with rest. Another study¹⁶ reported 2 cNLBP patients with exacerbated pain after initial core strength training; they continued treatment following pain relief with basic measures. Overall, none of the seven studies reported Tuina-related adverse events.

3.5. Sensitivity analysis

Given heterogeneity in pain, disability, and muscle function outcomes, sensitivity analyses (leave-one-out) were performed to explore heterogeneity sources. Sequential exclusion of each study showed stable effect sizes, which remained within the original 95% CI (Figs. 10–12), indicating robust and reliable meta-analysis conclusions.

3.6. Publication Bias assessment

Publication bias was evaluated via Egger’s test for four outcomes: pain, disability, muscle fitness and total effectiveness rate. Results (Table 2) showed no small-study effects for pain ($p = 0.177$), disability ($p = 0.26$), or muscle function ($p = 0.069$). However, the total effectiveness rate ($p = 0.036$) indicated potential publication bias. To assess the impact of publication bias on the pooled effect size, we performed a trim-and-fill analysis. The pooled OR before trim-and-fill was 1.427 (95% CI: 0.945, 1.909, $p < 0.0001$); after trim-and-fill with two studies imputed, the adjusted pooled OR was 3.784 (95% CI: 2.391, 5.989, $p < 0.0001$). Although this substantial change suggests the presence of publication bias, the direction of the effect remained consistent, and the statistically significant benefit of Tuina over non-Tuina was preserved (Fig. 13).

3.7. Evidence quality

Evidence quality was rated from low to very low due to risk of bias, inconsistency, imprecision, and publication bias in included trials (Table 3). Although the analysis for muscle fitness met the Optimal Information Size (OIS, $n = 60$), its 95%CI crossed the line of no effect (-0.00–2.83), indicating insufficient robustness of the result for clinical decision. Therefore, the downgrade for imprecision was maintained. Indirectness did not result in downgrading of any outcomes.

4. Discussion

4.1. Evidence summary

Our meta-analysis synthesized data from 21 studies involving 1612 participants. Findings provide key insights into the efficacy of Tuina for pain, disability, and muscle fitness in patients with cNLBP.

Pain-related effect sizes ranged from -0.76 to -1.37, and disability-related effect sizes from -0.72 to -1.62, confirming Tuina’s positive effects in reducing pain and disability. Subgroup analyses demonstrated that Tuina intervention duration significantly influenced pain relief in cNLBP patients: pain relief effect sizes increased with longer interventions, with the 12-week Tuina effect size approaching the 2.5 MCID threshold. This suggests that extended Tuina interventions may optimize pain relief. Although the analysis results further validate the

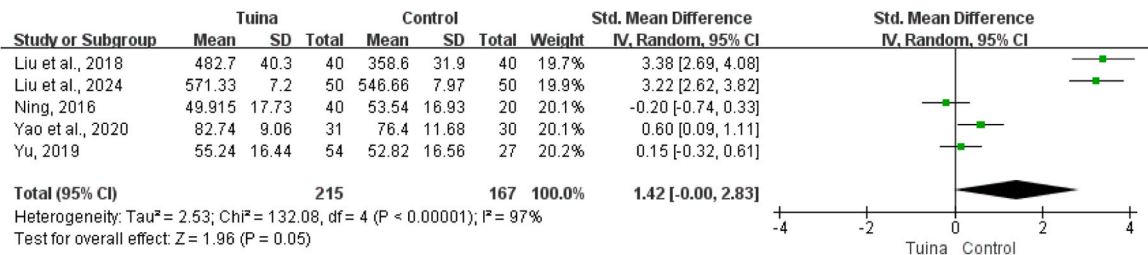


Fig. 7. Forest plot for outcome muscle fitness.

