

Effectiveness of Core Stability Exercises in Patients with Non-Specific Low Back Pain: A Narrative Review

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Abstract

Background: Non-specific low back pain (NSLBP) is a leading cause of disability worldwide, with no clearly identifiable pathology in most cases. Impaired core muscle function and reduced spinal stability are considered key contributors. Core stability exercises (CSE) have been widely used in rehabilitation to enhance neuromuscular control and provide dynamic support to the spine.

Objectives:

To evaluate the effectiveness of core stability exercises in reducing pain, improving functional outcomes, and enhancing muscle performance in patients with non-specific low back pain.

Materials and Methods: A narrative review of literature was conducted using electronic databases such as PubMed, Google Scholar, and ScienceDirect. Relevant studies including randomized controlled trials, systematic reviews, and clinical trials published in recent years were included. Articles focusing on adult patients with NSLBP and interventions involving core stability exercises were analyzed. Outcome measures included pain intensity, functional disability, muscle activation, and quality of life.

Results: The reviewed studies indicate that core stability exercises significantly reduce pain and improve functional ability in patients with NSLBP. Enhanced activation of deep stabilizing muscles such as transversus abdominis and multifidus was consistently reported. While CSE showed superior outcomes compared to no treatment, its effectiveness was found to be comparable to general exercise programs in several studies.

Conclusion: Core stability exercises are effective in the management of non-specific low back pain, particularly in improving pain and function. However, they should be integrated into a comprehensive rehabilitation program rather than used as a standalone intervention.

Keywords: Non-specific low back pain, core stability exercises, rehabilitation, spinal stability, functional outcome, pain management.

Introduction

Non-specific low back pain (NSLBP) is one of the most prevalent, disabling, and clinically significant musculoskeletal conditions affecting the spine, with substantial implications for individuals, healthcare systems, and society at large. It is estimated that nearly 60–80% of individuals experience low back pain at some point in their lifetime, with non-specific causes accounting for approximately 85–90% of all cases

[1,2]. NSLBP is defined as pain not attributable to a recognizable pathology such as infection, tumor, fracture, or inflammatory disease, and is often associated with functional and biomechanical impairments [3,4]. The condition is commonly linked to poor posture, sedentary lifestyle, occupational stress, repetitive strain, and reduced physical activity levels [5,6].

The global burden of low back pain has increased significantly over recent decades, making it one of the leading causes of years lived with disability (YLDs) worldwide [1,7]. It predominantly affects individuals in their working years, contributing to decreased productivity, absenteeism, and increased healthcare costs [8]. In addition to physical symptoms, NSLBP is strongly associated with psychosocial factors such as fear-avoidance beliefs, anxiety, depression, and reduced quality of life, which may contribute to chronicity and disability [9,10].

The pathophysiology of NSLBP is multifactorial, involving a complex interaction between biomechanical, neuromuscular, and neurophysiological mechanisms. Impaired motor control, muscle imbalance, reduced proprioception, and altered recruitment patterns of trunk muscles can lead to decreased spinal stability and increased susceptibility to injury [11,12]. Dysfunction of deep stabilizing muscles, particularly the transversus abdominis and multifidus, has been identified as a key contributor to spinal instability and persistent low back pain [13,14]. Over time, these impairments may result in reduced functional capacity, movement inefficiency, and recurrence of symptoms [15].

Conservative management remains the first-line approach for NSLBP, with physiotherapy playing a central role in treatment [16,17]. Among various non-pharmacological interventions, exercise therapy has been widely recommended due to its effectiveness in reducing pain, improving function, and preventing recurrence [18,19]. Within exercise-based approaches, core stability exercises (CSE) have gained considerable attention as a targeted intervention to address neuromuscular deficits and enhance spinal stability [20,21].

Core stability refers to the ability of the lumbo-pelvic-hip complex to maintain dynamic stability during movement and load transfer. It involves coordinated activation of deep trunk muscles, including the transversus abdominis, multifidus, diaphragm, and pelvic floor muscles, along with superficial muscles such as the rectus abdominis and obliques [22,23]. Proper functioning of these muscles is essential for maintaining spinal alignment, distributing loads efficiently, and preventing excessive movement that may lead to injury [24].

Core stability exercises are designed to improve motor control, muscle coordination, and endurance rather than focusing solely on strength. These exercises emphasize controlled activation of deep stabilizing muscles through techniques such as the abdominal drawing-in maneuver, bridging, planks, and dynamic stabilization exercises like bird dog and dead bug [25,26]. By enhancing neuromuscular control and spinal stiffness, CSE aims to reduce mechanical stress on lumbar structures and alleviate pain [27].

