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Manual Therapy Combined with Exercise for Neck Pain: A Scoping Review of Randomized Controlled Trials

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Abstract

Background: Neck pain is one of the leading causes of disability worldwide and substantially affects quality of life and work productivity. Manual therapy and exercise are among the most commonly used physiotherapy interventions, yet evidence regarding their combined application remains heterogeneous.

Objective: To map the existing evidence on neck pain types, pain assessment instruments, and combinations of manual therapy and exercise used in randomized controlled trials (RCTs).

Methods: A scoping review was conducted according to PRISMA-ScR guidelines. Electronic searches were performed in PEDro, PubMed, and ScienceDirect for RCTs published between January 2016 and August 2025. Eligible studies included adults with non-pathological neck pain receiving combined manual therapy and exercise. Data were extracted and synthesized narratively.

Results: Twenty RCTs involving sample sizes ranging from 18 to 619 participants were included. Chronic non-specific neck pain and mechanical neck pain were the most frequently investigated conditions. High-velocity low-amplitude manipulation combined with craniocervical flexion or stabilization exercises was the most common intervention. Sixteen of 20 studies reported significant pain reduction following combined interventions ($p<0.05$). Notable findings included greater improvements in pain, disability, and cervical mobility compared with exercise alone, with effect sizes reaching $d=2.21$ for cervical rotation and $d=1.33$ for disability outcomes. The Visual Analogue Scale was the most frequently used pain assessment tool (12 studies).

Conclusion: Combined manual therapy and exercise generally demonstrate favorable effects on pain and function in adults with neck pain. However, substantial heterogeneity in intervention protocols and outcome measures highlights the need for standardized approaches and further high-quality research.

Keywords

Neck Pain; Manual Therapy; Exercise Therapy; Spinal Manipulation; Physical Therapy Modalities; Randomized Controlled Trials as Topic.

Introduction

Neck pain is one of the top four leading causes of disability worldwide. This condition affects 30% of the global population and represents a significant health problem, particularly among working populations.[1,2] In Indonesia, the prevalence of neck pain has reached over 60% among healthcare workers in the past year,[3,4] And approximately 33% of workers in the industrial sector also experience it.[5] Studies have reported that healthcare costs and work absenteeism due to neck and back pain amount to US$346,308 per 1,000 workers.[6] Various studies indicate that neck pain not only affects quality of life and mental health but also interferes with daily activities.[7,8] Its etiology is multifactorial, encompassing both biological factors, such as neuromusculoskeletal disorders and autoimmune conditions, and psychological factors, including anxiety, depression, chronic stress, and lack of support, which can influence pain perception.[9]

Manual therapy and therapeutic exercise are commonly applied physiotherapeutic interventions for managing neck pain. Manual therapy includes mobilization and manipulation techniques targeting soft tissues and joints to relieve pain, improve mobility, and restore function.[10,11] Therapeutic exercise, on the other hand, plays a role in strengthening cervical support structures, enhancing motor control, and supporting long-term rehabilitation.[12,13] Investigating their combination is warranted, as studies included in this review suggest that integrating manual therapy with exercise may influence complementary mechanisms affecting pain reduction and functional outcomes.[14,15]

Recent evidence further illustrates this heterogeneity. Lee et al. conducted a multi-center randomized clinical trial in South Korea involving adults with chronic neck pain, comparing Chuna manual therapy with usual care over a 5-week program and reporting significant improvements in pain and function.[16] Bini et al. In a systematic review of randomized controlled trials on cervicogenic headache, researchers found that combined manual therapy and therapeutic exercise produced a greater reduction in pain and disability than exercise alone, although protocols and follow-up durations varied widely.[17] Gracia-González et al. compared different spinal manipulation techniques in adults with mechanical neck pain and showed clinical benefits across approaches, further underscoring variation in manual therapy techniques and treatment durations.[18]

Other studies conducted an RCT in 58 adults with chronic neck pain and upper cervical dysfunction, comparing four weekly sessions of upper cervical manual therapy plus exercise with exercise alone, and reported greater short and mid-term improvements in pain and function in the combined group.[19] A national meta-analysis showed that manual therapy significantly reduces neck pain.[20] However, other studies indicate that adding exercise to manual therapy does not result in significant differences in pain reduction or quality of life compared to either treatment applied individually, with moderate-quality evidence.[21]

A systematic review reported that combining manual therapy and exercise yields effects comparable to manual therapy alone but is more effective than exercise alone or other interventions (control, placebo, conventional treatment) in patients with non-

specific neck pain and disability.[22] Extending this methodological perspective, de Almeida Tolentino et al. applied a multimodal manual therapy plus exercise protocol in patients with migraine, demonstrating how intervention design and measurement strategies can vary.[23] While Mintken et al. examined the addition of cervicothoracic manual therapy to exercise in musculoskeletal populations, providing a classical reference for designing combined intervention trials.[24]

Differences in manual therapy and exercise techniques, intervention duration, and population characteristics likely contribute to the varying results reported across studies. Given this heterogeneity, a scoping review provides a more suitable framework than a systematic review or meta-analysis to comprehensively chart the evidence, identify knowledge gaps, and guide future research. Accordingly, this review systematically maps randomized controlled trials involving adults with neck pain (P) that investigated manual therapy combined with exercise (I) compared to exercise alone, manual therapy alone, or other controls (C), with a specific focus on pain outcomes (O). In addition, the review chart study characteristics, assessment instruments, and variations in intervention protocols across eligible trials (S), offering an overview of current methodological approaches and highlighting areas of heterogeneity in intervention design.

Methods

This scoping review was conducted following the PRISMA-ScR guidelines.[25] A structured approach was employed to map the relevant scientific evidence regarding manual therapy and exercise interventions for non-pathological neck pain. The review protocol was not registered in PROSPERO or other registries. Supplementary materials, including the charting table and search strings, are available at the Open Science Framework (OSF): https://doi.org/10.17605/OSF.IO/6N5SH.

