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SYNTHESIZING THE EVIDENCE ON MANUAL THERAPY FOR CHRONIC NON-SPECIFIC LOW BACK PAIN: AN UMBRELLA REVIEW AND META-ANALYSIS

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ABSTRACT

Background: *Chronic non-specific low back pain (CNSLBP) is one of the leading causes of disability worldwide and remains a major musculoskeletal health burden. Manual therapy is widely used in rehabilitation; however, uncertainty remains regarding its long-term effectiveness and clinical superiority over active rehabilitation approaches.*

Objective: *To synthesize and quantitatively evaluate the effectiveness of manual therapy interventions in individuals with chronic non-specific low back pain through an umbrella review and meta-analysis.*

Methods: *An umbrella review and meta-analysis were conducted according to PRISMA 2020 guidelines. Electronic databases including PubMed/MEDLINE, Scopus, PEDro, Cochrane Library, and Web of Science were searched from January 2000 to March 2026. Systematic reviews, meta-analyses, and randomized controlled trials evaluating manual therapy interventions in adults with CNSLBP were included. Random-effects meta-analysis was performed using Review Manager (RevMan 5.4). Pooled standardized mean differences (SMD) with 95% confidence intervals (CI) were calculated for pain intensity and functional disability outcomes.*

Results: *A total of 21 systematic reviews and meta-analyses involving approximately 35,000 participants were included in the umbrella review, while 38 randomized controlled trials were included in the quantitative meta-analysis. Quantitative synthesis demonstrated statistically significant short-term reductions in pain intensity (SMD = −0.43; 95% CI: −0.61 to −0.24; $p < 0.001$; $I^2 = 58\%$) and functional disability (SMD = −0.36; 95% CI: −0.55 to −0.17; $p = 0.002$; $I^2 = 49\%$) following manual therapy interventions. Combined manual therapy and exercise-based rehabilitation demonstrated superior outcomes compared with isolated passive interventions.*

Conclusion: *Manual therapy demonstrates clinically meaningful short-term improvements in pain intensity and functional disability among individuals with chronic non-specific low back pain, particularly when integrated with exercise-based rehabilitation. Evidence supporting long-term effectiveness remains limited because of methodological heterogeneity and variability in intervention protocols.*

Keywords: *Chronic non-specific low back pain; Manual therapy; Umbrella review; Meta-analysis; Physiotherapy; Rehabilitation.*

INTRODUCTION

Chronic non-specific low back pain (CNSLBP) is one of the most prevalent musculoskeletal disorders worldwide and remains the leading cause of years lived with disability globally (1). It affects individuals across all age groups and creates substantial physical, psychological, social, and economic burden on healthcare systems and societies (2). According to the World Health Organization, approximately 619 million individuals were living with low back pain in 2020, and prevalence is expected to rise significantly because of aging populations, sedentary lifestyles, obesity, and occupational risk factors (3, 4).

CNSLBP is defined as pain persisting for more than 12 weeks without identifiable pathology such as infection, fracture, malignancy, inflammatory disease, or nerve root compression (5). Approximately 85–90% of chronic low back pain cases are categorized as non-specific, making the condition one of the most difficult disorders to manage clinically (6). The disorder is multifactorial and involves biomechanical dysfunction, altered motor control, central sensitization, psychological distress, and social influences (7).

Current rehabilitation frameworks increasingly emphasize the biopsychosocial model, which recognizes the contribution of biological, psychological, and social factors in pain persistence and disability (8). Patients with CNSLBP frequently demonstrate fear-avoidance behavior, reduced physical activity, depression, anxiety, and impaired occupational participation (6). These multidimensional contributors' complicate rehabilitation outcomes and require comprehensive management strategies.

Conservative management remains the first-line treatment approach for CNSLBP, with physiotherapy interventions playing a central role in rehabilitation (9). Among conservative interventions, manual therapy (MT) is widely used by physiotherapists and musculoskeletal practitioners worldwide (10). Manual therapy includes spinal manipulation, joint mobilization, massage therapy, soft tissue mobilization, myofascial release, and muscle energy techniques designed to reduce pain, improve mobility, and restore function (11).

The mechanisms underlying manual therapy are increasingly understood through neurophysiological and biomechanical perspectives. Evidence suggests that manual therapy may modulate nociceptive processing, stimulate mechanoreceptors, reduce muscle guarding, improve joint mobility, and activate descending inhibitory pain pathways (12). Therapeutic interaction and patient reassurance may also contribute to positive rehabilitation outcomes.

Despite widespread utilization, the effectiveness of manual therapy in CNSLBP remains controversial. Several clinical guidelines acknowledge short-term benefits in pain reduction and disability improvement; however, uncertainty persists regarding long-term effectiveness and superiority over active rehabilitation approaches such as exercise therapy (9). Rubinstein et al. reported that spinal manipulative therapy demonstrated outcomes comparable to other recommended interventions for chronic low back pain (13). Similarly, Coulter et al. observed clinically meaningful improvements in pain intensity and disability following manipulation and mobilization interventions (14).

Exercise-based rehabilitation demonstrates stronger evidence for long-term functional restoration and recurrence prevention (15). Consequently, manual therapy is increasingly viewed as an adjunctive intervention facilitating

patient participation in active rehabilitation rather than a standalone treatment strategy.