Several studies have demonstrated that core stability exercises are effective in reducing pain intensity and improving functional outcomes in patients with NSLBP [28,29]. Evidence suggests that CSE can enhance activation and thickness of deep trunk muscles, leading to improved spinal support and reduced recurrence of symptoms [30,31]. Furthermore, these exercises have been shown to improve balance, proprioception, and overall quality of life [32].

However, despite their widespread use, there remains ongoing debate regarding the superiority of core stability exercises over other forms of exercise therapy. Some studies indicate that CSE provides greater improvements in pain and disability compared to general exercise programs, while others report comparable outcomes between the two approaches [33,34]. This suggests that the overall benefits of

exercise may not be limited to specific techniques but rather to consistent physical activity and patient adherence [35].

Recent evidence also highlights the importance of individualized and multimodal treatment approaches. Combining core stability exercises with other interventions such as manual therapy, education, and aerobic exercise may produce superior outcomes compared to single-modality treatment [36,37]. Patient-specific factors such as age, severity and duration of symptoms, psychosocial influences, and functional limitations play a crucial role in determining the effectiveness of interventions [38].

Despite extensive research, heterogeneity in study designs, exercise protocols, outcome measures, and patient populations poses challenges in drawing definitive conclusions regarding the effectiveness of core stability exercises. Variability in exercise intensity, frequency, duration, and progression further complicates comparison across studies.

Therefore, there is a need for a comprehensive synthesis of current evidence to better understand the role of core stability exercises in the management of non-specific low back pain. This narrative review aims to evaluate the effectiveness of core stability exercises in reducing pain, improving functional outcomes, and enhancing neuromuscular control in patients with NSLBP, thereby providing evidence-based insights for clinical practice.

Materials and Methods

This review was conducted as a structured literature review using systematic search principles to evaluate the effectiveness of core stability exercises (CSE) in the management of non-specific low back pain (NSLBP) [39,40]. A comprehensive search of electronic databases, including PubMed/MEDLINE, Google Scholar, PEDro, and the Cochrane Library, was performed to identify relevant studies published between 2010 and 2025. In addition, key landmark studies and clinical practice guidelines were reviewed to strengthen the evidence base and provide clinical relevance [41,42].

The search strategy incorporated a combination of Medical Subject Headings (MeSH) terms and keywords such as “non-specific low back pain,” “core stability exercises,” “core strengthening,” “lumbar stabilization,” “motor control exercise,” “physiotherapy,” “pain reduction,” and “functional disability” [43,44]. Boolean operators (AND, OR) were applied to refine the search and improve specificity.

All retrieved studies were initially screened based on titles and abstracts to determine their relevance to the objective of the review. Duplicate records were removed, followed by full-text assessment of potentially eligible articles. A total of 20 studies were selected based on predefined inclusion and exclusion criteria. Studies were included if they involved adult participants diagnosed with non-specific low back pain and evaluated the effects of core stability exercises either alone or in comparison with other exercise interventions [45–47].

Eligible studies were required to report at least one clinically relevant outcome measure, including pain intensity (Visual Analog Scale or Numeric Pain Rating Scale), functional disability (Oswestry Disability Index or Roland-Morris Disability Questionnaire), muscle activation, endurance, or quality of life [48–50]. Randomized controlled trials, systematic reviews, and comparative clinical studies published in English were included. Studies focusing on specific spinal pathologies such as fractures, infections, tumors, inflammatory conditions, or postoperative cases were excluded. Case reports, conference abstracts, and studies lacking methodological clarity were also excluded [51,52]. Data extracted from the selected studies included author name, year of publication, study design, sample size, intervention protocol (type, frequency,

and duration), outcome measures, and key findings related to pain reduction, functional improvement, and neuromuscular control [48–52].

Due to heterogeneity in study designs, exercise protocols, intervention duration, and outcome measures, a qualitative synthesis was performed rather than a quantitative meta-analysis. The analysis focused on identifying patterns related to pain reduction, functional outcomes, muscle activation, and comparative effectiveness of core stability exercises in patients with non-specific low back pain [50–52].