This scoping review included randomized controlled trials enrolling adults with neck pain of non-pathological origin, including non-specific and mechanical neck pain, as well as cervicogenic headache. Eligible studies had to investigate manual therapy delivered in combination with exercise, exercise alone, or other controls. The primary outcome of interest was pain, assessed using validated measurement instruments commonly applied in neck pain research (e.g., Visual Analogue Scale, Numeric Pain Rating Scale).

Only full-text, peer-reviewed journal articles published in English between January 2016 and August 2025 were included. Conference abstracts, preprints, and non-peer-reviewed materials were excluded. Because of resource constraints, we further limited our research to open-access articles, ensuring that all included studies were freely accessible for screening and data extraction. We acknowledge that this may introduce potential selection bias.

Studies were excluded if they involved pediatric populations, pathological conditions (radiculopathy, myelopathy, fracture, tumor, infection, autoimmune disease), or combined the target interventions with other modalities (e.g., TENS, ultrasound, pharmacotherapy).

Electronic databases used for the literature search included PEDro, PubMed, and Scopus (via ScienceDirect). The search covered publications from January 2016 to August 2025, and the last search was performed on 24 August 2025. A PRISMA-Scr flow diagram was used to illustrate the process of study identification, eligibility assessment, and inclusion. The diagram is presented in the Results section. The article search strategy was developed based on the PCC framework: Population (patients with neck pain), Concept (manual therapy and exercise), and Context (clinical research). Search terms included keywords, topics, and synonyms such as “manual therapy,” “manipulation,” “mobilization,” “exercise,” “neck pain,” “cervical pain,” and “RCT.” MeSH combinations were applied in the PubMed database, while filtering features were adjusted according to the characteristics of each database.

Search strings combining keywords and Boolean operators (AND, OR, NOT) were also customized for each database. All search results were exported, and selected articles were organized into separate folders using EndNote reference management software. The complete search string configuration is presented in the Online Appendix. For example, the PubMed search used the following string: ("Neck Pain"[Mesh] OR "neck pain"[tiab] OR "cervical pain"[tiab] OR "cervicalgia"[tiab] OR "mechanical neck pain"[tiab] OR "non-specific neck pain"[tiab] OR "cervicogenic headache"[tiab] OR "whiplash associated disorders"[tiab]) AND ("Manual Therapy"[tiab] OR "Manipulation, Spinal"[Mesh] OR "spinal manipulation"[tiab] OR "mobilization"[tiab] OR "manipulative therapy"[tiab] OR "myofascial release"[tiab] OR "soft tissue mobilization"[tiab] OR "trigger point therapy"[tiab]) AND ("Exercise Therapy"[Mesh] OR "exercise therapy"[tiab] OR "therapeutic exercise"[tiab] OR "neck exercise"[tiab] OR "cervical stabilization exercise"[tiab] OR "motor control exercise"[tiab]) AND ("Randomized Controlled Trial"[pt] OR "randomized controlled trial"[tiab] OR "RCT"[tiab]) NOT ("cervical radiculopathy"[tiab] OR "myelopathy"[tiab] OR "fracture"[tiab] OR "tumor"[tiab] OR "infection"[tiab]).

Titles and abstracts retrieved from the search were screened by the first author according to the eligibility criteria. Full text of potentially eligible studies was then assessed before final inclusion. After initial selection, the supervising faculty member reviewed the eligibility decisions, and any uncertainties were resolved through discussion between the two.

Articles that passed the screening of titles, abstracts, and full texts and met the inclusion criteria were subjected to data extraction by the first author using a standardized form. The supervising faculty member subsequently reviewed the extracted data to ensure accuracy, and any discrepancies or uncertainties were addressed through discussion and consensus. For each included study, the extracted information encompassed the first author’s name, year of publication, article title, country of origin, population, sample size, type and dosage of intervention, comparator, follow-up duration, and pain measurement instrument used. Other outcomes reported in the studies (such as function, disability, or quality of life) and funding sources were also noted when available.

In addition, the methodological quality of the included RCTs was assessed using the Physiotherapy Evidence Database scale. The PEDro scale consists of 11 items covering randomization, blinding, and data reporting. The first item related to external validity and is not included in the total score, which ranges from 0 to 10. All PEDro assessments were performed by the first author.[26]

The results from the data extraction tables were then collated and summarized into several subthemes in accordance with the objectives of this review. The methodological quality of individual RCTs was described using PEDro scores to provide an overview of study rigor and presented in Table 1. Publication bias or selective reporting was not formally assessed, and no subgroup, sensitivity, or meta-regression analyses were conducted, as these are beyond the scope of this review. The extracted data were synthesized narratively and thematically, with studies grouped according to the types of manual therapy and exercise interventions applied, the types of neck pain addressed, and the pain assessment instruments used.

Results

PEDro scores across the included trials ranged from 4 to 9, with most studies scoring between 6 to 8, reflecting overall moderate to high methodological quality. Randomization, baseline comparability, and between-group reporting were generally satisfied. While blinding of participants and therapists was rarely feasible, allocation concealment was inconsistently reported.

A total of 316 articles were identified from searches across the three databases. After removing seven duplicates, 309 articles were screened for inclusion criteria. Twenty-three articles passed the title and abstract screening, and 20 articles met the eligibility criteria for this scoping review. Three articles were excluded after full-text review: two studies combined manual therapy and exercise with additional modalities (e.g., ultrasound, infrared) and therefore did not meet the eligibility criteria, while one study was not available as open-access full text and was excluded due to accessibility constraints. The PRISMA diagram summarizing the study selection process is presented in Figure 1. Study characteristics are shown in Table 2, while the complete version with additional details, such as dosage parameters, is available in the Online Appendix. The main outcome results and effect estimates of the included studies are summarized in Table 3.

