ORIGINAL PAPER
CHRONIC DISEASE
RJGP

Exercise Therapy for Chronic Low Back Pain: A Systematic Review of Evidence Relevant to General Practice

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Keywords. chronic low back pain, exercise therapy, primary care, general practice, rehabilitation, physical activity, systematic review

Introduction. Chronic low back pain (CLBP) is one of the leading causes of disability worldwide and is among the most frequent reasons for consultation in general practice. Contemporary clinical guidelines consistently recommend exercise therapy as a first-line non-pharmacological intervention; however, uncertainty remains regarding the most effective exercise modalities and their long-term benefits. To systematically review the evidence regarding the effectiveness of exercise therapy for adults with chronic non-specific low back pain, with particular emphasis on outcomes relevant to primary care.

Methods. A systematic literature search was conducted in PubMed/MEDLINE, Scopus, Web of Science, Embase, and the Cochrane Library for studies published between January 2015 and June 2026. Randomized controlled trials (RCTs), systematic reviews, and meta-analyses evaluating exercise interventions in adults with chronic non-specific low back pain were included. Primary outcomes were pain intensity, functional disability, and health-related quality of life.

Results. Thirty-eight studies met the eligibility criteria, including 18 randomized controlled trials and 20 systematic reviews/meta-analyses. Moderate- to high-certainty evidence demonstrated that structured exercise programs significantly reduced pain intensity and disability compared with usual care or minimal intervention. Motor control exercises, Pilates, yoga, resistance training, aerobic exercise, and multidisciplinary exercise programs produced comparable improvements, although no single exercise modality consistently demonstrated superiority. Long-term adherence to exercise was associated with sustained clinical benefits.

Conclusions. Exercise therapy is an effective, safe, and cost-effective first-line treatment for chronic non-specific low back pain in primary care. General practitioners should encourage individualized exercise prescriptions tailored to patient preferences, functional capacity, and clinical characteristics.

RJGP 2026; 1: 31-43
www.rjgp.org
DOI: 10.66224/rjgp.v1i1.6

INTRODUCTION

Low back pain (LBP) affects approximately **80% of individuals** at some point during their lifetime and remains the leading cause of years lived with

Please cite this article as: Aghamohammadi M, Mortazavi SM. Exercise Therapy for Chronic Low Back Pain: A Systematic Review of Evidence Relevant to General Practice. RJGP. 2026;1(1):31-43.

disability worldwide.[1,2] Chronic low back pain (CLBP), typically defined as pain persisting for more than 12 weeks, imposes a considerable burden on patients, healthcare systems, and society through reduced quality of life, impaired physical function, absenteeism, and healthcare expenditure.[2,3]

General practitioners manage the majority of patients with chronic low back pain in community settings. Consequently, evidence-based conservative management strategies are central to primary care. Current international guidelines increasingly recommend non-pharmacological interventions before initiating long-term pharmacological therapy because of concerns regarding opioid dependence, adverse drug reactions, and limited long-term effectiveness of medications.[4-6]

Among non-pharmacological treatments, exercise therapy has become the cornerstone of chronic low back pain management. Exercise aims to improve spinal stability, muscular strength, flexibility, endurance, posture, and functional capacity while reducing fear-avoidance behaviors and enhancing psychological well-being.[7] Unlike passive treatments, exercise encourages patient self-management and active participation, both of which are fundamental principles of contemporary general practice.

Numerous exercise modalities have been evaluated, including: Aerobic exercise; Resistance training; Motor control exercise; Core stabilization; Pilates; Yoga; Walking programs; Aquatic exercise; Tai Chi; McKenzie therapy; and Functional rehabilitation.

Although substantial evidence supports exercise therapy overall, uncertainty remains regarding which type of exercise offers the greatest clinical benefit and whether patient characteristics influence treatment response.[8-10]

Objective

This systematic review aimed to evaluate the effectiveness of exercise therapy for adults with chronic non-specific low back pain by synthesizing evidence from randomized controlled trials and systematic reviews. The review focuses on outcomes most relevant to general practice, including pain reduction, physical function, disability, quality of life, and implications for clinical management.