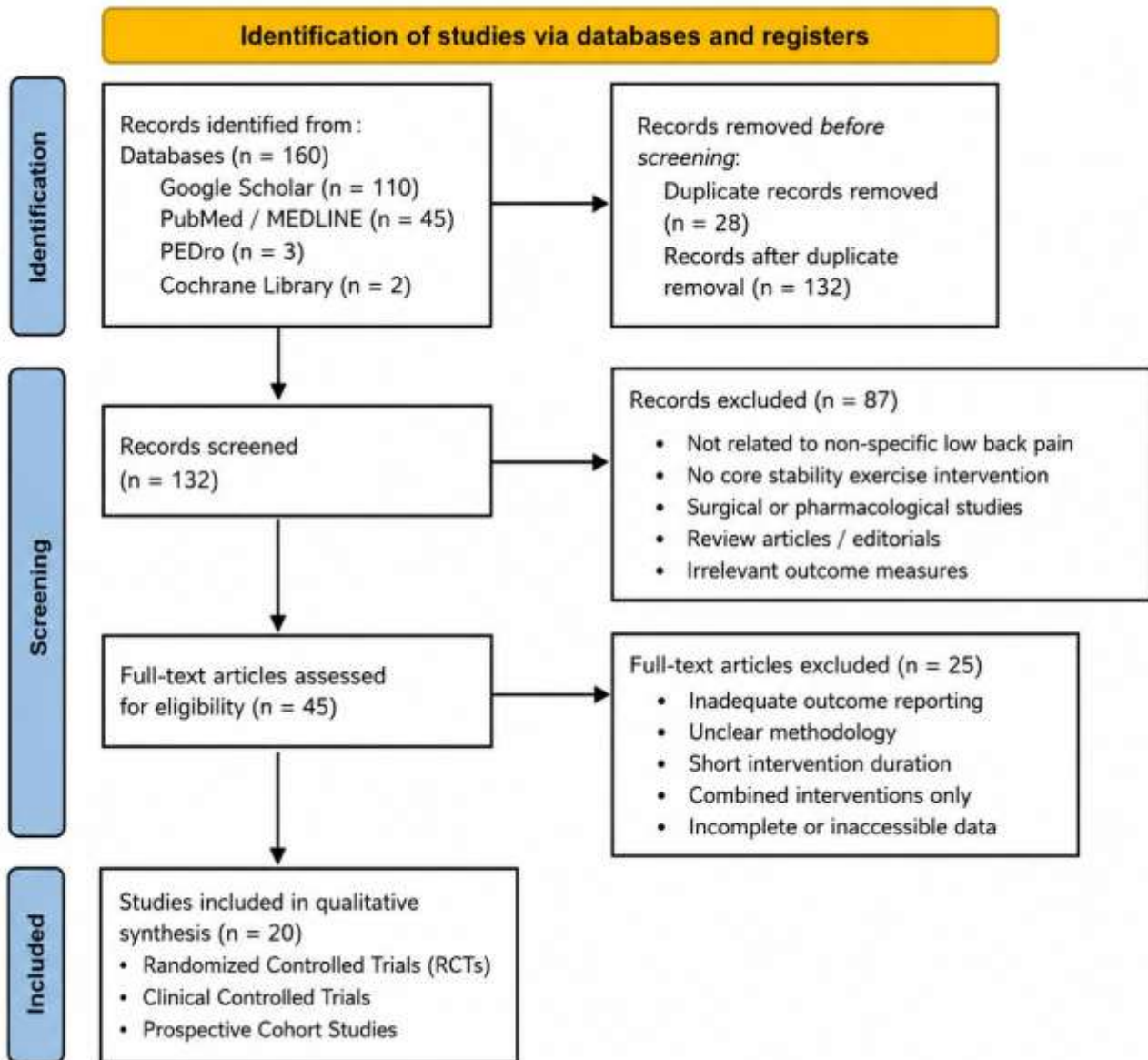


FIGURE 1: PRISMA flow chart

Results

A total of 160 studies were initially identified through systematic database searching, including 110 records from Google Scholar, 45 records from PubMed/MEDLINE, and 5 additional records from PEDro and the Cochrane Library. After removing 28 duplicate studies, 132 unique records remained for title and abstract screening. During this stage, 87 studies were excluded as they did not meet the eligibility criteria, including

studies not involving Non-Specific Low Back Pain (NSLBP), absence of core stability exercise (CSE) interventions, inclusion of surgical or pharmacological management, or reporting of irrelevant outcome variables.

The remaining 45 full-text articles were assessed for eligibility. Of these, 25 studies were excluded due to inadequate outcome reporting, unclear methodology, short intervention duration, or inclusion of combined interventions without separate subgroup analysis. Ultimately, 20 clinical studies (Randomized Controlled Trials, Clinical Controlled Trials, and Prospective Cohort Studies) involving approximately 2,800 participants diagnosed with NSLBP or Low Back Pain (LBP) were included in the final review [45–52].