Because of the marked variability in interventions, populations, and reported outcomes, a meta-analysis was not feasible. Instead, the findings were synthesized in a descriptive narrative manner and organized thematically according to the types of manual therapy and exercise interventions applied, the types of neck pain addressed, and the pain assessment instruments used. In addition, most of the included studies, 16 out of 20, demonstrated significant reductions in pain intensity ($p < 0.05$) following combined manual therapy and exercise, while a smaller number reported mixed or non-significant effects.

The included articles were published between 2016 and 2025 and employed a randomized controlled trial (RCT) design. Most studies were conducted in Turkey (n = 6), followed by Spain (n = 3), Sweden (n = 3), South Korea (n = 2), the USA (n = 1), Pakistan (n = 1), Brazil (n = 1), Greece (n = 1), Egypt (n = 1), and India (n = 1). Sample sizes in these studies varied widely, from as few as 18 participants[14] To as many as 619 participants.[27] Indicated variability in the scale of the research.

Analysis of the included articles showed considerable variation in the combined use of manual therapy and exercise for patients with neck pain. Spinal manipulation was the most frequently applied technique, reported in nine studies, most often targeting the cervical and upper thoracic segments using high-velocity low-amplitude (HVLA) techniques.[15,19,28–34] While some trials combined HVLA with craniocervical flexion or stretching exercise, the specific outcomes assessed varied across studies.

Joint mobilization approaches such as the Maitland, Kaltenborn, and Cyriax techniques were also widely used, sometimes integrated with clinical Pilates or stabilization exercises.[14,30,35–38] Several studies examined soft tissue interventions, including instrument-assisted techniques (IASTM, Graston), connective tissue massage, and deep tissue massage.[27,39–42] While one trial employed osteopathic manual therapy.[43]

Exercise programs were equally diverse, ranging from deep craniocervical flexor training, cervical and scapulothoracic stabilization exercises, to strengthening, stretching, neuromuscular control, and supervised progressive exercise programs.[14,15,19,27–43] This heterogeneity in exercise modalities and dosing reflects the lack of a standardized protocol for combining manual therapy and exercise in neck pain populations. The study selection process is presented in Figure 1. A systematic search was conducted across three electronic databases, followed by duplicate removal, title and abstract screening, full-text eligibility assessment, and final inclusion of studies according to the PRISMA-ScR framework.

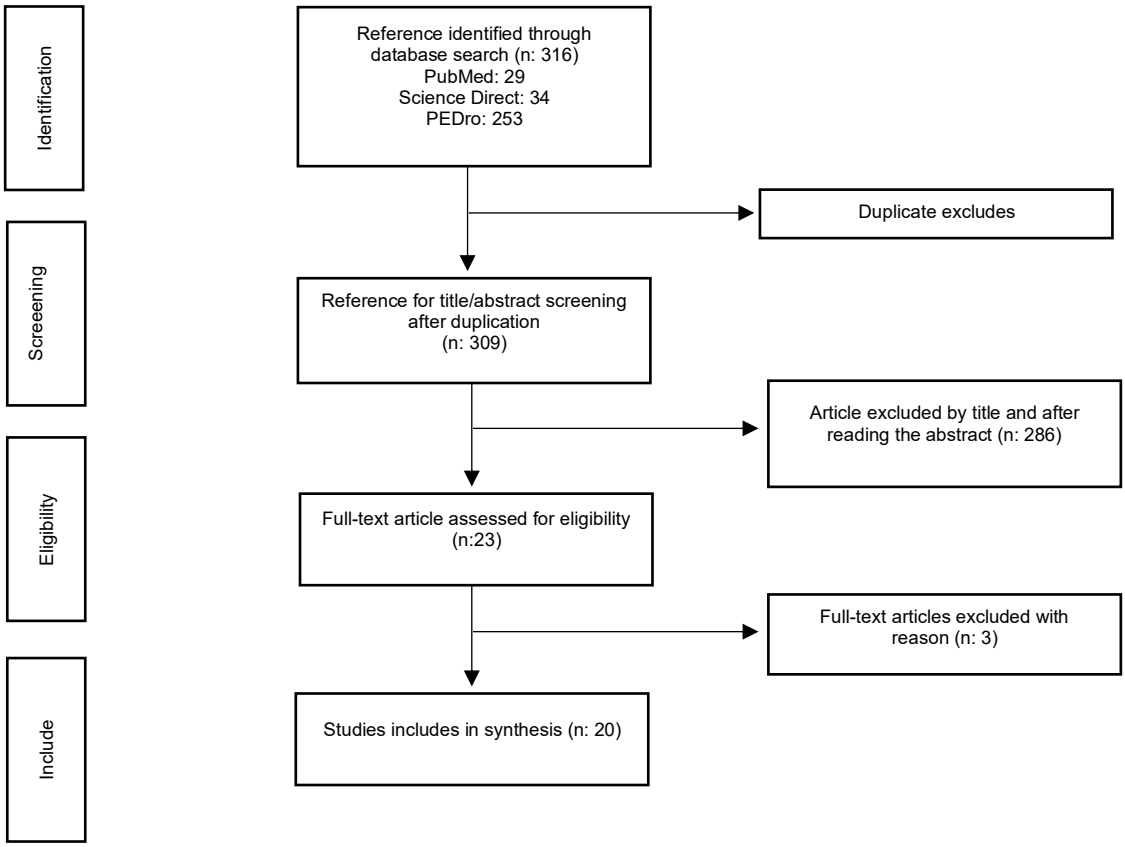

Figure 1. PRISMA-ScR flow diagram of the study selection process.

