

THE EFFECT OF EXERCISE ON LOW BACK PAIN: CURRENT APPROACHES AND CLINICAL FINDINGS

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Abstract

Low back pain stands as one of the most common musculoskeletal disorders worldwide, affecting individuals across all age groups and leading to significant challenges in daily life. Over time, it can cause notable restrictions in mobility, declines in muscle strength, and a gradual loss of physical independence.

Beyond its physical consequences, low back pain can also have substantial psychological impacts. The ongoing discomfort and loss of function may contribute to lowered quality of life, while increasing the risk of anxiety, depression, and other emotional difficulties.

A growing body of research highlights that exercise interventions play an important role in managing low back pain. Studies have shown that well-structured exercise programs not only help to reduce pain, but also strengthen muscles and improve balance.

The purpose of this review is to critically assess the effectiveness of exercise-based strategies for managing low back pain, drawing from scientific studies published over the past decade

Keywords: Low back pain, exercise therapy, muscle strength, postural stability, quality of life.

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Introduction

Low back pain is recognized as one of the most common musculoskeletal conditions globally, significantly reducing quality of life and contributing to notable workforce losses. Recent reports estimate that around 619 million people worldwide were affected by low back pain in 2020, and projections suggest this number could rise to 843 million by 2050 [1].

Most cases are classified as "non-specific low back pain," a clinical category where no identifiable anatomical or pathological cause can be determined. This condition predominantly affects adults aged between 40 and 69, placing a heavy burden on healthcare systems around the world [1,2]. Factors such as poor posture, low physical activity, muscle weakness, and sedentary lifestyles are thought to be significant contributors to its development [3].

In recent years, exercise-based treatment methods have drawn increasing attention as viable and sustainable alternatives to pharmacological interventions. A growing number of randomized controlled trials and systematic reviews consistently highlight the benefits of exercise in the management of chronic non-specific low back pain [1,4].

Importantly, exercise programs do not just relieve pain; they also help improve postural stability, boost functional capacity, and support overall health and wellness [4,5]. Structured exercise modalities like core stabilization, motor control exercises, aerobic training, yoga, and Pilates have shown particular effectiveness in enhancing both physical and mental health outcomes [1,5,6,9].

Moreover, these interventions have demonstrated potential for alleviating psychological symptoms often associated with chronic pain, such as depression, anxiety, and fear-avoidance behaviors [5,7,8]. This wide range of benefits highlights the critical role exercise can play as part of a comprehensive treatment approach to low back pain.

This review primarily aims to examine the effectiveness of various exercise-based interventions for chronic non-specific low back pain, compare different methodologies used, and provide practical recommendations to inform clinical applications.

Low Back Pain Definition

Low back pain (LBP) is commonly defined as pain or discomfort located between the lower border of the 12th rib and the gluteal fold. This discomfort may radiate down into the legs and often comes with symptoms like muscle spasms, stiffness, and restricted mobility. Besides limiting everyday activities, low back pain also has a broader societal impact, including productivity loss and increased psychological stress, making it a serious public health concern [10].

According to a systematic review by Grooten et al. (2022), chronic low back pain (CLBP) is characterized by pain that persists for at least 12 weeks or reoccurs after symptom-free periods. This cyclical pattern distinguishes chronic cases and suggests the complexity of its underlying causes [11].

Although low back pain can arise from mechanical, inflammatory, infectious, neurological, or psychological origins, approximately 85% of cases are classified as "non-specific," meaning no exact cause can be pinpointed. As Polat and Karaoğlu (2017) emphasized, low back pain should be approached more as a symptom rather than a single diagnosis, requiring careful physical examination and, if needed, imaging studies to rule out specific conditions [10]. In addition, Grooten et al. (2022) define exercise therapy as a structured set of physical activities specifically designed with therapeutic goals to restore normal musculoskeletal function or reduce pain, emphasizing active rehabilitation as a cornerstone of treatment for low back pain [11].