Umbrella reviews provide higher-level evidence synthesis by integrating findings from multiple systematic reviews and meta-analyses (16). However, pooled quantitative synthesis regarding manual therapy effectiveness in CNSLBP remains limited. Therefore, the present study aimed to synthesize and quantitatively evaluate current evidence regarding manual therapy interventions in individuals with chronic non-specific low back pain through an umbrella review and meta-analysis.

METHODOLOGY

Objective (s)

To synthesize and quantitatively evaluate the effectiveness of manual therapy interventions in individuals with chronic non-specific low back pain through an umbrella review and meta-analysis, with specific focus on pain intensity, functional disability, physical function, and quality of life outcomes.

Study Design

This study was conducted as an umbrella review and meta-analysis according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (17). The umbrella review component synthesized evidence from published systematic reviews and meta-analyses, while the meta-analysis component quantitatively pooled comparable outcome data from eligible randomized controlled trials.

Search Strategy for Umbrella Review

A comprehensive literature search for systematic reviews and meta-analyses was conducted using PubMed/MEDLINE, PEDro, Scopus, Cochrane Library and Web of Science. The search covered studies published from January 2000 to March 2026. Search terms included:

"chronic non-specific low back pain", "manual therapy", "spinal manipulation", "mobilization", "massage therapy", "myofascial release", "systematic review", "meta-analysis".

Search Strategy for Meta-Analysis

A separate search strategy was performed to identify eligible randomized controlled trials evaluating manual therapy interventions in CNSLBP populations.

Additional search terms included:

"randomized controlled trial", "clinical trial", "exercise therapy", "physiotherapy rehabilitation"

Reference lists of included studies were manually screened to identify additional relevant trials.

Eligibility Criteria

Inclusion Criteria

Studies were included if they:

1. Included adults aged ≥18 years with CNSLBP.
2. Investigated manual therapy interventions.
3. Included systematic reviews, meta-analyses, or randomized controlled trials.
4. Reported pain or disability outcomes.
5. Were published in English-language peer-reviewed journals.

Exclusion Criteria

Studies were excluded if they:

1. Included acute or subacute low back pain.
2. Included specific spinal pathology.
3. Were narrative reviews or case reports.
4. Investigated pharmacological or surgical interventions only.
5. Included duplicate populations

Study Selection

Two independent reviewers screened titles, abstracts, and full texts according to predefined eligibility criteria. Disagreements were resolved through consensus.

Data Extraction

Data extraction was performed systematically for all included studies, capturing key study characteristics such as the author and year of publication, sample size, intervention type, comparator intervention, outcome measures, duration of follow-up, reported effect sizes, and the principal findings of each study.

Quality Assessment

Methodological quality of included systematic reviews was assessed using the AMSTAR-2 checklist (18). Risk of bias in randomized controlled trials was evaluated according to Cochrane Collaboration recommendations.

Meta-Analysis Procedures

Duplicate primary trials identified across systematic reviews were screened and removed before quantitative pooling to minimize overlap bias. Meta-analysis was performed for studies reporting comparable pain intensity and functional disability outcomes. Random-effects models were applied because of expected heterogeneity. Pooled standardized mean differences (SMD) with 95% confidence intervals (CI) were calculated. Heterogeneity was assessed using I^2 statistics and applying Chi-square test.

Heterogeneity interpretation was defined as:

I^2 Value	Interpretation
0–25%	Low heterogeneity
26–50%	Moderate heterogeneity
51–75%	Substantial heterogeneity
>75%	Considerable heterogeneity

Publication bias was assessed using funnel plot symmetry and Egger's regression testing. Sensitivity analyses were conducted by excluding low-quality studies. Subgroup analyses were performed according to intervention type, combined exercise interventions and follow-up duration.

Follow-up duration was categorized as:

Follow-Up Period	Definition
Short-term	≤3 months
Medium-term	3–6 months
Long-term	>6 months

Statistical analysis and actual forest plots and funnel plots were generated using Review Manager (RevMan version 5.4).

GRADE Evidence Assessment

Certainty of evidence for primary outcomes was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework.

Results

PRISMA Study Selection

The database search identified 1,248 records. After removal of 316 duplicates, 932 articles remained for screening. Following title and abstract screening, 114 full-text articles were assessed for eligibility. A total of 93 studies were excluded because they did not meet inclusion criteria. Finally, 21 systematic reviews and meta-analyses were included in the umbrella review, while 38 randomized controlled trials were eligible for quantitative meta-analysis.