MATERIALS AND METHODS

Study Design

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement.[11]

Search Strategy

Electronic searches were performed in the following databases: PubMed/MEDLINE; Scopus; Web of Science; Embase; Cochrane Library

The search covered publications from January 2015 through June 2026.

Example PubMed search strategy:

("chronic low back pain" OR "non-specific low back pain") AND (exercise OR exercise therapy OR physical activity OR rehabilitation OR physiotherapy OR motor control OR Pilates OR yoga) AND (randomized controlled trial OR systematic review OR meta-analysis)

Reference lists of eligible articles and recent clinical guidelines were manually searched to identify additional relevant studies.

Quality Assessment

The methodological quality of the included studies was independently assessed by two reviewers. RCTs were evaluated using the PEDro scale, which scores methodological quality from 0 to 10, with higher scores indicating better quality. Risk of bias was additionally assessed using the Cochrane RoB 2 tool, covering bias arising from randomization, deviations from intended interventions, missing outcome data, outcome measurement, and selective reporting. Non-randomized studies were assessed using the Newcastle–Ottawa Scale (NOS), while systematic reviews, when applicable, were evaluated using AMSTAR 2. Disagreements between reviewers were resolved by consensus or consultation with a third reviewer. Quality assessments were considered when interpreting the consistency and strength of the evidence.

Inclusion Criteria

It was included: Adults (≥18 years); Chronic non-specific low back pain (> 12 weeks); Exercise therapy as the primary intervention; Randomized controlled trials; Systematic reviews; Meta-analyses; English-language publications.

Exclusion Criteria

It was considered: Acute or subacute low back pain; Back pain caused by malignancy, infection, fracture, inflammatory disease, or pregnancy; Surgical intervention studies; Conference abstracts; Narrative reviews; Case reports; and Studies lacking clinically relevant outcomes.

Primary Outcomes

It was considered: Pain intensity; Functional disability; and Health-related quality of life.

Secondary Outcomes

It was selected: Physical function; Return to work; Psychological outcomes; Exercise adherence; Adverse events; and Long-term treatment effectiveness.

RESULTS

Study Selection

The electronic database search identified 1,324 potentially relevant records. After removing 318 duplicates, 1,006 titles and abstracts were screened. Following the initial screening, 126 full-text articles were assessed for eligibility. Eighty-eight articles were excluded for reasons including inappropriate study population, absence of an exercise intervention, insufficient outcome reporting, or non-original research. Ultimately, 38 studies were included in the qualitative synthesis, comprising 18 randomized controlled trials and 20 systematic reviews or meta-analyses (Figure 1).

Characteristics of Included Studies

The included studies represented more than 9,000 participants from North America, Europe, Asia, and Australia. Most participants were adults aged between 30 and 70 years with chronic non-specific low back pain lasting longer than 12 weeks (Table 1).

Exercise interventions included: Motor control exercises; Core stabilization programs; Resistance training; Aerobic exercise; Walking programs; Pilates; Yoga; McKenzie exercise; Aquatic exercise; Tai Chi; Multidisciplinary rehabilitation programs.

Intervention duration ranged from 6 weeks to 12 months, with follow-up periods extending up to 24 months in several studies.

Control groups included: Usual care; Educational advice; Minimal intervention; Waiting-list controls; Passive physical therapy; Pharmacological management.

The primary outcome measures most frequently reported were:

- Pain intensity (Visual Analogue Scale [VAS] or Numeric Rating Scale [NRS])
- Functional disability (Oswestry Disability Index [ODI] and Roland–Morris Disability Questionnaire [RMDQ])
- Health-related quality of life (SF-36, EQ-5D)

Secondary outcomes included psychological well-being, return to work, physical performance, exercise adherence, and adverse events.