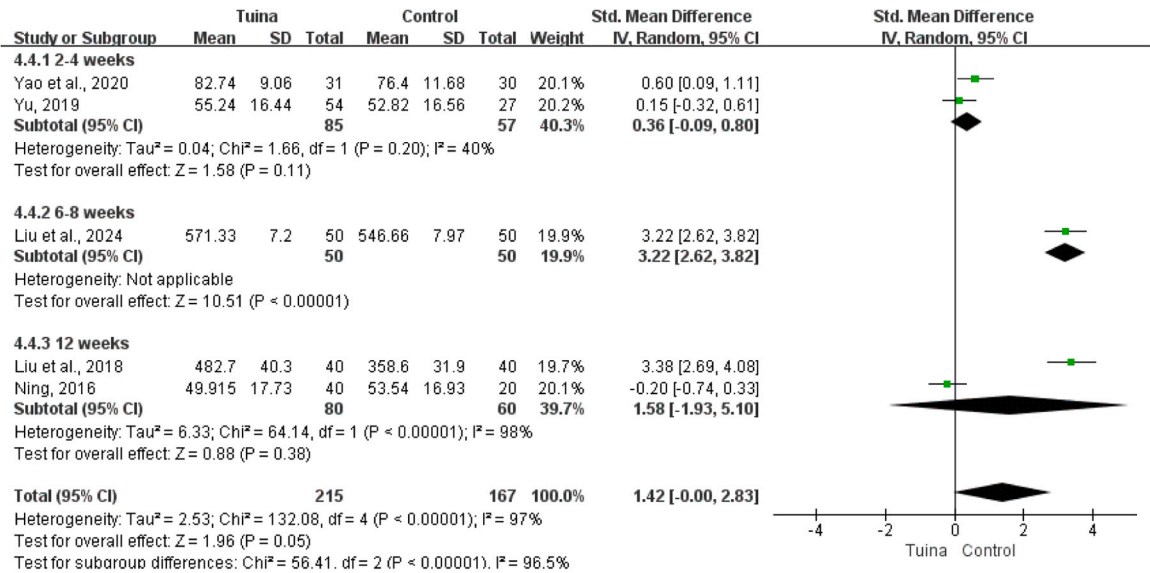


Fig. 8. Forest plot for outcome muscle fitness—subgroup of treatment duration.