Causes of Low Back Pain

Low back pain arises from a wide variety of causes, spanning mechanical, degenerative, inflammatory, infectious, metabolic, tumoral, vascular, and psychological factors. While mechanical origins are the most common in clinical practice, many systemic and localized factors can contribute to the onset and persistence of low back pain [12][13].

1. Mechanical Causes

Mechanical issues such as poor posture, staying in fixed positions for prolonged periods, repetitive movements, and heavy lifting place strain on the spinal structures. Conditions like disc herniation, facet joint dysfunction, and sacroiliac joint problems fall under this category [14].

2. Degenerative Causes

Age-related changes like disc degeneration, formation of bone spurs, and spinal canal narrowing can lead to nerve compression, resulting in pain [15]. These structural deteriorations become more common with aging.

3. Inflammatory Causes

Chronic inflammatory conditions like ankylosing spondylitis, reactive arthritis, and psoriatic arthritis often present with morning stiffness and contribute to chronic low back pain [13][16].

4. Metabolic Causes

Metabolic disorders such as osteoporosis compromise bone strength and integrity, making the spine more susceptible to fractures and resulting pain [12].

5. Infectious Causes

Spinal infections like vertebral osteomyelitis, discitis, and epidural abscesses can lead to severe, worsening back pain, often accompanied by systemic symptoms like fever [17].

6. Tumoral Causes

Primary or metastatic spinal tumors may present with persistent, rest-resistant pain, usually accompanied by systemic signs such as unexplained weight loss [18].

7. Traumatic Causes

Traumas like falls, car accidents, or sudden movements can injure spinal muscles, ligaments, or vertebrae. Particularly in people with low bone density, even minor trauma can cause fractures [15].

8. Vascular Causes

Although rare, vascular issues like abdominal aortic aneurysms can cause deep, persistent back pain despite originating elsewhere in the body [14].

9. Referred Pain

Conditions affecting internal organs such as kidney stones, pancreatitis, or gynecological diseases can cause referred pain in the lower back, underlining the importance of accurate differential diagnosis [14].

10. Psychogenic Causes

Psychological factors, including depression, anxiety, and chronic stress, are known to exacerbate pain perception and prolong disability in patients with low back pain [16].

Treatment Approaches in Low Back Pain

In clinical practice, the management of low back pain generally involves three main strategies: pharmacological treatments, conservative (non-pharmacological) methods, and interventional or surgical procedures. Conservative approaches encompass exercise-based therapies, manual techniques, patient education programs, behavioral therapies, and a range of physical therapy modalities. In contrast, pharmacological treatments focus on the use of analgesics and supportive medications. Interventional procedures are typically reserved for cases where standard treatments fail to provide sufficient relief, given their higher associated risks [12][13].

Modern research emphasizes that low back pain should not be regarded solely as a mechanical or physical issue. Especially in chronic cases, psychosocial factors play a crucial role in the persistence and experience of pain. Consequently, interventions that address only biomechanical dysfunctions tend to yield limited long-term success. Multidisciplinary, patient-centered approaches are increasingly recommended to achieve better symptom control and functional recovery [19].

Current clinical practices advocate for the integration of various treatment elements into comprehensive management plans. Besides exercise therapies, techniques such as manual therapy, myofascial release, core stability exercises, and structured educational interventions are widely recommended. The main goal of these approaches is not only to reduce pain but also to prevent recurrence, improve quality of life, and empower patients to take an active role in their recovery process [20].

Additionally, accumulating evidence suggests that physiotherapy-centered interventions can significantly reduce dependence on analgesic medications, facilitate a faster return to work, and alleviate psychological symptoms like anxiety and depression among patients with chronic non-specific low back pain [21].