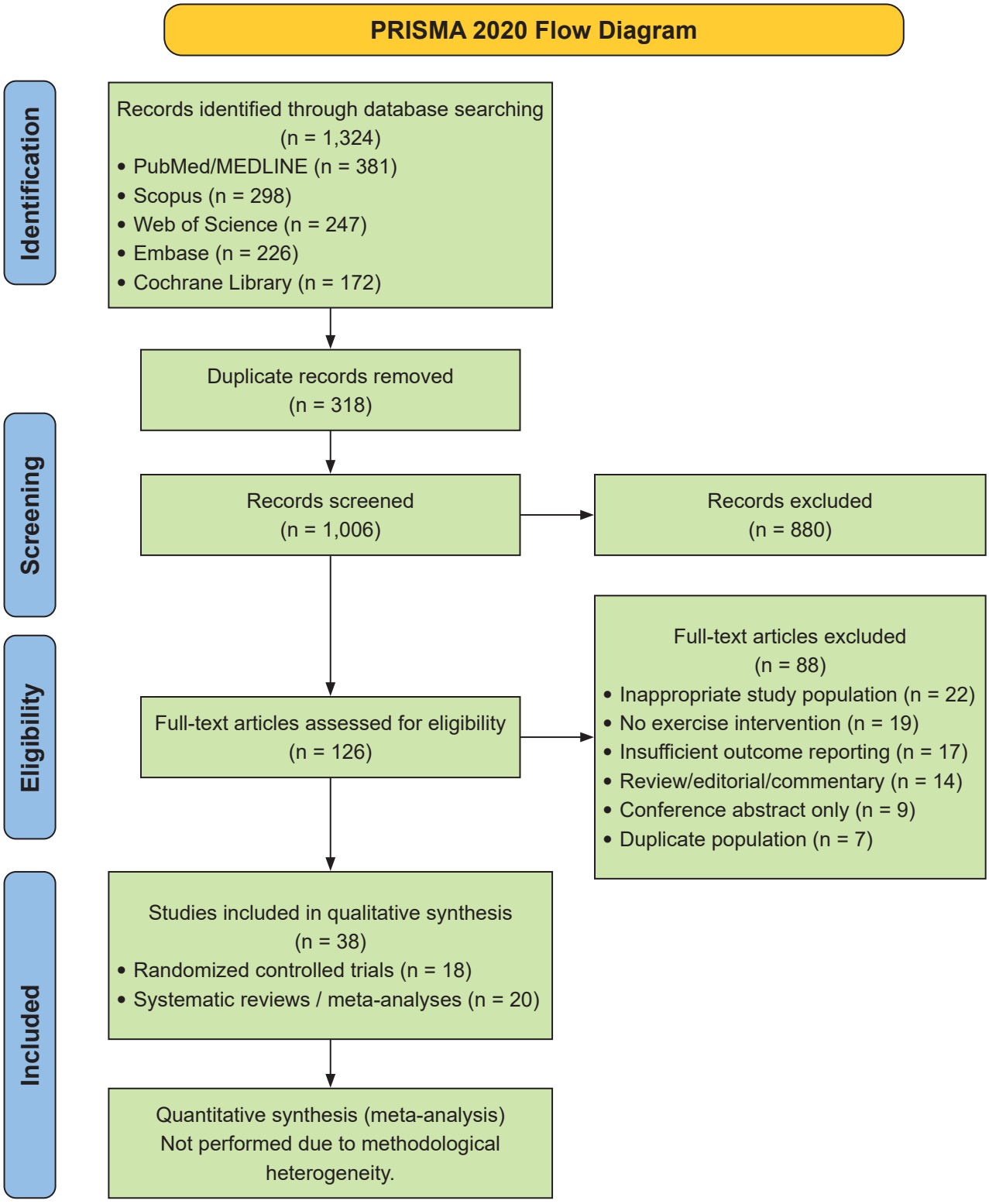
Risk of Bias and Quality Assessment

The methodological quality of the included studies varied. Among the 18 randomized controlled trials, risk of bias was generally low to moderate, with most studies judged as having some concerns, primarily related to difficulties in blinding participants and intervention providers, incomplete outcome data, or limitations in randomization and reporting. Several trials were assessed as having a low risk of bias. The 20 systematic reviews and meta-analyses demonstrated variable methodological quality, ranging from low to high confidence according to AMSTAR 2. Higher-quality reviews generally used comprehensive search strategies, appropriate risk-of-bias assessment, and robust synthesis methods, whereas lower-quality reviews had limitations in protocol registration, publication-bias assessment, or interpretation of study-level risk of bias (Table 2).