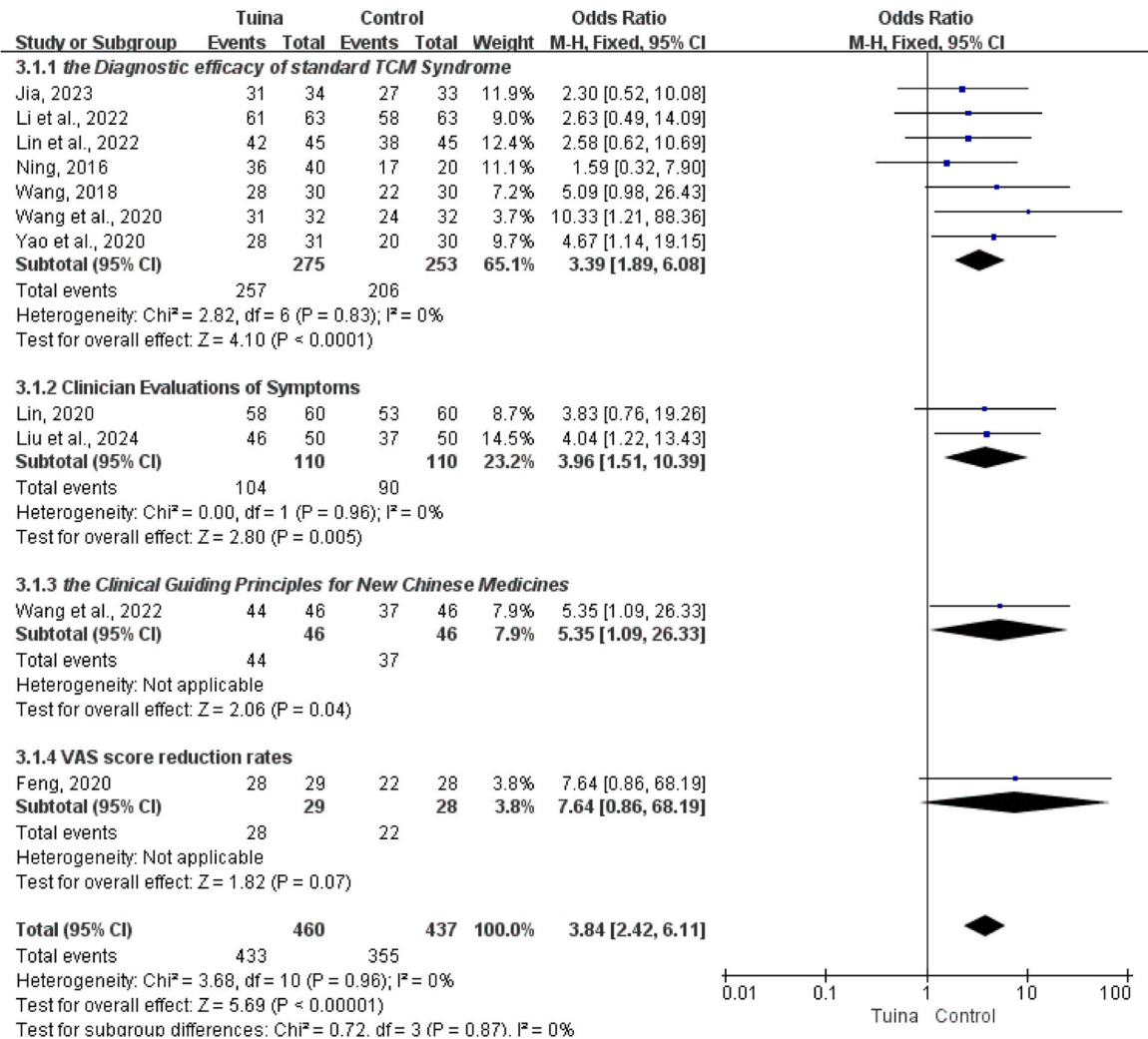


Fig. 9. Forest plot for outcome overall effectiveness.

effectiveness of Tuina in diverse application scenarios, they do not shed light on the sources of heterogeneity. The subgroup analyses based on

intervention regimen and control type did not reveal statistically significant differences ($p > 0.05$ for subgroup differences), suggesting that

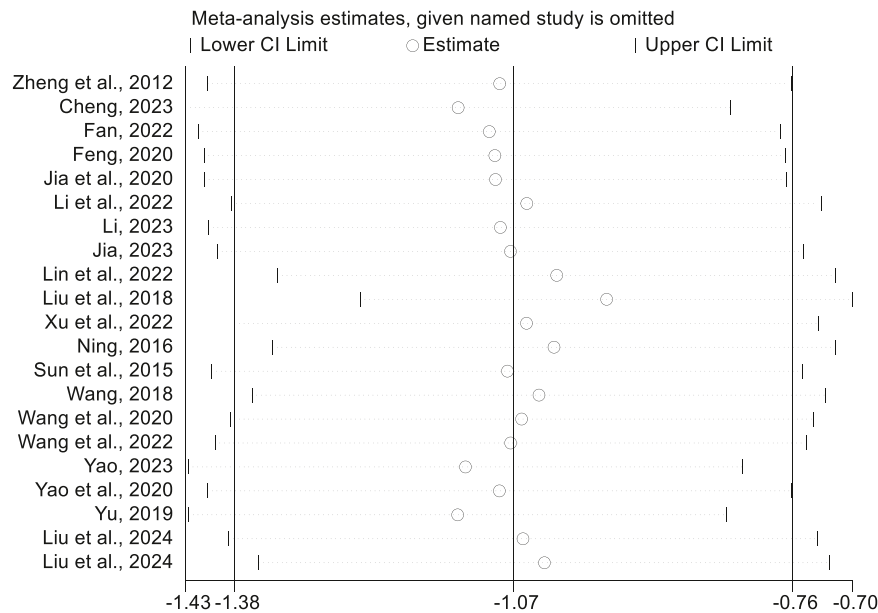


Fig. 10. Sensitivity analyses of pain after Tuina for cNLBP.