The methodological quality of the included randomized controlled trials was assessed using the PEDro scale. As shown in Table 1, PEDro scores ranged from 4 to 9, with most studies demonstrating moderate to high methodological quality (scores 6–8). Random allocation, baseline comparability, and between-group comparisons were consistently reported across studies, whereas blinding of participants and therapists was infrequently achieved due to the nature of the interventions.

Table 1. Methodological Quality of Included Randomized Controlled Trials Based on the PEDro Scale

Author(s), Year	Eligibility Criteria Stated	Random Allocation	Concealed Allocation	Baseline Comparability	Blinding of Subjects	Blinding of Therapists	Blinding of Assessors	Adequate Follow-up	Intention-to-Treat Analysis	Between-Group Comparisons	Point Estimates and Variability	Total Score (0–10)
Celenay, Akabyrak et al., 2016	Yes	1	1	1	0	0	1	1	0	1	1	7
Celenay, Kaya et al., 2016	Yes	1	0	1	0	0	1	1	0	1	1	6
Dunning et al., 2016	Yes	1	1	1	0	0	1	1	1	1	1	8
K.-W. Lee & Kim, 2016	No	1	0	1	0	0	1	1	0	1	1	6
K.-S. Lee & Lee, 2017	Yes	1	0	1	0	0	0	0	0	1	1	4
Rodriguez-Sanz et al., 2020	Yes	1	1	1	0	0	1	1	1	1	1	8
Groisman et al., 2020	Yes	1	1	1	0	0	1	1	1	1	1	8
Skillgate et al., 2020	Yes	1	1	1	0	0	0	1	1	1	1	7
Mylonas et al., 2021	No	1	0	1	0	0	1	1	0	1	1	6
Rodriguez-Sanz et al., 2021	No	1	1	1	0	0	1	1	1	1	1	8
Abdel-Aal et al., 2021	Yes	1	1	1	0	0	1	1	1	1	1	8
Bakken et al., 2021	Yes	1	1	1	0	0	1	1	1	1	1	8
Galaasen Bakken et al., 2021	Yes	1	1	1	0	0	1	1	1	1	1	8
Rodriguez-Sanz et al., 2022	No	1	1	1	0	0	1	1	0	1	1	7
Tahir et al., 2022	Yes	1	0	1	1	0	0	1	0	1	1	6
Akguller et al., 2024	Yes	1	1	1	0	1	1	1	0	1	1	8
Bostan & Kaya, 2024	Yes	1	0	1	0	0	0	1	1	1	1	6
Satpute et al., 2024	Yes	1	1	1	1	0	1	1	1	1	1	9
Uzun, Ekmekyapar Firat et al., 2024	Yes	1	0	1	0	0	0	0	0	1	1	4
Uzun, Ikidag et al., 2024	Yes	1	0	1	0	0	0	0	0	1	1	4

The methodological quality of the 20 included randomized controlled trials (RCTs) was assessed using the Physiotherapy Evidence Database (PEDro) scale, with total scores ranging from 4 to 9 out of a maximum of 10. The majority of studies demonstrated moderate methodological quality (scores 6–8), with three studies achieving high-quality ratings (≥8 points), including those by Dunning et al., Rodriguez-Sanz et al., and Satpute et al. The lowest scores (4 points) were observed in trials by K.-S. Lee & Lee and Uzun et al., primarily due to the absence of blinding and incomplete follow-up procedures.

Common methodological limitations included a lack of blinding of subjects and therapists, which is a typical challenge in manual therapy research due to the nature of the intervention. However, random allocation, baseline comparability, and between-group comparisons were consistently reported across most trials. Overall, the included RCTs provide moderate to strong evidence supporting the methodological rigor of studies examining the combined effects of manual therapy and exercise for neck pain.

The studies identified in this scoping review involved a variety of neck pain conditions. Most studies included patients with chronic non-specific neck pain.[14,15,19,32,33,39,43] Or mechanical neck pain.[28,35,36,40,42] Several studies specifically examined patients with cervicogenic headache.[30,34,37,38,41] Others targeted patients with persistent/recurrent neck pain.[29,31] And subacute disabling neck pain.[27] This distribution indicates a predominance of chronic non-specific conditions as the primary target for combined manual therapy and exercise.

Pain intensity was consistently evaluated across studies, though the choice of instruments varied. The Visual Analogue Scale (VAS) was the most frequently employed,[14,15,19,28,33,35,37–42] followed by the Numeric Pain Rating Scale (NPRS),[30,32,36,43] and the Numeric Rating Scale-11 (NRS-11).[29,31] Only one study applied the Chronic Pain Grade (CPG) questionnaire, with pain intensity assessed based on the NRS-11.[27] Meanwhile, another study reported pain intensity on a 0–10 scale without specifying the measurement instrument.[34] Although NPRS and NRS-11 both represent a numerical 0-10 scale for pain intensity, in this review, they were reported separately according to how they were described in the original articles.

The characteristics of the included randomized controlled trials are summarized in Table 2, while the primary outcomes and effect estimates reported by each study are presented in Table 3. Across the 20 included studies, sample sizes ranged from 18 to 619 participants and represented a broad spectrum of neck pain conditions, including chronic non-specific neck pain, mechanical neck pain, cervicogenic headache, subacute disabling neck pain, and persistent or recurrent neck pain. Considerable variation was observed in intervention protocols, comparator groups, treatment duration, follow-up periods, and outcome measures.

As shown in Table 2, the most commonly investigated interventions involved combinations of manual therapy and exercise, including spinal manipulation, joint mobilization, connective tissue massage, instrument-assisted soft tissue mobilization, osteopathic manipulative treatment, and clinical Pilates-based approaches. These manual therapy techniques were frequently combined with stabilization, strengthening, stretching, neuromuscular control, or deep cervical flexor exercises. Despite substantial heterogeneity in treatment protocols and dosage parameters, most studies reported favorable outcomes following combined interventions.