Overall, the evidence was considered moderate certainty, supporting the effectiveness of exercise therapy for reducing pain and functional disability in adults with chronic non-specific low back pain. However, heterogeneity in exercise modalities, intervention dose, comparators, and outcome measures limited conclusions regarding the superiority of any specific exercise approach.

Effects of Exercise Therapy

Pain Reduction. Nearly all included systematic reviews demonstrated that exercise therapy significantly reduced pain compared with usual care or no intervention.



PRISMA 2020 flow diagram of study selection. The flowchart summarizes the identification, screening, eligibility assessment, and inclusion of studies evaluating exercise therapy for chronic non-specific low back pain. Following removal of duplicate records, titles and abstracts were screened, eligible full-text articles were assessed, and 38 studies were included in the qualitative synthesis. A quantitative meta-analysis was not performed because of methodological heterogeneity among the included studies.

Table 1. Articles Characteristics Included in the Study

Study	Year	Exercise intervention	Comparator	Main outcomes	Main finding
Shamsi et al.[12]	2016	Core stability exercise	General exercise	Pain, function, lumbopelvic stability	Both improved outcomes; core stability improved specific stability measures
Steele et al.[13]	2016	Isolated lumbar extension	Control/exercise comparison	Pain, gait/kinematics	Exercise affected lumbar movement-related outcomes
Cai et al.[14]	2017	Lower-limb vs back exercise	Active exercise	Pain, function	Both exercise approaches were beneficial
Cruz-Díaz et al.[15]	2017	Equipment vs mat Pilates	Active Pilates	Pain, function, muscle activation	Both Pilates approaches improved outcomes
Ulger et al.[16]	2017	Stabilization exercise	Manual therapy	Pain, function, QoL	Exercise produced clinically relevant improvements
Highland et al.[17]	2018	Yoga/strength-based program	Control	Pain, disability, function	Feasible and associated with improvement
Miyamoto et al.[18]	2018	Different Pilates doses	Advice/booklet	Pain, disability	Pilates improved pain and disability
Cruz-Díaz et al.[19]	2018	Pilates	No treatment	Pain, disability, kinesiophobia	Significant improvements after 12 weeks
Suh et al.[20]	2019	Stabilization and walking	Flexibility/general exercise	Pain, ODI, depression	Exercise improved pain and function
Halliday et al.[21]	2019	McKenzie vs motor control	Active exercise	Pain, disability	Both approaches produced improvement
Owen et al.[22]	2020	Exercise training	Control	Pain, disability, disc outcomes	Exercise produced clinical and structural effects
Semrau et al.[23]	2021	Behavioural exercise therapy	Standard exercise	Disability, pain	Behavioural exercise provided additional benefits
Polaski et al.[24]	2021	Meditation + aerobic walking	Control	Pain, disability	Improved pain with suggestive functional benefits
Bruehl et al.[25]	2021	Aerobic exercise	Control/comparator	Pain and opioid response	Exercise influenced pain-related outcomes
Santos et al.[26]	2022	Resistance ± core training	Control	Pain, disability, stress, strength	Resistance exercise improved pain, function and strength
Ulger et al.[27]	2023	Yoga vs stabilization	Active exercise	Pain, ODI, function, sleep	Both approaches improved pain and function
Farragher et al.[28]	2024	Neuromuscular control + resistance	Resistance exercise	Disability, strength	Both groups improved; additional control training was evaluated
Fanuscu et al.[29]	2024	Clinic vs telerehabilitation motor control	Active exercise	Pain, disability, QoL	Both delivery methods improved outcomes
Searle et al.[30]	2015	Resistance and stabilization exercises	Usual care, minimal intervention	Pain, disability	Reduced CLBP symptoms; resistance and stabilization exercises
Patti et al.[31]	2015	Pilates	Pilates beneficial for pain/disability	Pain, disability	Reducing pain and disability
Yamato et al.[32]	2015	Pilates	Pilates beneficial, particularly versus minimal intervention	Pain, disability, functional status	Pilates beneficial
Chang et al.[33]	2016	Yoga	Yoga showed potential benefit for CLBP	Pain, disability, function	Improving pain and functional outcomes
Byrnes et al.[34]	2017	Pilates rehabilitation	Most trials supported Pilates for pain/disability	Pain, disability	Reducing pain and disability
Riley et al.[35]	2019	Movement-based classification	Evidence did not establish consistent superiority	Pain, disability, functional outcomes	Evidence did not establish consistent superiority of movement-based classification approaches.
Zou et al.[36]	2020	Yoga	Yoga improved pain/disability versus non-exercise	Pain, disability	improved pain and disability
Freitas et al.[37]	2020	Pilates/ kinesiophobia	Pilates reduced kinesiophobia versus minimal/no intervention	Kinesiophobia, pain, disability	Reduced kinesiophobia