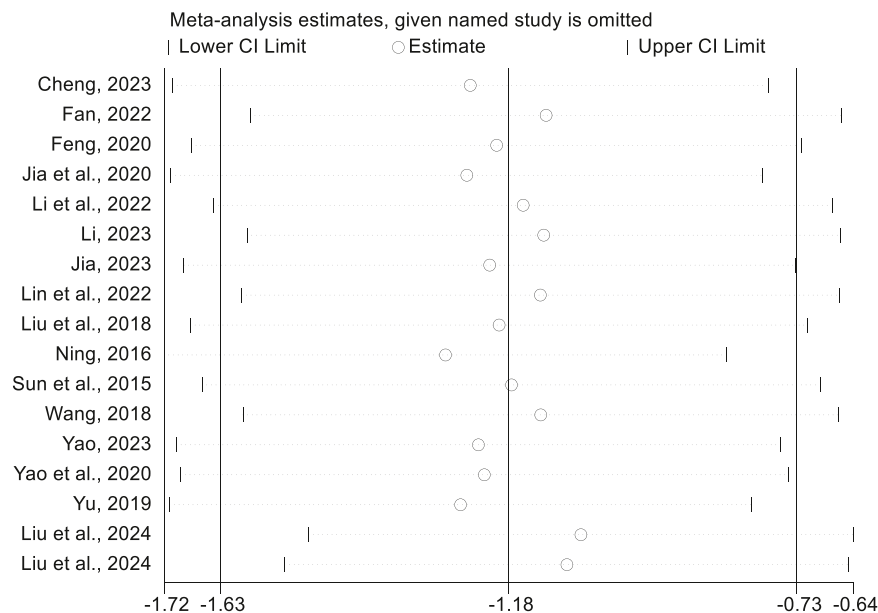


Fig. 11. Sensitivity analyses of disability after Tuina for cNLBP.

other clinical factors, such as variations in Tuina techniques and differences in patients' baseline characteristics, may play a more significant role in contributing to the heterogeneity observed in the pain and disability outcomes. Notably, pain and disability evidence was of low quality, highlighting the need for more rigorous subgroup studies. Disability outcomes differed slightly from pain: short-term treatment (2–4 weeks) showed an effect size of -1.02 , while medium-term treatment (6–8 weeks) yielded more significant disability improvements ($SMD=-2.36$). In contrast, long-term Tuina showed no significant difference from conventional treatments, potentially due to several factors. First, lifestyle and environmental factors influence treatment outcomes:^{41,42} short-term adherence improvements reduce pain, but long-term regression of these factors to baseline may diminish efficacy. Second, Tuina, a passive intervention with mild skin stimulation, has limited efficacy for disability. The potential symptomatic relief from Tuina, mediated through enhanced local circulation, reduced muscle

tension, and anti-inflammatory effects,^{7–10} must be considered within the pathophysiology of chronic low back pain. This condition is frequently associated with persistent muscle deactivation, atrophy of the multifidus and psoas major, and fatty infiltration—structural alterations that may be irreversible without sustained active rehabilitation.^{2,3} Consequently, notwithstanding its local effects, Tuina's ability to improve functional outcomes is likely limited unless it can effectively reactivate neuromuscular control and reverse muscular atrophy. Watanabe et al.⁴³ reported that while all 12 participants receiving mild mechanical stimulation showed reduced VAS scores, only 8 of 12 demonstrated improved joint mobility, suggesting mild stimulation alleviates pain more effectively than disability. This may similarly explain our muscle fitness findings: despite medium-term Tuina advantages, its effect on improving lumbar muscle function did not differ from conventional treatments. Lasting improvements in muscular fitness typically require active, progressive resistance training to induce adaptive

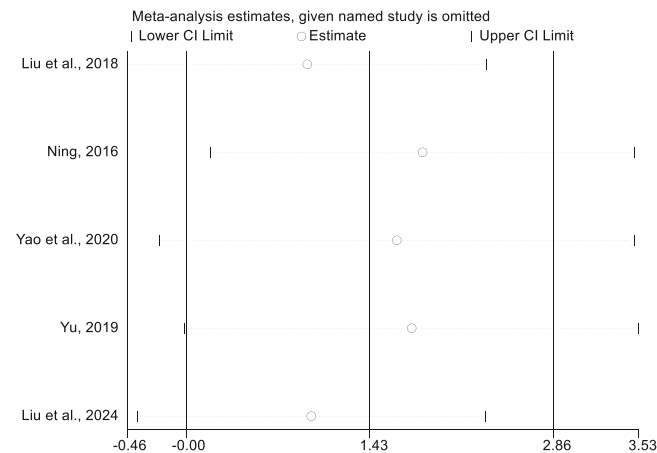


Fig. 12. Sensitivity analyses of muscle fitness after Tuina for cNLBP.