The effectiveness of these interventions is summarized in Table 3. Overall, the findings demonstrated that manual therapy combined with exercise was associated with greater improvements in pain intensity, neck-related disability, cervical mobility, and functional outcomes compared with exercise alone or other control interventions. Several studies reported statistically significant reductions in pain and disability, together with improvements in pressure pain threshold, cervical range of motion, muscle endurance, and patient-reported recovery. However, a small number of studies involving persistent or recurrent neck pain populations reported non-significant between-group differences.

Considerable heterogeneity was also observed in the outcome assessment tools used across studies. Pain assessment instruments are summarized in Table 4, demonstrating the predominance of the Visual Analogue Scale (VAS), followed by the Numeric Pain Rating Scale (NPRS) and Numeric Rating Scale-11 (NRS-11). Functional disability and health-related quality of life measures are presented in Table 5, with the Neck Disability Index (NDI) being the most frequently used instrument. Physical and functional assessment tools are summarized in Table 6, including measures of cervical range of motion, pressure pain threshold, deep neck flexor endurance, postural alignment, and autonomic function. Collectively, these instruments provided a comprehensive evaluation of pain, disability, physical performance, and functional status across the included studies.

Table 2. Summary of Included Randomized Controlled Trials on Manual Therapy and Exercise for Neck Pain

Author(s), Year	Country	Population and Sample Size	Intervention	Outcomes	Follow-up	Funding Sources
Celenay, Akabyrak et al., 2016	Turkey	Mechanical neck pain (n=102)	A: Cervical and scapulothoracic stabilization exercise + Maitland mobilization B: Cervical and scapulothoracic stabilization exercise	NDI, VAS (rest, activity, night), PPT, cervical ROM, QoL (SF-36 PCS/MCS)	4 weeks	None
Celenay, Kaya et al., 2016	Turkey	Mechanical neck pain (n=60)	A: Cervical and scapulothoracic stabilization exercise + Connective tissue massage B: Cervical and scapulothoracic stabilization exercise	NDI, PPT, Anxiety (STAI), Mental health (SF-36 MCS)	4 weeks	None
Dunning et al., 2016	USA	Cervicogenic headache (n=110)	A: Cervical–thoracic manipulation B: Mobilization + Exercise	Headache intensity (NPRS), frequency, duration, NDI, medication intake, GRC	1 week, 4 weeks, 3 months	None
K.-W. Lee & Kim, 2016	South Korea	Chronic non-specific neck pain (n=46)	A: Thoracic manipulation + Deep craniocervical flexor (DCF) training B: DCF training C: Active self-exercise	Pain (VAS), NDI, Muscle strength and endurance, Cervical/thoracic ROM	10 weeks	Not reported
K.-S. Lee & Lee, 2017	South Korea	Chronic non-specific neck pain (n=18)	A: Maitland mobilization (Grade III–IV) + Therapeutic exercise B: Therapeutic exercise	Pain (VAS), NDI, Cervical ROM, Static balance, Upper trapezius tone, Respiratory function	2 weeks	Not reported
Rodriguez-Sanz et al., 2020	Spain	Chronic neck pain (n=58)	A: Exercise B: Manual therapy + Exercise	NDI, FRT, VAS, CCFT, PPT, GRC, adherence	Baseline, post, 3 and 6 months	Not reported
Groisman et al., 2020	Brazil	Chronic non-specific neck pain (n=90)	A: Exercise B: Osteopathic manipulative treatment (OMT) + Exercise	NDI, Pain intensity, PPT, Cervical ROM	Baseline, post, 3 months	None
Skillgate et al., 2020	Sweden	Subacute or persistent disabling neck pain (n=619)	A: Deep tissue massage therapy (DMT) B: Supervised strengthening and stretching exercise C: DMT + Exercise D: Advice to stay active	Pain intensity and disability (CPG), GPE, Sickness absence	7, 12, 26, and 52 weeks	Not reported
Mylonas et al., 2021	Greece	Mechanical neck pain (n=20)	A: IASTM + Neuromuscular exercise B: Massage + Neuromuscular exercise	CVA, VAS, NDI, Cervical ROM, Strength	Baseline, post, 2 and 4 weeks	None
Rodriguez-Sanz et al., 2021	Spain	Chronic neck pain with upper cervical rotation restriction (n=58)	A: Manual therapy + Exercise B: Exercise	NDI, FRT, PPT, Cervical ROM, Pain intensity	Baseline, post, 3 and 6 months	None
Abdel-Aal et al., 2021	Egypt	Cervicogenic headache (n=60)	A: Exercise B: Graston technique + Exercise	VAS, NDI, ROM, Headache frequency and duration, Medication intake, PPT, CCFT, GRC	Baseline, 2 and 4 weeks	Not reported
Bakken et al., 2021	Sweden	Persistent or recurrent neck pain (n=131)	A: Stretching B: Spinal manipulative therapy (SMT) + Stretching	NRS-11, McGill Pain Questionnaire, NDI, EQ-5D	Baseline, 1 and 2 weeks, and daily SMS	Not reported
Galaasen Bakken et al., 2021	Sweden	Persistent or recurrent neck pain (n=131)	A: SMT + Stretching B: Home stretching exercise	HRV (RMSSD), Other HRV indices	Baseline, 1 and 2 weeks	Not reported
Rodriguez-Sanz et al., 2022	Spain	Chronic neck pain with upper cervical dysfunction (n=58)	A: Cervical stabilization exercise B: Cervical stabilization exercise + Manual therapy	PPT, Cervical mobility, Pain intensity	Immediate (pre–post single session)	None
Tahir et al., 2022	Pakistan	Mechanical neck pain (n=36)	A: Upper thoracic spine mobilization + Mobility exercise B: Upper cervical spine mobilization + Stabilization exercise	NPRS, Cervical ROM, NDI	Weekly × 4 weeks	None
Akguller et al., 2024	Turkey	Mechanical neck pain (n=60)	A: Cervical thrust manipulation B: Supervised progressive exercise program C: Manipulation + Exercise	VAS, NDI, PPT, ROM, SF-36, GRC	6 weeks (2×/week)	Not reported
Bostan & Kaya, 2024	Turkey	Chronic neck pain (n=48)	A: Exercise therapy B: IASTM + Exercise therapy	VAS, DNF endurance	Baseline, 4 weeks	Not reported
Satpute et al., 2024	India	Cervicogenic headache (n=99)	A: Exercise B: Mulligan manual therapy (MMT) + Exercise C: Sham MMT + Exercise	Headache frequency, Intensity, Duration, Disability, Medication intake, ROM, PPT, Satisfaction	Baseline, 4, 13, and 26 weeks	None
Uzun, Ekmekyapar Firat et al., 2024	Turkey	Cervicogenic headache (n=37)	A: Cervical mobilization B: Clinical Pilates exercise C: Cervical mobilization + Pilates exercise	Headache frequency and intensity (VAS), Medication intake, Posture (head/shoulder alignment, translation), Cervical ROM, DNF endurance	Baseline, 6 weeks	None
Uzun, Ikidag et al., 2024	Turkey	Cervicogenic headache (n=25)	A: Cervical mobilization B: Cervical mobilization + Clinical Pilates exercise	Headache intensity (VAS), Frequency, Medication intake, Muscle stiffness, ICA and VA blood flow	Baseline, 6 weeks	None