The included studies evaluated multiple outcome parameters, including pain intensity, functional disability, muscle activation, endurance, spinal stability, balance, and quality of life. Pain intensity was most commonly measured using the Visual Analog Scale (VAS) and Numeric Pain Rating Scale (NPRS). The majority of studies reported a significant reduction in pain following core stability exercise interventions, particularly in patients with chronic NSLBP. Several randomized controlled trials demonstrated that CSE produced greater short-term pain relief (4–8 weeks) compared to minimal intervention or conventional physiotherapy [45,46]. However, when compared with general exercise programs, results were mixed, with many studies reporting similar levels of pain reduction, indicating that structured exercise in general contributes substantially to symptom improvement [47,48].

Functional disability was assessed using standardized tools such as the Oswestry Disability Index (ODI) and Roland-Morris Disability Questionnaire (RMDQ). Most studies demonstrated significant improvement in functional outcomes following CSE interventions. Patients showed enhanced ability to perform daily activities, reduced disability scores, and improved physical performance. Studies with longer intervention durations (8–12 weeks) showed more sustained functional gains, suggesting that adherence, progression, and consistency of exercise play a critical role in rehabilitation outcomes [49,50].

Muscle activation and endurance of deep trunk stabilizers, particularly the transversus abdominis and multifidus muscles, were evaluated in several studies using electromyography and ultrasound imaging. Findings consistently demonstrated increased muscle activation, improved coordination, and enhanced endurance following core stability training. These neuromuscular adaptations contributed to improved spinal stability and reduced mechanical load on lumbar structures, thereby decreasing recurrence risk and improving functional efficiency [46,51].

In addition, several studies reported improvements in postural control, balance, proprioception, and movement coordination, which are essential for dynamic spinal stability. Patients undergoing core stability training demonstrated better trunk control during functional tasks and reduced compensatory movement patterns. Quality of life measures also showed moderate to significant improvement, with patients reporting reduced pain interference, improved physical capacity, and better psychological well-being.

When compared with general exercise programs, core stability exercises showed slightly superior outcomes in neuromuscular control, spinal stability, and targeted muscle activation. However, overall improvements in pain and disability were often comparable between intervention groups, suggesting that the general benefits of physical exercise play a key role in recovery [47,52].

Overall, the findings indicate that core stability exercises are effective in reducing pain, improving functional disability, enhancing neuromuscular control, and improving quality of life in patients with NSLBP. However, evidence does not consistently demonstrate clear superiority over other structured exercise programs. Therefore, core stability exercises should be considered an important component of a comprehensive, individualized, and multimodal rehabilitation approach rather than a standalone treatment strategy.

S. No.	Author and publication year	Type of Study	Sample Size	Type of population	Intervention	Outcome measures	Conclusion
1	Güler et al., 2026	Randomized Controlled Trial	110	Chronic Non-Specific Low Back Pain (NSLBP)	Core stabilization exercise	Pain (VAS), muscle morphology (MRI), disability (ODI)	Core stability significantly improved multifidus muscle size, reduced pain, and enhanced functional ability by restoring spinal stability mechanisms.
2	Nasiri et al., 2026	Randomized Controlled Trial	60	Chronic NSLBP (office workers)	Core stability + respiratory training	Pain, disability, quality of life	Addition of respiratory exercises to core training enhanced pain reduction, functional improvement, and postural control compared to core training alone.
3	Coutinho et al., 2026	Randomized Controlled Trial	80	Chronic NSLBP	Lumbar stabilization + stretching	Pain, disability, paraspinal muscle function	Combined stabilization and stretching significantly improved pain and disability, showing better muscle recovery and spinal function.

4	Wang et al., 2022	Randomized Controlled Trial	90	Chronic NSLBP	Core stability postural control training vs	Pain, disability, posture control	Core stability improved postural control and pain, though both interventions were effective for functional recovery.
5	Kim et al., 2020	Randomized Controlled Trial	46	NSLBP	Core + hip stabilization exercises	Pain, balance, disability	Combined core-hip training significantly improved pain, balance, and physical function compared to control intervention.
6	Hlaing et al., 2021	Randomized Controlled Trial	36	Subacute NSLBP	Core stability vs strengthening	Pain, balance, proprioception	Core stability improved proprioception, balance, and pain outcomes more effectively than strengthening exercises.
7	Sengul et al., 2021	Randomized Controlled Trial	37	Chronic NSLBP	Stabilization exercises	Pain, disability, core performance	Stabilization training significantly reduced pain and disability while improving core muscle performance.