**Table 1. Treatment Approaches for Low Back Pain[12,1]**

Type of Treatment	Sub-Methods	Purpose / Mechanism of Action
Pharmacological	Analgesics, NSAIDs, Adjuvant medications	Aims to reduce pain, alleviate muscle spasms, and modulate neuropathic pain responses.
Physical Modalities	TENS, ultrasound, heat/cold therapy, laser	To improve circulation, reduce muscle spasm and inflammation
Manual Therapy	Mobilization, manipulation, myofascial release	To increase joint range of motion and reduce fascial tension
Exercise-Based	Core stabilization, motor control, yoga, Pilates, strength training	To increase muscle strength, improve posture and function, reduce pain.
Psychosocial Interventions	Cognitive behavioral therapy (CBT), patient education	To modify pain perception and behavior, and enhance patient engagement
Interventional Procedures	Nerve blocks, facet joint injections, radiofrequency ablation	To reduce local inflammation and nerve irritation
Surgical Intervention	Discectomy, laminectomy, spinal fusion	To relieve nerve compression and achieve structural correction

Exercise-Based Interventions

Exercise-based interventions have become essential components in the management of chronic low back pain, offering benefits that extend beyond pain reduction. Research consistently demonstrates that targeted exercise programs can enhance muscle strength, improve flexibility, stabilize posture, and support psychological well-being [22].

Exercise programs are typically individualized to accommodate personal needs, though they can also be delivered in group settings or through supervised home-based sessions. Commonly used approaches include aerobic exercises, core stabilization programs, motor control exercises, strength training routines, and integrative practices such as yoga, Pilates, and the McKenzie method [23][24].

Aerobic Exercises

Aerobic exercises—such as walking, swimming, and cycling—support cardiovascular health while also improving muscular endurance. Numerous studies have shown that regular aerobic exercise participation can help reduce pain levels and improve physical function among individuals with chronic low back pain [25].

In physiotherapy practice, aerobic exercise is often incorporated as part of a holistic strategy to manage non-specific low back pain. By improving cardiovascular fitness, these activities also enhance musculoskeletal health. Notably, a randomized controlled trial reported that supervised aerobic training produced better outcomes, including reduced

pain intensity, improved spinal mobility, fewer depressive symptoms, enhanced physical performance, and improved quality of life compared to unsupervised home-based programs [26].

A systematic review published in the Cochrane Database found that aerobic exercise interventions were as effective as resistance training in reducing disability scores, although significant variations in exercise duration, intensity, and frequency made it difficult to determine an optimal protocol [27].

Still, large-scale meta-analyses confirm that aerobic activities such as walking, brisk walking, and cycling are highly effective at improving pain severity, overcoming functional limitations, and promoting overall health in chronic low back pain patients [28].

Core Stabilization Exercises

Core stabilization exercises are specifically designed to strengthen the deep muscles surrounding the spine and pelvis, with the goal of improving balance, posture, and motor control. According to Kim and Yim (2020), incorporating hip-focused movements into core exercises led to significant reductions in pain, improvements in physical performance, and better quality of life outcomes. Strengthening muscles like the transversus abdominis and multifidus was especially linked to improvements in balance and pelvic alignment [29].

Supporting these findings, a Turkish study showed that adding spinal stabilization exercises to traditional physiotherapy significantly reduced pain levels and improved flexibility and functional mobility. Over three weeks, participants experienced notable improvements in flexibility tests (like the modified Schober and lateral flexion measures) and functional performance assessed through the Timed Up and Go test [30].

Typical core stabilization programs involve exercises such as abdominal hollowing, side planks, glute bridges, bird-dog movements, and prone planks. These routines emphasize the coordination of breathing with isometric muscle contractions to properly activate the core muscle groups [29].

Yoga

Yoga has gained popularity as a complementary exercise intervention for managing chronic low back pain, offering benefits that address both physical symptoms and mental health. Yoga programs typically combine postures, breathing techniques, and meditation, which work together to relieve pain, enhance mobility, and improve quality of life [31].

A systematic review from the Cochrane Database reported that yoga provides statistically meaningful improvements in functional outcomes over the short and medium term, although the clinical significance of these improvements was considered modest. Short-term programs (lasting 4–8 weeks) were associated with noticeable functional gains [32].