Table 2
Result of Egger test.

Outcomes	Study number	Sample size	Analysis model	Egger test	
				t	p
Pain	20	1592	Random effect	-1.40	0.177
Disability	16	1296	Random effect	-1.17	0.260
Muscle function	5	382	Random effect	2.77	0.069
Clinical efficacy	11	897	Fixed effect	2.47	0.036

changes in muscles.⁴⁴ As a passive treatment, Tuina may produce immediate effects by relieving muscle tension, improving local blood circulation, and alleviating delayed-onset muscle soreness after exercise.⁴⁵ In the subgroup analysis stratified by control type, Tuina appeared to be more effective than both physical passive therapy and acupuncture in improving muscular fitness in patients with cNLBP. However, these findings should be interpreted with extreme caution, as each of these subgroup comparisons was based on only one study. Therefore, further high-quality research is warranted to validate these preliminary results. The extremely low quality of muscle function evidence underscores the need for high-quality randomized controlled trials (RCTs) to evaluate Tuina's impact on muscle fitness in cNLBP patients.

Overall effectiveness outcomes showed effect sizes of 2.42–6.11,

suggesting Tuina benefits cNLBP. Nonetheless, the definition of overall effectiveness varied greatly across studies, using criteria like TCM syndrome scores and VAS reduction rates, introducing clinical heterogeneity. Subgroup analysis found no significant effect size differences, indicating consistent Tuina benefits despite non-standard definitions, adding robustness to the pooled estimate. Yet, evidence quality was low due to bias risks and publication bias. The lack of a core outcome set for cNLBP also limits the field. Thus, clinical efficacy findings should be interpreted cautiously.

Included RCTs reported few, mild adverse events, consistent with previous review.^{46,47} However, prior studies have identified headaches, syncope, hematoma, and fractures following Tuina.⁴⁸ Despite their low incidence, Tuina practitioners should fully inform patients of potential risks and closely monitor for adverse events.

4.2. Comparison with other literature

Kong et al.⁴⁹ demonstrated that TCM integrative therapies incorporating Tuina reduced pain (SMD=0.91) and disability (SMD=1.64) in patients with low back pain, consistent with our findings on Tuina efficacy. However, only one of the studies included by Kong et al. reported long-term effects of Tuina combined with acupuncture, leaving long-term effect data limited. A prior systematic review examining Tuina's impact on pain, disability, and quality of life concluded that Tuina may reduce pain and disability but showed no significant effect on quality of life, attributed to wide confidence intervals and uncertain validity.⁴⁶ Our analysis, which includes several new studies, yields more robust and sometimes differing conclusions. For example, we identified a strong association between Tuina's pain-relieving effect and treatment duration: 12-week Tuina approached the 2.5 MCID threshold, and short-to medium-term durations significantly reduced disability. In contrast, Yang et al.'s systematic review⁴⁶ reported smaller effect sizes (pain: 0.83; disability: 0.91) than observed in our study.

Furthermore, our focus on Tuina's effects on lumbar muscle fitness represents a novel contribution not addressed in other systematic reviews or meta-analyses. Patients with cNLBP typically exhibit muscle atrophy, resulting in reduced lumbar muscle fitness. As a core indicator of musculoskeletal functional status, improving muscle fitness is clinically critical for cNLBP rehabilitation. Previous research has shown that physical activity to enhance muscle fitness aids in low back pain prevention,^{50,51} and comprehensive exercise programs combining strength, flexibility, and aerobic training benefit cNLBP rehabilitation.^{52,53} Increased core muscle strength supports the lumbar spine, while improved back muscle, tendon, and ligament flexibility enhances range