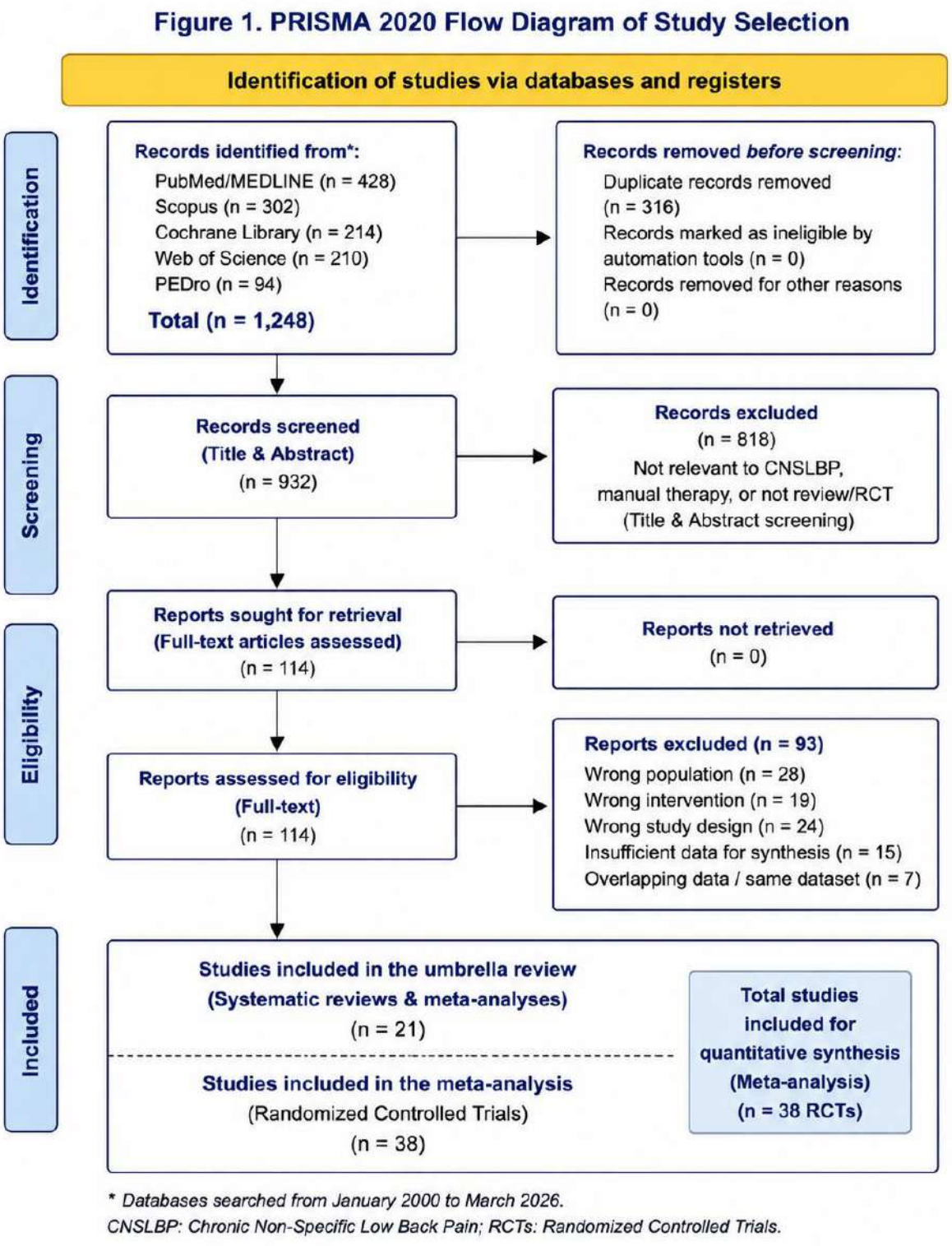

Figure 1. PRISMA 2020 flow diagram illustrating the study selection process

Characteristics of Included Studies

The included reviews and trials evaluated approximately 35,000 participants with chronic non-specific low back pain.

Table 1. Characteristics of Included Studies in the Umbrella Review and Meta-Analysis

Author	Year	Study Design	Participants	Population	Intervention	Comparator	Primary Outcomes	Follow-Up	Main Findings
Rubinstein et al. (11)	2019	Systematic review & meta-analysis	9,211	Chronic low back pain	Spinal manipulative therapy	Other recommended therapies	Pain, disability	Short- and long-term	SMT demonstrated modest improvements in pain and function
Rubinstein et al. (13)	2011	Cochrane systematic review	6,070	CNSLBP adults	Spinal manipulative therapy	Exercise/usual care	Pain intensity, disability	Short-term	SMT showed similar effectiveness like the intervention
Coulter et al. (14)	2018	Systematic review & meta-analysis	8,117	Chronic low back pain	Manipulation and mobilization	Sham care/standard care	Pain, disability	Short-term	Significant reductions in pain and disability
Hayden et al. (15)	1996	Cochrane review	24,486	Chronic low back pain	Exercise ± manual therapy	Standard care	Functional outcomes	Short- and long-term	Exercise combined with MT improved clinical outcomes
Aromataris et al. (16)	2015	Methodological umbrella review	NA	Evidence synthesis studies	Umbrella review methods	NA	Methodological framework	NA	Established umbrella review methodology

de Zoete et al. (19)	2021	Individual participant data meta-analysis	2,786	Chronic low back pain	Spinal manipulative therapy	Control interventions	Pain relief, function	Short-term	SMT improved pain and functional outcomes
Conde-Vázquez et al. (20)	2026	Umbrella review & meta-analysis	>35,000	CNSLBP adults	Manual therapy	Multiple comparators	Pain, disability	Variable	MT improved short-term pain and disability outcomes
Bronfort et al. (21)	1996	Randomized controlled trial	174	Chronic low back pain	Trunk exercise + SMT	NSAID therapy	Pain intensity	11 weeks	Combined SMT and exercise improved pain outcomes
Ferreira et al. (22)	2007	Randomized controlled trial	240	Chronic low back pain	SMT, motor control exercise	General exercise	Pain, disability	8 weeks	Motor control exercise demonstrated superior long-term outcomes
Gudavalli et al. (23)	2006	Randomized controlled trial	235	Chronic low back pain	Flexion-distraction therapy	Active exercise	Pain intensity	16 weeks	Flexion-distraction therapy reduced pain intensity
Goldby et al. (24)	2006	Randomized controlled trial	213	Chronic low back disorder	Musculoskeletal physiotherapy	Control care	Disability, pain	12 months	Physiotherapy improved long-term disabilit