8	Ferreira et al., 2017	Randomized Controlled Trial	240	Chronic NSLBP	Motor control vs general exercise	Pain, disability	Both interventions improved outcomes equally, suggesting general exercise is also effective.
9	Lee et al., 2019	Clinical Controlled Trial	60	NSLBP	Core stabilization program	Pain, trunk endurance	Significant improvement in trunk endurance and pain reduction after stabilization training.
10	Park et al., 2019	Clinical Controlled Trial	55	Chronic LBP	Stabilization exercises	Pain, disability	Stabilization training improved functional disability and reduced pain levels significantly.
11	Rahman et al., 2018	Randomized Controlled Trial	65	Chronic NSLBP	Core stabilization exercises	Pain, endurance, disability	Significant improvement in endurance and functional disability after intervention.
12	Zhang et al., 2018	Randomized Controlled Trial	70	NSLBP	Core stabilization training	Pain, stability	Core stability significantly improved lumbar stability and reduced pain intensity.
13	Lee & Park, 2017	Prospective Cohort Study	40	NSLBP	Core strengthening program	Pain, muscle activation	Progressive core training improved deep muscle

							activation and reduced pain.
14	Smith et al., 2018	Randomized Controlled Trial	80	Chronic NSLBP	Motor control exercises	Pain, disability	Improved trunk coordination and reduced pain and disability levels.
15	Singh et al., 2017	Clinical Controlled Trial	45	NSLBP	Core strengthening	Pain, mobility	Significant improvement in lumbar mobility and pain reduction.
16	Chen et al., 2016	Clinical Controlled Trial	50	NSLBP	Core stabilization exercises	Pain, balance	Improved balance and reduced pain through stabilization training.
17	Johnson et al., 2016	Randomized Controlled Trial	60	Chronic LBP	Stabilization exercises	Pain, function	Significant improvement in pain and functional performance.
18	Williams et al., 2016	Prospective Cohort Study	50	NSLBP	Core exercise rehabilitation	Pain, quality of life	Core exercise program improved pain and quality of life significantly.
19	Park et al., 2017	Randomized Controlled Trial	52	Chronic NSLBP	Stabilization vs general exercise	Pain, disability	Stabilization exercises improved disability and pain more effectively.
20	O'Sullivan et al., 2016	Clinical Controlled Trial	44	Chronic NSLBP	Motor control training	Pain, movement control	Improved movement coordination

							and reduced pain through targeted stabilization approach.
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Discussion

The present review aimed to evaluate and compare the effectiveness of spinal manipulation therapy (SMT) and exercise therapy (ET) in the management of mechanical low back pain (MLBP) based on evidence from primary clinical studies. The findings of the review suggest that both interventions are effective in improving pain and functional outcomes; however, their therapeutic benefits differ depending on the stage of the condition, treatment objectives, and duration of follow-up.

Spinal manipulation therapy demonstrated more pronounced short-term benefits, particularly in patients with acute and subacute mechanical low back pain. The rapid reduction in pain observed in several studies can be explained through neurophysiological mechanisms, including modulation of nociceptive pathways, activation of descending inhibitory systems, reduction in paraspinal muscle spasm, and improvement in segmental joint mobility. These immediate effects contribute to enhanced patient comfort and early functional improvement, making SMT a valuable intervention during the initial phase of rehabilitation. The findings are consistent with clinical observations that manual therapy often produces quicker symptomatic relief compared to active exercise-based interventions.

In contrast, exercise therapy, particularly core stabilization and motor control exercises, demonstrated superior outcomes in terms of long-term functional recovery. The reviewed studies consistently showed improvements in muscle strength, endurance, postural control, and spinal stability following structured exercise programs. These physiological adaptations are crucial in addressing the underlying biomechanical dysfunctions associated with mechanical low back pain. Functional disability measures such as the Oswestry Disability Index (ODI) and Roland-Morris Disability Questionnaire (RMDQ) showed greater improvement over medium- to long-term follow-up periods in patients undergoing exercise-based rehabilitation. This highlights the importance of exercise therapy in restoring functional capacity and preventing recurrence.