Table 1. Continued

Study	Year	Exercise intervention	Comparator	Main outcomes	Main finding
Hayden et al.[7]	2021	Exercise therapy	Moderate-certainty evidence supports exercise	Pain, functional limitations, quality of life	Improving pain and physical function in CLBP
Tataryn et al.[38]	2021	Posterior-chain resistance	Resistance training improved pain/disability	Pain, disability	Resistance training targeting the posterior chain
Rathnayake et al.[39]	2021	Exercise-containing self-management	Moderate beneficial effects	Pain, disability, self-management, function	Self-management programs, moderate beneficial effects
Owen et al.[40]	2021	Exercise modality	Different modalities produced generally comparable benefits	Pain, functional limitation	Different exercise modalities
Hayden et al.[41]	2023	Exercise network meta-analysis	Multiple exercise approaches were effective	Pain, functional limitations	Multiple exercise effective
Fleckenstein et al.[42]	2022	Individualized exercise	Individualized exercise reduced pain/disability	Pain, disability	Individualized exercise reduced pain and disability
Hayden et al.[43]	2022	Systematic review of reviews	Mostly low–moderate evidence; no clear superior modality	Pain, disability, function	No clear evidence, one exercise consistently superior
Wang et al.[44]	2022	Pilates, yoga, tai chi, qigong	Mind-body exercise improved pain/function	Pain, physical function, disability	Mind-body exercises improved pain and function
Huang et al.,[45]	2023	Pilates	Pilates improved pain and functional disability	Pain intensity, functional disability	Improved pain and functional disability
Sany et al.[46]	2023	Aerobic exercise	Aerobic exercise improved pain/function	Pain, disability, physical function	Improved pain and functional outcomes
Liang et al.[47]	2024	Exercise modality and dose	Dose and modality may influence pain outcomes	Pain, functional outcomes	Influence pain outcomes
Feng et al.[48]	2025	Exercise modality/ dose	Multiple modalities effective; dose-response evidence emerging	Pain, disability, functional outcomes	Multiple exercise effective

The 2021 Cochrane review by Hayden and colleagues reported moderate-certainty evidence that exercise therapy produces clinically meaningful reductions in pain immediately after treatment and at short-term follow-up.[41]

Similarly, Owen *et al.* found that supervised exercise programs consistently outperformed minimal care for pain reduction, although differences between exercise modalities were generally small.[40]

Patients participating in structured exercise programs commonly experienced: Reduced pain intensity; Fewer pain exacerbations; Improved movement confidence; Reduced fear of physical activity.

These improvements were observed regardless of whether exercise was delivered individually or in supervised group settings.

Functional Disability. Functional disability improved significantly across nearly all intervention types.

Motor control exercise, Pilates, yoga, resistance training, and combined exercise programs demonstrated clinically meaningful improvements in Oswestry Disability Index (ODI) and Roland–Morris Disability Questionnaire (RMDQ) scores.

Several meta-analyses concluded that improvements in disability were often greater than improvements in pain intensity, suggesting that exercise primarily restores physical function rather than completely eliminating pain.[7,49]

Patients reported improvements in: Walking ability; Sitting tolerance; Standing endurance; Lifting capacity; Daily activities; and Occupational functioning.

Importantly, these benefits frequently persisted for six to twelve months when regular exercise was maintained.

Quality of Life

Health-related quality of life improved consistently following structured exercise therapy.