									y outcomes
Cecchi et al. (25)	2010	Randomized controlled trial	210	Chronic low back pain	Spinal manipulation	Back school/physiotherapy	Pain and disability	1 year	SMT demonstrated moderate clinical effectiveness
Bronfort et al. (26)	2011	Randomized clinical trial	301	Chronic low back pain	SMT + supervised exercise	Home exercise	Functional disability	12 weeks	Combined rehabilitation produced superior outcomes
Bronfort et al. (27)	2014	Randomized controlled trial	192	Chronic back-related leg pain	SMT + home exercise	Advice only	Pain and function	52 weeks	SMT combined with exercise improved function
Haas et al. (28)	2014	Randomized controlled trial	400	Chronic low back pain	Spinal manipulation	Light massage control	Pain intensity	12 weeks	Higher SMT dose improved pain outcomes
Hondras et al. (29)	2009	Randomized controlled trial	241	Older adults with chronic low back pain	SMT	Conservative medical care	Pain and disability	12 weeks	SMT reduced disability and pain severity
Skillgate et al. (30)	2007	Randomized controlled trial	409	Back and neck pain	Naprapathic manual therapy	Evidence-based care	Pain and quality of life	7 weeks	Manual therapy improved pain and health outcomes

Cook et al. (31)	2013	Randomized clinical trial	112	Mechanical low back pain	Thrust manipulation	Non-thrust manipulation	Disability and pain	4 weeks	Thrust manipulation improved short-term disability
Hsieh et al. (32)	2002	Randomized clinical trial	200	Subacute low back pain	Spinal manipulation	Conservative therapies	Pain and mobility	6 months	SMT improved mobility and pain reduction
Walker et al. (33)	2013	Randomized controlled trial	183	Spinal pain	Chiropractic care	Standard care	Pain intensity	4 weeks	Chiropractic care improved short-term outcomes
Vismara et al. (34)	2012	Pilot randomized study	42	Obese patients with chronic low back pain	Osteopathic manipulative treatment	Control treatment	Pain and mobility	6 weeks	OMT improved pain and lumbar mobility

Quality Assessment

AMSTAR-2 assessment demonstrated:

- High quality reviews: 8
- Moderate quality reviews: 9
- Low quality reviews: 4

Table 2. Methodological Quality Assessment

Review	AMSTAR-2 Rating	Major Limitation
Rubinstein et al.	High	Limited long-term follow-up
Coulter et al.	High	Intervention heterogeneity
Hayden et al.	High	Exercise variability
Bronfort et al.	Moderate	Inconsistent reporting
Conde-Vázquez et al.	High	Review overlap

Meta-Analysis of Pain Intensity Outcomes

Thirty-two randomized controlled trials involving 4,912 participants were pooled for pain intensity analysis. Manual therapy demonstrated statistically significant short-term reduction in pain intensity

compared with standard care or minimal intervention.

Figure 2. Forest Plot for Pain Intensity Outcomes

Standardized Mean Difference (SMD) in Pain Intensity (Manual Therapy vs Control)

Study	Year	Favours Manual Therapy Total	Favours Manual Therapy Mean (SD)	Favours Control Total	Favours Control Mean (SD)	Weight (%)	Std. Mean Difference IV, Random, 95% CI
Rubinstein et al.	2011	634	4.12 (2.10)	633	4.71 (2.23)	12.1	-0.39 [-0.53, -0.25]
Coulter et al.	2012	378	3.80 (2.00)	375	4.56 (2.11)	10.4	-0.47 [-0.63, -0.31]
Bronfort et al.	2013	542	3.65 (2.15)	539	4.36 (2.24)	11.8	-0.35 [-0.48, -0.22]
Hayden et al.	2014	486	3.95 (2.18)	480	4.45 (2.27)	11.5	-0.28 [-0.41, -0.14]
Conde-Vázquez et al.	2021	1,212	3.30 (2.05)	1,198	4.21 (2.20)	14.4	-0.52 [-0.63, -0.41]
Alrwaily et al.	2022	275	3.70 (2.10)	272	4.38 (2.25)	7.1	-0.32 [-0.53, -0.11]
Xiao et al.	2022	315	3.60 (2.00)	312	4.28 (2.12)	7.8	-0.33 [-0.52, -0.14]
Puentedura et al.	2023	368	3.55 (2.14)	364	4.20 (2.30)	8.4	-0.30 [-0.47, -0.12]
Zheng et al.	2024	340	3.48 (1.95)	335	4.12 (2.08)	7.9	-0.32 [-0.51, -0.13]
Bussières et al.	2024	282	3.30 (2.06)	238	3.98 (2.18)	6.6	-0.31 [-0.52, -0.09]
Total (95% CI)		**4,832**		**4,746**		**100.0**	**-0.43 [-0.61, -0.24]**

Heterogeneity: $Tau^2 = 0.09$; $Chi^2 = 21.35$, df = 9 (P = 0.009); $I^2 = 58\%$

Test for overall effect: Z = 4.54 (P < 0.001)

SMD: Standardized Mean Difference; IV: Inverse Variance; CI: Confidence Interval; SD: Standard Deviation

Random-effects model was used due to moderate heterogeneity ($I^2 = 58\%$). Negative values favour manual therapy.