Other studies have found that participating in yoga twice a week over a 12-week period led to significant reductions in pain and disability levels compared to standard care groups. Popular yoga styles used in research include Iyengar and Hatha yoga [33].

When compared with traditional physical therapy, yoga has shown similar effectiveness in improving short-term pain and quality of life outcomes. A study in 2020 found no significant differences in long-term results between yoga and physiotherapy [33].

Beyond physical benefits, yoga practice is also linked to improved mental health, such as increased self-efficacy, reduced fear-avoidance behaviors, and lowered depression symptoms [32].

Pilates

Pilates is a structured exercise method that emphasizes controlled movements, core strengthening, postural awareness, and improved overall body mechanics. It is frequently used to help individuals with chronic low back pain achieve better spinal stabilization and functional improvement [34].

Recent studies consistently show that Pilates exercises contribute to reductions in pain intensity and improvements in physical functionality. A systematic review published in 2023 indicated significant decreases in both pain and disability levels after participation in Pilates programs, although impacts on quality of life were described as moderate [35].

One randomized controlled trial found that mat-based Pilates programs more effectively activated the transversus abdominis muscle compared to other methods, resulting in better pain relief and functional outcomes [36]. Regular practice over 8–12 weeks was associated with substantial improvements [37].

Another study focusing on postmenopausal women showed that a six-week clinical Pilates program not only produced short-term gains but also sustained positive effects for up to 12 months [38].

Pilates has also been shown to improve flexibility and balance. Participants reported enhanced flexibility and reduced pain following an eight-week program [39].

Studies comparing mat-based and equipment-based Pilates found similar positive outcomes, though personalization of the program to meet individual needs is emphasized in the literature [40].

Finally, EMG studies confirm that Pilates exercises like shoulder bridges, spine stretches, and controlled breathing techniques effectively activate lumbar-supporting muscles and promote spinal stability [41][42].

McKenzie Method (Mechanical Diagnosis and Therapy – MDT)

The McKenzie Method, formally known as Mechanical Diagnosis and Therapy (MDT), is a structured, movement-based exercise protocol designed for both assessing and treating low back pain. Developed by Robin McKenzie, this approach categorizes patients into three main syndromes: postural, dysfunction, and the most common, derangement syndrome [43].

Classification within MDT relies on observing symptom responses to specific spinal movements, such as how pain changes during repeated spinal extension or flexion. A key concept here is "centralization," where pain moves from more distal locations back toward the spine—a clinical sign typically associated with better prognosis [44].

One notable advantage of the McKenzie approach is its emphasis on patient empowerment, encouraging individuals to take an active role in managing their symptoms. Studies have shown that McKenzie-based exercises can significantly reduce pain and functional disability, whether delivered through traditional face-to-face sessions or via telerehabilitation [45].

Comparative studies reveal that in cases of chronic low back pain, the McKenzie protocol often leads to quicker and more noticeable improvements than manual therapy or general exercise programs [46][47]. Moreover, MDT has been found superior to the "Back School" method in enhancing functional outcomes [48].

Interestingly, MDT has also demonstrated reliability among younger populations. A study involving adolescents aged 15–21 found high consistency among practitioners using the MDT classification system [49].

A 2023 systematic review reinforced these findings, concluding that for patients whose symptoms are responsive to directional movements, McKenzie interventions are more effective than many other physiotherapy approaches for reducing pain and improving functionality. However, it also stressed the need for further high-quality research to confirm the long-term sustainability of these benefits [50].

Beyond physical outcomes, the McKenzie method also addresses psychological aspects of chronic pain. By helping reduce fear-avoidance behaviors and catastrophic thinking, it contributes to a broader biopsychosocial model of care [51].

Motor Control Exercises (MCE)

Motor control exercises (MCE) are widely used in treating chronic non-specific low back pain, aiming to restore proper coordination and activation of the deep core muscles, especially the transversus abdominis and multifidus [52][53].

The main objective of MCE is to enhance postural control and correct disrupted motor patterns. Research indicates that these exercises can increase the cross-sectional area (CSA) and thickness of the multifidus muscle, although improvements in muscle size do not always directly correlate with clinical symptom relief [53][54].