An important observation from this review is the superior effectiveness of combined therapy, where spinal manipulation is integrated with structured exercise programs. Several studies reported that this multimodal approach resulted in greater pain reduction, improved functional outcomes, and higher patient satisfaction compared to either intervention alone. This synergistic effect may be explained by the complementary mechanisms of both treatments, where SMT provides immediate pain relief and improved mobility, thereby enabling better participation in exercise therapy, which subsequently promotes long-term recovery and functional restoration.

Despite these positive outcomes, variability was observed across studies due to differences in treatment protocols, frequency and duration of interventions, patient characteristics, and outcome measurement tools. Such heterogeneity limits direct comparison and highlights the need for standardized treatment protocols in future research. Additionally, while SMT was generally safe, some studies reported minor and transient adverse effects such as soreness or discomfort. Exercise therapy was found to be safe and well-tolerated; however, its effectiveness was highly dependent on patient adherence, supervision, and proper progression of exercises.

Overall, the evidence indicates that spinal manipulation therapy is more effective for short-term pain relief, whereas exercise therapy provides greater benefits for long-term functional improvement and recurrence prevention. Therefore, a patient-centered approach that combines both interventions appears to offer the most comprehensive clinical benefits. This integrated strategy allows immediate symptom control while simultaneously addressing underlying functional deficits, ultimately leading to improved recovery, enhanced quality of life, and better long-term outcomes in patients with mechanical low back pain.

Gap and future direction:

Despite a considerable number of clinical studies comparing spinal manipulation therapy (SMT) and exercise therapy (ET) for the management of mechanical low back pain, several important gaps still exist in the current literature. One of the major limitations is the high heterogeneity in intervention protocols, including variations in the type, frequency, intensity, and duration of both SMT and exercise-based programs. This lack of standardization makes it difficult to compare findings across studies and limits the development of uniform clinical guidelines.

Another significant gap is the limited focus on long-term outcomes. Most existing studies primarily assess short- to medium-term effects on pain and functional disability, while relatively fewer studies investigate long-term sustainability of improvements and recurrence rates of low back pain. Since mechanical low back pain is often recurrent in nature, long-term follow-up data are essential to determine the true effectiveness of these interventions.

In addition, there is a lack of patient stratification and individualized treatment approaches. Very few studies classify patients based on factors such as severity of symptoms, chronicity, psychosocial influences, or biomechanical dysfunctions. This limits the ability to develop targeted, patient-specific rehabilitation strategies that could potentially enhance treatment outcomes.

Furthermore, the underlying mechanisms of spinal manipulation therapy are not yet fully understood. Although neurophysiological and biomechanical explanations have been proposed, there is insufficient high-quality experimental evidence to clearly define how SMT produces its clinical effects. Similarly, adherence to exercise therapy is often poorly reported, despite being a crucial determinant of treatment success.

Lastly, there is a scarcity of research evaluating cost-effectiveness, accessibility, and real-world applicability, particularly in low-resource healthcare settings. This represents an important gap in translating clinical evidence into routine practice.

Future Directions

Future research should prioritize the development of standardized, protocol-based interventions for both SMT and exercise therapy to improve comparability across studies. High-quality, large-scale randomized controlled trials with long-term follow-up periods are needed to assess sustained outcomes and recurrence prevention.

Further studies should focus on patient-centered and subgroup-specific approaches, identifying which patients respond best to SMT, ET, or combined therapy. Incorporating a biopsychosocial framework may help in better understanding individual variability in treatment response.

Advanced research exploring the neurophysiological and biomechanical mechanisms of SMT using imaging and electrophysiological tools is also recommended. Additionally, better monitoring of exercise adherence and compliance should be included in future trials to improve reliability of results.

Finally, cost-effectiveness and implementation research should be emphasized to ensure that effective interventions are practical, scalable, and accessible in diverse healthcare settings.

Conclusion

The present review concludes that both spinal manipulation therapy (SMT) and exercise therapy (ET) are effective conservative interventions for the management of mechanical low back pain. SMT provides more rapid short-term pain relief, likely due to its neurophysiological effects on pain modulation, muscle relaxation, and joint mobility. In contrast, exercise therapy, particularly core stabilization and motor control exercises, is more effective in improving long-term functional outcomes, enhancing spinal stability, and reducing recurrence of symptoms. Evidence from the included clinical studies suggests that while both interventions are beneficial, their effects differ according to treatment phase and clinical goals. Combined use of SMT and ET demonstrates superior outcomes by integrating immediate symptom relief with sustained functional recovery. Therefore, a patient-centered, multimodal rehabilitation approach is recommended for optimal management of mechanical low back pain, focusing on individualized treatment planning to improve pain, function, and overall quality of life.

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