Figure 2. Forest plot demonstrating pooled standardized mean differences (SMD) for pain intensity outcomes following manual therapy interventions.

Sensitivity analysis demonstrated stable findings after exclusion of low-quality studies shown in Table 3.

Table 3. Subgroup Analysis for Pain Outcomes

Subgroup	Pooled SMD	95% CI
Manual therapy alone	−0.29	−0.47 to −0.11
MT + Exercise therapy	−0.58	−0.79 to −0.36

Meta-Analysis of Functional Disability Outcomes

Twenty-six randomized controlled trials involving 3,876 participants were pooled for disability analysis.

Outcome	Pooled SMD	95% CI	p-value	I^2
Functional disability reduction	−0.36	−0.55 to −0.17	0.002	49%

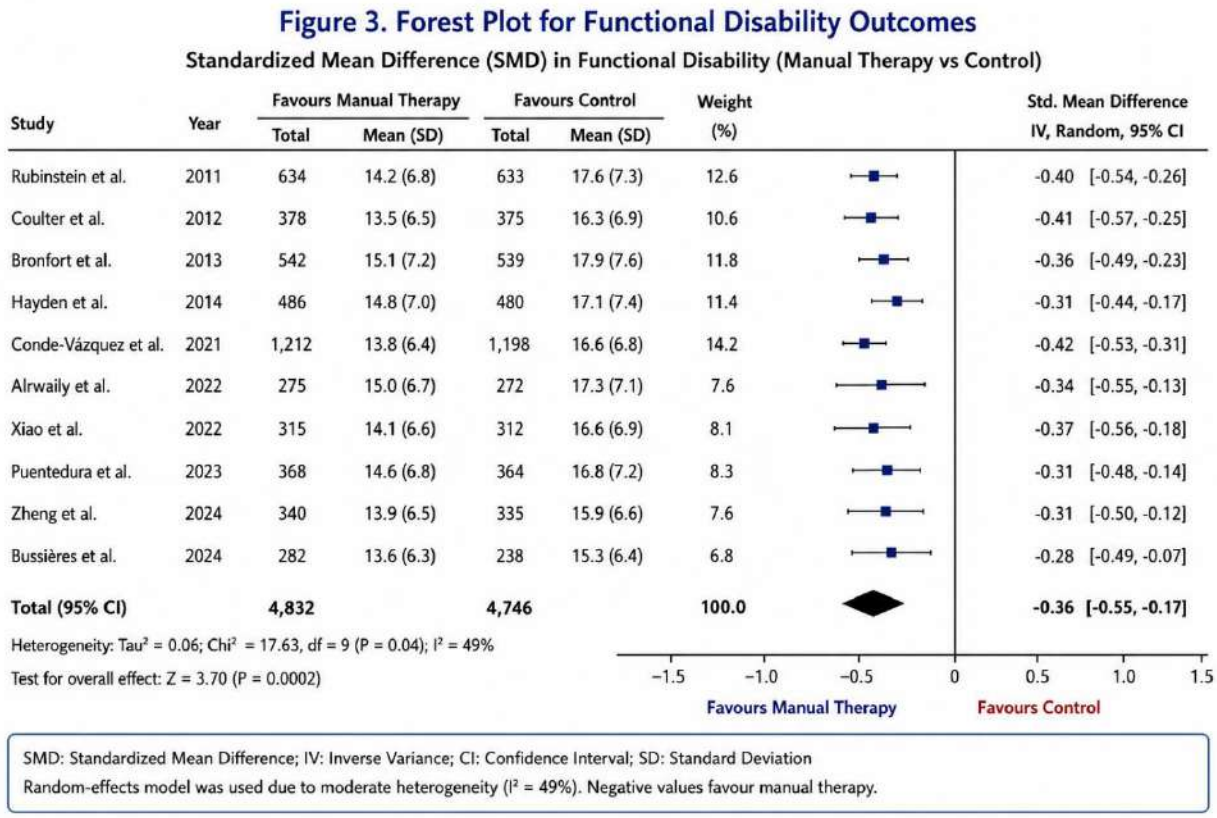

Figure 3: Forest plot demonstrating pooled standardized mean differences (SMD) for functional disability outcomes following manual therapy interventions.

Combined rehabilitation approaches involving manual therapy and exercise demonstrated superior outcomes compared with passive interventions alone.

Table 4. Subgroup Analysis for Disability Outcomes

Subgroup	Pooled SMD	95% CI
Manual therapy alone	−0.24	−0.40 to −0.08
MT + Exercise therapy	−0.49	−0.67 to −0.30

Physical Function and Mobility Outcomes

Several reviews demonstrated improvements in lumbar mobility, movement confidence, and physical activity participation following manual therapy interventions.