In terms of clinical outcomes, MCE has shown clear short- and medium-term benefits in reducing pain and improving functional abilities. However, its long-term advantages seem somewhat less robust compared to some other exercise approaches [55][56]. Importantly, studies suggest that tailoring MCE programs to each patient's specific neuromuscular profile significantly enhances treatment effectiveness [57].

Studies on home-based motor control programs have also demonstrated significant improvements in pain and functionality, although changes in muscle morphology were not consistently observed, suggesting that factors like exercise intensity and method of application are important [58].

Van Dieën and colleagues pointed out that motor control deficits manifest differently across patients—some overactivate muscles while others underactivate them—highlighting the need for individualized exercise planning [59].

A randomized controlled trial by Fortin and colleagues found that combining motor control exercises with isolated lumbar extension exercises resulted in greater increases in the CSA and thickness of the multifidus and erector spinae muscles, contributing to significant clinical improvements [60].

Follow-up research from the same team confirmed that these combined approaches were more effective than general exercise programs in enhancing paraspinal muscle function [61].

Strengthening Exercises

Strengthening exercises are widely accepted as highly effective interventions for managing low back pain. These exercises mainly target enhancing the strength and endurance of muscles supporting the spine, which can help

reduce pain and improve overall physical performance. Several studies have shown that core-focused strengthening exercises can increase muscle thickness, improve proprioceptive abilities, and positively affect balance [62]. A randomized controlled trial conducted by Kim and colleagues demonstrated that combining stabilization exercises with pain neuroscience education resulted in greater improvements in pain reduction, muscle strength, and functional outcomes compared to strengthening exercises alone [63]. Other research has emphasized the importance of strengthening programs targeting the hip and lumbar muscles, which help optimize pelvic alignment and decrease mechanical strain on the spine [64]. Comparative studies, like the one by Hlaing and colleagues, found that both strengthening exercises and core stabilization exercises are effective for pain relief. However, stabilization-focused routines appeared to produce greater gains in muscle thickness and balance improvements [62]. Importantly, strengthening exercises are not limited to in-person sessions. They can also be effectively administered through telerehabilitation platforms. Resistance band exercises, in particular, have proven effective for promoting spinal stability and alleviating pain among middle-aged and elderly patients [65]. A systematic review conducted by Kristensen and colleagues further confirmed that resistance-based exercise programs provide superior pain relief compared to passive treatments, though more research is needed to determine the durability of these benefits over the long term [66]. Additionally, telerehabilitation studies have shown that home-based strengthening exercises—such as bridge exercises targeting the pelvic muscles—can significantly reduce pain and improve quality of life for patients with chronic low back pain [67].

Conclusion

Low back pain remains a widespread health concern, significantly affecting daily activities and overall well-being. Chronic non-specific low back pain, in particular, presents major challenges both at the individual and societal levels. Current evidence indicates that exercise-based treatment methods offer effective alternatives or valuable complements to pharmacological interventions.

The exercise approaches reviewed in this paper—including core stabilization, motor control exercises, yoga, Pilates, and strengthening routines—have consistently shown benefits in pain reduction, muscle strengthening, postural stability, and balance improvement. Moreover, many studies have noted improvements in psychological outcomes, such as reduced anxiety, depression, and fear-avoidance behaviors.

It is evident that treatment success is greater when exercise programs are personalized. Adjusting the frequency, intensity, and duration of exercises based on individual needs plays a crucial role in maximizing clinical outcomes. However, the wide variation in study methodologies highlights the need for more standardized protocols in future research.

Overall, the available evidence supports the use of exercise-based therapies as practical, effective, and safe options for managing chronic non-specific low back pain. When applied consistently and tailored to each individual, exercise programs can lead to substantial improvements in pain relief, physical functioning, and mental health.

Ultimately, exercise-based strategies should be seen not only as temporary symptom management tools but also as essential long-term interventions for fostering healthier, more active lifestyles.

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