Note:
NDI = Neck Disability Index; VAS = Visual Analog Scale; PPT = Pressure Pain Threshold; ROM = Range of Motion; QoL = Quality of Life; SF-36 = Short Form Health Survey; PCS = Physical Component Summary; MCS = Mental Component Summary; STAI = State–Trait Anxiety Inventory; NPRS = Numeric Pain Rating Scale; GRC = Global Rating of Change; FRT = Flexion Rotation Test; CCFT = Craniocervical Flexion Test; DCF = Deep Craniocervical Flexor; DNF = Deep Neck Flexor; SMT = Spinal Manipulative Therapy; HRV = Heart Rate Variability; RMSSD = Root Mean Square of Successive Differences; ICA = Internal Carotid Artery; VA = Vertebral Artery; CPG = Clinical Practice Guidelines; GPE = Global Perceived Effect; IASTM = Instrument-Assisted Soft Tissue Mobilization; OMT = Osteopathic Manipulative Treatment; MMT = Mulligan Manual Therapy.

Table 3. Summary of Population, Primary Outcomes, and Effect Estimates of Included Randomized Controlled Trials

References	Population	Primary Outcomes	Effect Estimate
Celenay, Akbayrak, et al., 2016	Mechanical neck pain	NDI	StEx+MT improved cervical rotation (−4.3° to −5.0°; p<0.05), nocturnal pain (−1.1 cm; 95% CI 0.0–2.3; p<0.05), NDI (+2.2; 95% CI 0.1–4.3; p<0.05), SF-36 PCS (−2.9; 95% CI −5.4 to −0.4), and MCS (−3.1; 95% CI −6.2 to 0.0).
Celenay, Kaya, et al., 2016	Mechanical neck pain	NDI, VAS	Night pain, PPT, anxiety, and mental health improved more in the StEx+CTM group (p<0.05).
Dunning et al., 2016	Cervicogenic headache	NPRS	Manipulation group showed higher GRC (p<0.001), fewer and shorter headaches (p<0.001), and larger reductions in headache intensity and NDI (p<0.001).
K.-W. Lee & Kim, 2016	Chronic nonspecific neck pain	VAS, NDI, Muscle strength, Endurance, Cervical/Thoracic ROM	Pain, NDI, ROM, strength, and endurance all improved in the TM+DCF training group (p<0.05).
K.-S. Lee & Lee, 2017	Chronic nonspecific neck pain	VAS, NDI, Cervical ROM	Both groups improved (p<0.05); exercise + mobilization performed better in right rotation and lateral flexion (p<0.05).
Groisman et al., 2020	Chronic nonspecific neck pain	NDI, NPRS, PPT	Pain (p=0.001), PPT (p=0.002), and NDI (p=0.006) improved significantly; ROM not affected (p=0.161).
Mylonas et al., 2021	Mechanical neck pain	CVA, VAS, NDI, Cervical ROM, Strength	VAS (short-term −5.97 vs −3.1; p<0.05), CVA (+7.2° vs +1.1°), NDI (−25.2 vs −5.8).
Rodriguez-Sanz et al., 2021	Chronic neck pain with upper cervical rotation restriction	NDI, FRT	At 6 months, MT+Exercise improved NDI, FRT, pain, PPT, and ROM (all p<0.005).
Rodriguez-Sanz et al., 2022	Chronic neck pain with upper cervical dysfunction	PPT	Exercise-only group declined (p<0.05); MT+Exercise improved cervical flexion, FRT, and pain intensity (p<0.05).
Tahir et al., 2022	Mechanical neck pain	NPRS, Cervical ROM	NDI wk4: Group A 17.40±5.66 vs Group B 5.37±3.46 (p=0.00); ROM ↑ in Group B (p<0.05); NPRS wk4: Group A 4.26±1.09 vs Group B 1.00±0.89 (p=0.00).
Akguller et al., 2024	Mechanical neck pain	VAS, NDI	Manual therapy + exercise superior (VAS-rest p=0.004; activity p=0.009; night p=0.011); NDI MD −10.25 (MCID 7.5); ES=0.36 (large).
Rodriguez-Sanz et al., 2020	Chronic neck pain	NDI, FRT	FRT +20.53±2.58° (d=2.21); NDI −7.10 to −7.55 (d=1.20–1.33; all p<0.001).
Abdel-Aal et al., 2021	Cervicogenic headache	VAS, NDI	NDI −3.0 to −3.1 (p=0.038–0.027); VAS −8.9 to −11.37 (p=0.002–0.0001).
Bakken et al., 2021	Persistent/recurrent neck pain	McGill Pain Questionnaire, NRS-11	No significant differences (NRS-11: p=0.305; McGill: p=0.879; NDI: p=0.514).
Galaasen Bakken et al., 2021	Persistent/recurrent neck pain	HRV	SDNN (p=0.792), HF power (p=0.935), RMSSD (p=0.829); no significant effects.
Bostan & Kaya, 2024	Chronic neck pain	VAS, DNF endurance	CT group ↑ DNF endurance (p<0.05); between-group p=0.143 (NS); VAS difference significant (p=0.019).
Satpute et al., 2024	Cervicogenic headache	Headache frequency, intensity, disability	Headache frequency ↓2–4 days/month; intensity ↓1.2/10; disability ↓8 points (all p<0.001).
Uzun, Ekmekyapar Firat, et al., 2024	Cervicogenic headache	Headache frequency, VAS, Medication intake	CM & CM+CPE improved pain, posture, and cervical mobility (p<0.05); DNFE ↑ most in CM+CPE (p=0.001).
Uzun, Ikidag, et al., 2024	Cervicogenic headache	Headache frequency, VAS, Medication intake, Muscle stiffness, ICA & VA blood flow	Both groups improved (p<0.05); CM+CPE superior in left SCM stiffness (p=0.044) and headache intensity (p=0.025).
Skillgate et al., 2020	Subacute/persistent disabling neck pain	Pain intensity, disability (CPQ NRS-11)	Massage + exercise improved perceived recovery (RR 1.28–1.39; p<0.05), but no consistent long-term effects on disability or sick leave.