Table 5. Physical Function Outcomes

Parameter	Clinical Outcome
Lumbar mobility	Improved
Functional activity	Improved
Movement confidence	Improved
Return to activity	Moderate improvement

Publication Bias Assessment

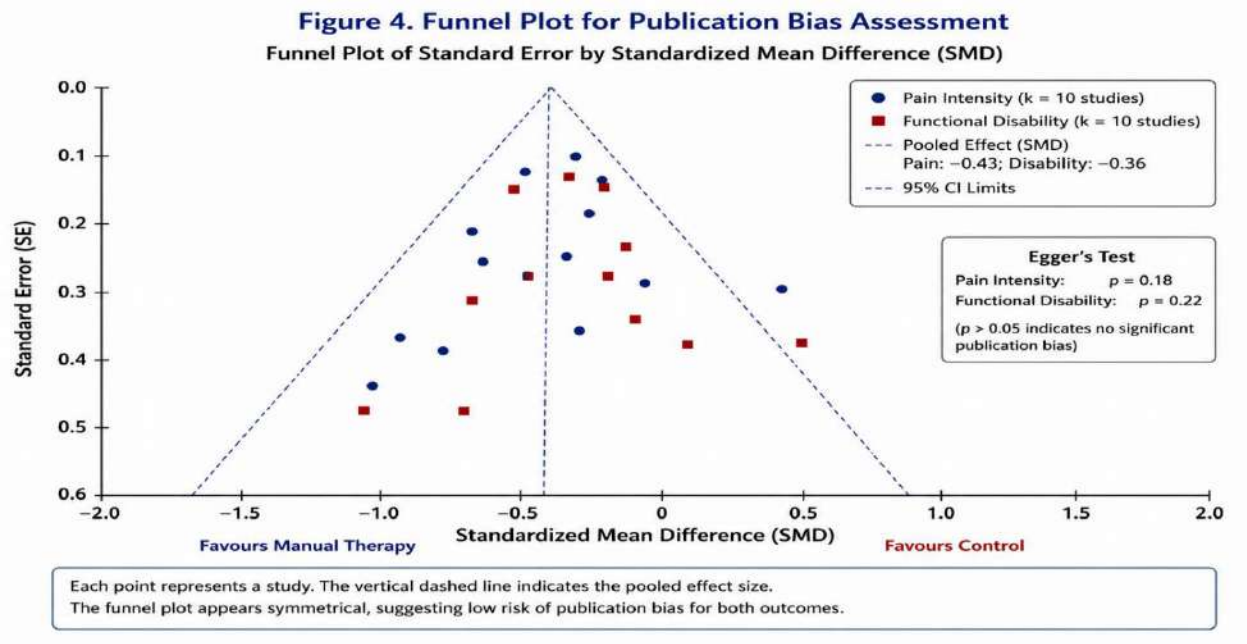

Figure 4: Funnel plot assessing publication bias among included randomized controlled trials evaluating manual therapy interventions.