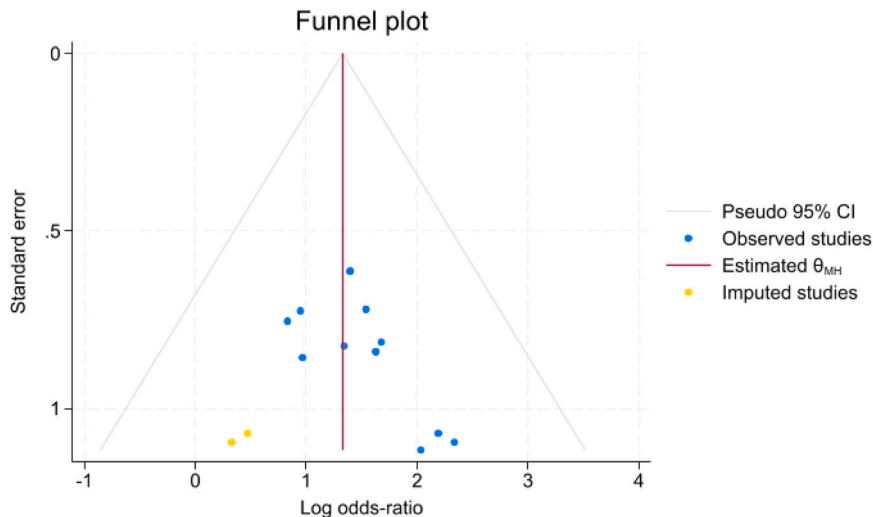


Fig. 13. Funnel plot after trim-and-fill.

Table 3
GRADE evaluation of Tuina for patients with chronic nonspecific low back pain.

Outcomes	Number of literatures	Evidence Quality Assessment					Simple Size		Effect Size	Evidence Level
		Bias Risk	Inconsistency	Indirectness	Imprecision	Publication Bias	Tuina	Control		
Pain scores-time	20	Serious ^a	Serious ^b	Not serious	Not serious	Not serious	820	772	SMD = -1.06,95% CI(-1.37, -0.76)	⊕⊕○○ low ^{a,b}
Pain scores-intervention	20	Serious ^a	Serious ^b	Not serious	Not serious	Not serious	820	772	SMD = -1.09,95% CI(-1.39, -0.79)	⊕⊕○○ low ^{a,b}
Pain scores-control types	20	Serious ^a	Serious ^b	Not serious	Not serious	Not serious	820	772	SMD = -1.06,95% CI(-1.37, -0.76)	⊕⊕○○ low ^{a,b}
Disability scores-time	16	Serious ^a	Serious ^b	Not serious	Not serious	Not serious	672	624	SMD = -1.17,95% CI(-1.62, -0.72)	⊕⊕○○ low ^{a,b}
Disability scores-intervention	16	Serious ^a	Serious ^b	Not serious	Not serious	Not serious	672	624	SMD = -1.10,95% CI(-1.53, -0.66)	⊕⊕○○ low ^{a,b}
Disability scores-control types	16	Serious ^a	Serious ^b	Not serious	Not serious	Not serious	672	624	SMD = -1.17,95% CI(-1.62, -0.72)	⊕⊕○○ low ^{a,b}
Muscle fitness-time	5	Serious ^a	Serious ^b	Not serious	Serious ^c	Not serious	215	167	SMD = 1.42,95% CI (-0.00, 2.83)	⊕○○○ Very low ^{a,b,c}
Muscle fitness-intervention	5	Serious ^a	Serious ^b	Not serious	Serious ^c	Not serious	215	167	SMD = 1.16,95% CI (-0.13, 2.45)	⊕○○○ Very low ^{a,b,c}
Muscle fitness-control types	5	Serious ^a	Serious ^b	Not serious	Serious ^c	Not serious	215	167	SMD = 1.42,95% CI (-0.00, 2.83)	⊕○○○ Very low ^{a,b,c}
Clinical efficacy-definition	11	Serious ^a	Not serious	Not serious	Not serious	Serious ^d	433/460 (94.1%)	355/437 (81.2%)	OR = 3.84,95% CI (2.42, 6.11)	⊕⊕○○ low ^{a,d}

CI: Confidence interval; OR: Odds ratio; SMD: Standardized mean difference
^a > 30% RCT have missing hidden grouping
^b I² statistics > 50%
^c Wide confidence interval
^d Small-study effects

of motion and functional mobility.^{54,55} Similar to exercise, Tuina is thought to enhance lumbar muscle strength and relieve soft tissue tension.⁵⁶ However, our meta-analysis of muscle fitness revealed no statistically significant difference between Tuina and other conventional rehabilitation treatments in this regard. This finding is likely limited by the small number of included studies and low-quality evidence, but it does not negate potential benefits of Tuina for lumbar muscle fitness in cNLBP patients.