Table 4. Summary of Pain Assessment Instruments Used Across Included Studies

Instrument	Description	Number of Studies (n)
Visual Analogue Scale (VAS)	100-mm continuous scale used to quantify pain intensity, with endpoints representing “no pain” and “worst imaginable pain.”	12
Numeric Pain Rating Scale (NPRS)	11-point numerical rating scale ranging from 0 (“no pain”) to 10 (“worst possible pain”).	4
Numeric Rating Scale-11 (NRS-11)	11-point numerical rating scale assessing pain severity, typically ranging from 0 to 10.	4

Table 5. Functional Disability and Health-Related Quality of Life Instruments

Instrument	Description	Number of Studies (n)
Neck Disability Index (NDI)	Ten-item questionnaire assessing self-reported neck-related disability in daily activities.	14
Short Form-36 (SF-36)	Health-related quality of life questionnaire assessing eight domains including physical and mental components.	2
Cervical Pain Questionnaire (CPQ)	Composite index evaluating pain intensity, functional limitation, and disability related to neck pain.	1
Headache Disability Index (HDI)	Tool used to assess the impact of headache on daily functioning and quality of life.	2

Table 6. Range of Motion, Muscle Performance, and Postural Assessment Instruments

Instrument	Description	Number of Studies (n)
Cervical Range of Motion (CROM) Goniometer	Device used to measure cervical spine movement across flexion, extension, lateral flexion, and rotation.	9
Flexion Rotation Test (FRT)	Clinical test assessing upper cervical spine rotation, commonly used in cervicogenic headache assessment.	3
Craniovertebral Angle (CVA)	Photographic measure used to evaluate forward head posture and cervical alignment.	2
Pressure Pain Threshold (PPT)	Quantitative measure of mechanical pain sensitivity, typically assessed with algometry.	5
Deep Neck Flexor Endurance Test (DNFE)	Functional test to assess the endurance capacity of deep cervical flexor muscles.	2
Heart Rate Variability (HRV)	Physiological measure of autonomic nervous system activity related to pain and recovery.	1

Discussion

This review demonstrates that the combination of manual therapy and exercise generally results in pain reduction across various neck pain conditions. The findings support the theory that manual therapy exerts neuromodulatory effects through the inhibition of nociceptors and stimulation of mechanoreceptors.[44] Exercise also contributes to pain reduction at the central nervous system level by enhancing the release of endogenous opioids and serotonin, thereby activating pain-inhibitory pathways while simultaneously decreasing NMDA receptor phosphorylation and serotonin transporter expression, both of which are involved in pain facilitation.[45]

The combination of these approaches may produce synergistic effects, leading to faster pain relief alongside improved cervical function. However, the existing evidence remains highly heterogeneous in terms of manual therapy techniques, exercise protocols, population characteristics, as well as intervention dose and frequency. Reported intervention frequencies range from 1–3 sessions per week, typically delivered over 2–10 weeks, although some trials included longer follow-up assessments extending to 6 or even 12 months. Most studies also incorporated a home exercise program. Such variability in dosage and duration may contribute to inconsistent outcomes across studies. Shorter protocols may not allow sufficient time for motor adaptation, while longer or more intensive regimens could enhance effects but reduce adherence. This highlights the need for standardized protocols to ensure comparability and clinical applicability.