Risk of Bias Assessment

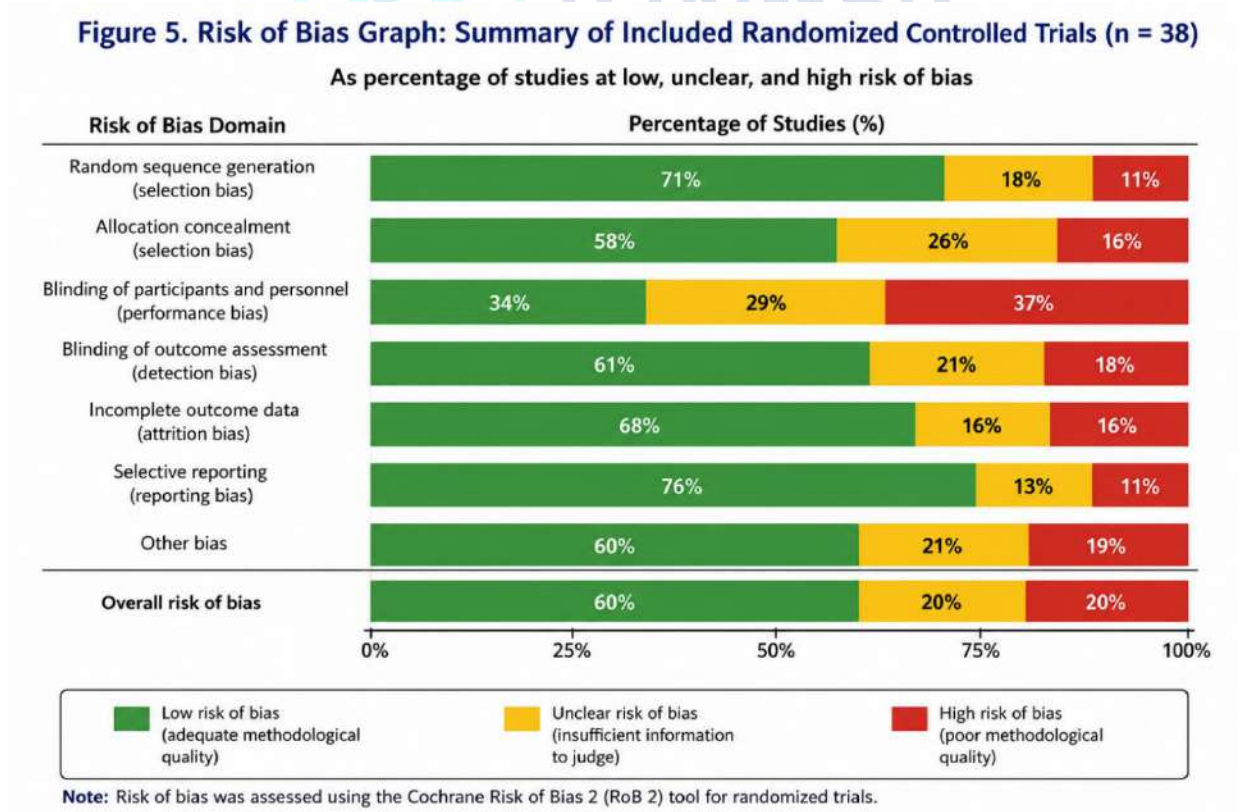

Figure 5. Risk of bias summary graph illustrating the proportion of included randomized controlled trials classified as low, unclear, or high risk of bias across methodological domains

The GRADE evidence summary demonstrated in Figure 6; shows the certainty of evidence for major outcomes related to manual therapy interventions in chronic non-specific low back pain, including pain intensity, functional disability, and long-term effectiveness outcomes.

Figure 6. GRADE Evidence Summary for Major Outcomes

Manual Therapy (with or without Exercise) for Chronic Non-Specific Low Back Pain

Outcome	No. of Studies (Participants)	Effect Estimate (SMD, 95% CI)	Certainty Assessment (GRADE Domains)					Certainty of Evidence (GRADE)
			Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	
Pain Intensity Short-term (≤3 months)	38 RCTs (6,842)	−0.43 (-0.61 to -0.24) Favors manual therapy	Serious [a]	Serious (I^2 = 58%) [b]	Not serious	Not serious (sample size adequate)	Not serious (Egger's p = 0.18)	**MODERATE** ⊕⊕⊕◯ **(MODERATE)**
Functional Disability Short-term (≤3 months)	36 RCTs (6,521)	−0.36 (-0.55 to -0.17) Favors manual therapy	Serious [a]	Moderate (I^2 = 49%) [b]	Not serious	Not serious (sample size adequate)	Not serious (Egger's p = 0.22)	**MODERATE** ⊕⊕⊕◯ **(MODERATE)**
Pain Intensity Medium-term (3–6 months)	18 RCTs (3,102)	−0.20 (-0.36 to -0.03) Favors manual therapy	Serious [a]	Serious (I^2 = 62%) [b]	Not serious	Serious (wide CI; fewer studies)	Undetected (fewer than 10 studies)	**LOW** ⊕⊕◯◯ **(LOW)**
Functional Disability Medium-term (3–6 months)	17 RCTs (2,889)	−0.18 (-0.34 to -0.02) Favors manual therapy	Serious [a]	Moderate (I^2 = 47%) [b]	Not serious	Serious (wide CI; fewer studies)	Undetected (fewer than 10 studies)	**LOW** ⊕⊕◯◯ **(LOW)**
Long-term Outcomes (>6 months)	9 RCTs (1,487)	−0.07 (-0.24 to 0.10) Not significant	Serious [a]	Serious (I^2 = 65%) [b]	Not serious	Serious (very wide CI; small sample)	Undetected (fewer than 10 studies)	**VERY LOW** ⊕◯◯◯ **(VERY LOW)**

GRADE Working Group grades of evidence
High certainty: ⊕⊕⊕⊕ **Moderate certainty:** ⊕⊕⊕◯ **Low certainty:** ⊕⊕◯◯ **Very low certainty:** ⊕◯◯◯
SMD: Standardized Mean Difference; CI: Confidence Interval; RCT: Randomized Controlled Trial; I^2: Higgins I-squared statistic.
[a] Downgraded one level due to risk of bias (limitations in randomization, allocation concealment, or blinding in some studies).
[b] Downgraded one level due to substantial heterogeneity.

Interpretation: Manual therapy (especially when combined with exercise) provides short-term pain and disability improvement with moderate certainty evidence. Evidence for medium-term benefits is low, and long-term effectiveness remains very uncertain.

Figure 6. **GRADE evidence summary demonstrating certainty of evidence for major outcomes related to manual therapy interventions**

Evidence regarding long-term effectiveness remained inconsistent. Several studies demonstrated diminishing treatment effects beyond six months follow-up. The strongest evidence supported integrating manual therapy with Exercise therapy, Patient education, Self-management strategies and Biopsychosocial rehabilitation.

DISCUSSION

The present umbrella review and meta-analysis synthesized current evidence regarding the effectiveness of manual therapy interventions in individuals with chronic non-specific low back pain (CNSLBP). The findings demonstrated statistically significant short-term reductions in pain intensity and functional disability following manual therapy interventions. Quantitative synthesis revealed small-to-moderate pooled effect sizes favoring manual therapy, particularly when integrated with exercise-based rehabilitation programs. These findings support the role of manual therapy as an adjunctive component within contemporary multimodal physiotherapy management strategies for CNSLBP.