4.3. Limitations and implications for future research

This review has several limitations that warrant consideration. First, marked variability in intervention protocols across included studies constrains the interpretation of results. Despite subgroup analyses stratifying by Tuina duration, intervention regimen and control types, variations in specific techniques (e.g., type, intensity, frequency) likely contributed to the high heterogeneity observed in this meta-analysis. Documenting such details would enhance the assessment of Tuina efficacy, yet few studies reported these parameters. Second, evidence quality was downgraded to “low” due to methodological limitations, including inadequate reporting of blinding in most studies, and extreme heterogeneity. While subgroup analyses reduced heterogeneity for some outcomes, residual variability persisted, reflecting the challenges of synthesizing highly diverse interventions. Consequently, pooled effect sizes should be interpreted with caution. Additionally, gray literature was not searched, leaving unresolved whether completed but unpublished trials exist; thus, potential publication bias cannot be fully excluded. The predominance of studies from China may introduce regional publication bias, limiting the generalizability of findings.

Given the complexity introduced by multiple variables and potential interactions, several directions for future research are proposed: First of all, standardization of Tuina protocols. Future research should prioritize

investigating different Tuina manipulation, intervention parameters (e.g., frequency, intensity, duration), and patient populations. Tuina encompasses diverse manipulation, including compression-type (vertical pressing with retention), oscillatory-type (rolling), friction-type (smooth tendon-pushing or surface-stroking), percussive-type (elastic rhythmic striking), and vibratory-type (high-frequency, low-amplitude vibration).⁵⁷ To ensure its efficacy and safety, developing standardized, evidence-based guidelines and establishing uniform training programs are critical, including systematic standardization of key parameters such as intensity, frequency, and duration. The most important thing is strengthening the evidence base. The evidence supporting Tuina’s efficacy and safety in cNLBP patients requires enhancement through larger sample sizes, longer follow-up periods, and more rigorous study designs. Additionally, greater attention to muscle fitness and cost-effectiveness analyses is needed to generate high-quality evidence that can inform clinical practice and healthcare policy.

4.4. Clinical implications

This review suggests that Tuina may offer advantages over conventional interventions for patients with cNLBP. Thus, Tuina may be considered a viable non-pharmacological intervention for this population.

Additionally, findings indicate that Tuina exerts positive effects on pain and disability in cNLBP patients. Notably, long-term Tuina (12 weeks) demonstrates particular efficacy, supporting its use for relieving persistent pain. This suggests clinicians may consider extending treatment duration as appropriate to optimize pain relief in patients with cNLBP.

Despite the low certainty of evidence, this review offers valuable guidance for future research on Tuina as a therapeutic intervention for cNLBP.

5. Conclusions

Overall, Tuina improves outcomes in cNLBP, particularly in pain relief and disability improvement, with optimal effects observed in medium- to long-term interventions. However, insufficient evidence supports significant improvements in lumbar muscle function with Tuina compared to conventional rehabilitation. Standardized treatment protocols and additional high-quality RCTs are required to further validate Tuina's efficacy and safety.

CRedit authorship contribution statement

Weilu Li: Investigation. **Liang Peng:** Project administration, Conceptualization. **Yimin Chen:** Methodology, Formal analysis. **Panpan Mu:** Methodology, Formal analysis. **Haihua Xie:** Writing – review & editing, Software, Data curation. **Miaomiao Duan:** Supervision, Methodology. **Bo Huang:** Writing – review & editing, Writing – original draft, Software, Investigation, Data curation, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT (OpenAI) in order to improve the readability and language of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ctim.2026.103381](https://doi.org/10.1016/j.ctim.2026.103381).

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