The combined approach of manual therapy and exercise is not limited to mechanical or nonspecific neck pain but has also been applied to conditions such as cervicogenic headache, persistent/recurrent neck pain, and subacute disabling neck pain. This suggests that the intervention may apply to a wide range of patient populations. Furthermore, studies outside the scope of this review have shown that the combination of mechanical traction, segmental mobilization, and exercise therapy is effective in reducing pain and disability in patients with cervical radiculopathy.[46] Our findings are consistent with a recent systematic review and meta-analysis, which concluded that manual therapy combined with therapeutic exercise is among the most effective approaches for reducing pain in patients with chronic non-specific neck pain, although heterogeneity and methodological concerns limit the certainty of evidence.[47]

Beyond the clinical interpretations, it is also important to consider the strength of evidence. While most included RCTs demonstrated moderate to high methodological quality based on PEDro scores, the predominance of small to medium sample sizes, with only one large-scale pragmatic trial, together with inherent difficulties of blinding participants and therapists, as well as variability in protocols and outcomes, limits consistency and reduces overall certainty.

Pain measurement instruments used across the included studies were relatively consistent, with the Visual Analogue Scale (VAS) being the most frequently employed, followed by the Numeric Pain Rating Scale (NPRS) and the 11-point Numeric Rating Scale (NRS-11). The VAS has demonstrated high validity and reliability in assessing subjective pain perception.[48] Nevertheless, the coexistence of multiple instruments complicated direct comparison across studies and may partly explain divergent findings. Some trials also failed to specify the instrument clearly, underscoring the need for standardized outcome measures in future research. Importantly, most included studies evaluated broader and more specific outcomes, such as cervical disability and function,[19] head and shoulder posture,[37] health-related quality of life,[35] anxiety levels,[42] And heart rate variability.[31] Additionally, other studies have identified the cost-effectiveness of manual therapy combined with exercise.[49] These findings extend the clinical relevance of this combined intervention, although such outcomes were not systematically mapped in this review.

This review has several limitations that should be acknowledged. At the study level, the sample size mostly ranged from 18 to around 100 participants, with only one large pragmatic trial.[27] The predominance of small-scale, often single-center RCTs reduces statistical power and limits the generalizability of findings. Methodological concerns also persisted, such as inconsistent blinding and variation in intervention protocols, as reflected in the moderate-to-high but not uniformly strong PEDro scores. Follow-up periods varied substantially, with some studies assessing only immediate or short-term effects, while others extended assessments up to 6 or even 12 months, which limits comparability and conclusions regarding long-term effectiveness.

At the outcome level, pain was consistently assessed but not always designated as the primary outcome. The studies used different measurement instruments, such as VAS, NPRS, NRS-11, and the Chronic Pain Grade questionnaire, which complicates direct comparisons. While pain reduction was the dominant outcome, other relevant domains such as disability, quality of life, cost-effectiveness, or physiological markers were less consistently prioritized. This variability restricts synthesis and may underrepresent the broader impact of combined manual therapy and exercise.

At the review level, inclusion was restricted to open-access, English-language RCTs indexed in only three databases, which may have excluded relevant evidence published elsewhere or in other languages. This selective inclusion introduces the possibility of publication and language bias. In addition, PEDro ratings were conducted by a single reviewer rather than being independently duplicated, which may increase the risk of subjective bias. Moreover, the review protocol was not formally registered, which may reduce methodological transparency. Most included populations were also reported only as adults with chronic or mechanical neck pain, without detailed demographic information such as age ranges, sex distribution, or occupational background. This limits the assessment of generalizability to older adults or pediatric populations and to patients with different baseline severity or comorbidities.

Finally, individual trial findings were heterogeneous, with variability in the outcomes assessed and in the significance of reported effects, which makes synthesis challenging. Potential publication bias toward positive findings cannot be excluded, particularly given the small sample sizes and single-center nature of many trials.

From a clinical standpoint, the available evidence indicates that combining manual therapy with exercise, most frequently high velocity low amplitude (HVLA) manipulation with craniocervical flexion exercise, provides consistent short-term pain relief in adults with chronic or non-specific neck pain. These findings are in line with the recent systematic review by Wilhelm et al., which also reported short-term benefits of combined interventions, although evidence for sustained long-term effects remains limited.[22] Importantly, this pattern reflects the included trials in this review, the majority of which targeted chronic or non-specific neck pain and assessed short-term outcomes.

For primary care clinicians, exercise should remain the cornerstone of management, with manual therapy added selectively to address movement restriction or higher pain intensity. For specialist practitioners, such as musculoskeletal physiotherapists or chiropractors, more advanced combinations, such as HVLA with craniocervical flexion, may be considered when appropriate, provided they are tailored to patient safety and clinical context. Individualized approaches based on patient characteristics, technique preference, and contextual factors are essential.

Given the predominance of small to medium sample sizes in most trials, variability in intervention protocols and methodological quality, and many studies had relatively short intervention and follow-up durations, the overall confidence in these findings is moderate. Current recommendations should therefore be regarded as tentative and applied with caution until larger,

more definitive trials are available. Future research should prioritize more homogeneous designs, longer follow-up, cost-effectiveness analyses, and systematic assessment of non-pain outcomes to provide a more comprehensive evaluation of these interventions.

Conclusion

This scoping review is among the first to systematically map variations in manual therapy and exercise combination and pain assessment tools for neck pain. The most frequently applied combination, HVLA manipulation with craniocervical flexion exercise, shows consistent short-term benefits, particularly for chronic non-specific neck pain, in line with previous reviews. Clinicians may consider integrating this combined strategy as an adjunct to standard exercise programs, while the heterogeneity of interventions and outcomes limits firm recommendations. Future research should prioritize long-term randomized trials, cost-effectiveness analysis, and patient-centered outcomes to strengthen the evidence base and guide clinical practice.

Author Contribution

Taufik Eko Susilo: Conceptualization, Supervision.
Salsabila Malikatul Jannah: Data curation, Investigation, Literature search, Writing – original draft.
Salsabila Malikatul Jannah and Taufik Eko Susilo: Methodology, Data interpretation, Writing – review and editing.
All authors have read and approved the final version of the manuscript.

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