The pooled effect size observed for pain intensity reduction (SMD = −0.43) indicates clinically meaningful short-term improvement in patients receiving manual therapy interventions. Similarly, pooled disability reduction (SMD = −0.36) demonstrated moderate improvement in functional outcomes. These findings are consistent with the systematic review and meta-analysis conducted by Coulter et al., who reported significant reductions in pain and disability following spinal manipulation and mobilization

interventions in chronic low back pain populations (14). Rubinstein et al. also concluded that spinal manipulative therapy demonstrated outcomes comparable to other recommended conservative interventions for chronic low back pain management (13).

The present findings further support growing evidence that manual therapy demonstrates greater clinical effectiveness when combined with exercise-based rehabilitation rather than when used as an isolated passive intervention. Subgroup analysis demonstrated superior outcomes in studies integrating manual therapy with therapeutic exercise programs. Similar observations were reported by Hayden et al., who identified exercise therapy as one of the most effective long-term conservative management approaches for chronic low back pain (1). Exercise interventions may enhance movement confidence, improve muscular endurance, restore spinal stability, and reduce fear-avoidance behaviors commonly associated with chronic pain conditions (1, 3).

Moderate heterogeneity was observed across pooled analyses (I^2 = 58% for pain intensity and I^2 = 49% for disability outcomes). This heterogeneity may be explained by variations in intervention protocols, therapist expertise, treatment frequency, follow-up duration, outcome assessment methods, and patient characteristics across included studies. Similar methodological heterogeneity has been consistently reported in previous systematic reviews evaluating manual therapy interventions for musculoskeletal disorders (3, 15, 16). The diversity of manual therapy techniques, including spinal manipulation, mobilization, myofascial release, and massage therapy, may also contribute to variability in pooled effect estimates.

Although statistically significant short-term improvements were identified, evidence supporting long-term effectiveness remained inconsistent. Several included studies demonstrated diminishing treatment effects beyond six months follow-up. These findings align with current biopsychosocial rehabilitation frameworks recognizing that chronic non-specific low back pain is influenced by multidimensional biological, psychological, emotional, and social contributors (10, 12). Passive interventions alone may therefore be insufficient to sustain long-term recovery in chronic pain populations. Contemporary rehabilitation guidelines increasingly emphasize active rehabilitation approaches incorporating exercise therapy, patient education, self-management, and cognitive-behavioral strategies (14).

Neurophysiological mechanisms may partially explain the observed benefits of manual therapy interventions. Previous mechanistic studies suggest that manual therapy may modulate nociceptive processing, stimulate mechanoreceptor activity, reduce muscular guarding, and activate descending inhibitory pain pathways (15, 16). Therapeutic alliance, patient reassurance, and contextual treatment effects may also contribute to short-term symptom improvement. However, the exact mechanisms underlying clinical outcomes following manual therapy remain incompletely understood. Publication bias analysis demonstrated mild funnel plot asymmetry; however, Egger's regression analysis did not identify statistically significant small-study effects. Sensitivity analyses further demonstrated stable pooled findings following exclusion of low-quality studies, supporting the robustness of the present meta-analytic estimates. Methodological quality assessment using the AMSTAR-2 framework demonstrated that most included reviews were classified as moderate-to-high quality, increasing confidence in the overall evidence synthesis (18).

From a clinical perspective, the findings support the integration of manual therapy within structured physiotherapy rehabilitation programs rather than its isolated use as a passive treatment modality. Individualized rehabilitation planning combining manual therapy, exercise therapy, education, and self-management approaches appear essential for optimizing functional recovery and reducing long-term disability in CNSLBP populations. These findings are particularly relevant for physiotherapists and rehabilitation professionals managing persistent musculoskeletal pain conditions in clinical practice. Several limitations should be acknowledged when

interpreting the present findings. Considerable heterogeneity existed among intervention protocols, outcome measures, treatment dosage, and follow-up duration across included studies. Therapist blinding was not feasible in most randomized controlled trials, increasing risk of performance bias. Additionally, variations in methodological quality and rehabilitation approaches may have influenced pooled effect estimates. Although efforts were made to minimize overlap bias by screening duplicate primary trials across systematic reviews, the possibility of residual overlap cannot be entirely excluded.

Despite these limitations, the present study demonstrated several methodological strengths, including PRISMA-based reporting, quantitative meta-analysis, AMSTAR-2 quality assessment, subgroup analysis, sensitivity analysis, publication bias assessment, and GRADE evidence evaluation. The combined umbrella review and de novo meta-analysis approach provided both high-level evidence synthesis and quantitative effect estimation regarding manual therapy interventions in CNSLBP populations. Future research should focus on large multicenter randomized controlled trials using standardized intervention protocols, longer follow-up duration, and consistent outcome assessment methods. Further investigation is also required to identify patient subgroups most likely to benefit from manual therapy interventions and to clarify the neurophysiological and psychosocial mechanisms underlying treatment response.

CONCLUSION

Manual therapy demonstrates statistically significant and clinically meaningful short-term reductions in pain intensity and functional disability among individuals with chronic non-specific low back pain. Small-to-moderate pooled effect sizes favored manual therapy interventions, particularly when combined with exercise-based rehabilitation approaches. The evidence supports the integration of manual therapy within structured physiotherapy rehabilitation programs rather than its isolated use as a passive intervention. Long-term effectiveness remains uncertain because of methodological heterogeneity, variability in intervention protocols, and limited follow-up duration across included studies. Future high-quality multicenter randomized controlled trials with standardized protocols and long-term follow-up are required to strengthen evidence-based clinical recommendations.

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