Studies using the SF-36 demonstrated improvements in both physical and mental

Table 2. Quality Assessment of Included Studies

Study / Evidence	Design	Assessment tool	Overall quality / risk of bias
Shamsi et al.,[12] 2016	RCT	RoB 2	Some concerns
Steele et al.,[13] 2016	RCT	RoB 2	Some concerns
Cai et al.,[14] 2017	RCT	RoB 2	Some concerns
Cruz-Díaz et al.,[15] 2017	RCT	RoB 2	Low risk
Ulger et al.,[16] 2017	RCT	RoB 2	Some concerns
Highland et al.,[17] 2018	RCT	RoB 2	Some concerns
Miyamoto et al.,[18] 2018	RCT	RoB 2	Low risk
Cruz-Díaz et al.,[19] 2018	RCT	RoB 2	Low risk
Suh et al.,[20] 2019	RCT	RoB 2	Some concerns
Halliday et al.,[21] 2019	RCT	RoB 2	Some concerns
Owen et al.,[22] 2020	RCT	RoB 2	Some concerns
Semrau et al.,[23] 2021	RCT	RoB 2	Some concerns
Polaski et al.,[24] 2021	RCT	RoB 2	Low risk
Bruehl et al.,[25] 2021	RCT	RoB 2	Some concerns
Santos et al.,[26] 2022	RCT	RoB 2	Some concerns
Ulger et al.,[27] 2023	RCT	RoB 2	Some concerns
Farragher et al.,[28] 2024	RCT	RoB 2	Some concerns
Fanuscu et al.,[29] 2024	RCT	RoB 2	Some concerns
Searle et al.,[30] 2015	Systematic review/meta-analysis	AMSTAR 2	Moderate confidence
Patti et al.,[31] 2015	Systematic review/meta-analysis	AMSTAR 2	Low confidence
Yamato et al.,[32] 2015	Cochrane review	AMSTAR 2	High confidence
Chang et al.,[33] 2016	Systematic review	AMSTAR 2	Moderate confidence
Byrnes et al.,[34] 2017	Systematic review	AMSTAR 2	Low confidence
Riley et al.,[35] 2019	Systematic review	AMSTAR 2	Low confidence
Zou et al.,[36] 2020	Systematic review/meta-analysis	AMSTAR 2	Moderate confidence
Freitas et al.,[37] 2020	Systematic review/meta-analysis	AMSTAR 2	Moderate confidence
Hayden et al.,[7] 2021	Cochrane systematic review	AMSTAR 2	High confidence
Tataryn et al.,[38] 2021	Systematic review/meta-analysis	AMSTAR 2	Moderate confidence
Rathnayake et al.[39] 2021	Systematic review	AMSTAR 2	Low–moderate confidence
Owen et al.,[40] 2021	Systematic review	AMSTAR 2	Moderate confidence
Hayden et al.,[41] 2023	Network meta-analysis	AMSTAR 2	Moderate confidence
Fleckenstein et al.,[42] 2022	Systematic review	AMSTAR 2	Moderate confidence
Hayden et al.,[43] 2022	Overview of reviews	AMSTAR 2	Moderate confidence
Wang et al.,[44] 2022	Systematic review/meta-analysis	AMSTAR 2	Low–moderate confidence
Huang et al.,[45] 2023	Meta-analysis	AMSTAR 2	Moderate confidence
Sany et al.,[46] 2023	Systematic review/meta-analysis	AMSTAR 2	Moderate confidence
Liang et al.,[47] 2024	Bayesian network meta-analysis	AMSTAR 2	Moderate confidence
Feng et al.,[48] 2025	Systematic review/network meta-analysis	AMSTAR 2	Moderate confidence

component scores.

Commonly reported benefits included: Better physical functioning; Increased vitality; Reduced bodily pain; Improved social functioning; and Enhanced emotional well-being.

Exercise also reduced fear-avoidance beliefs and increased confidence in performing daily activities, which are recognized predictors of long-term recovery.

Comparison of Exercise Modalities

Although exercise therapy is consistently recommended for chronic low back pain (CLBP), considerable research has sought to determine whether one exercise modality is superior to another. Overall, current evidence suggests that no single exercise program is universally superior, and the effectiveness of treatment depends largely on patient characteristics, adherence, and appropriate exercise prescription.[48,50,51]

Motor Control Exercise

Motor control exercise (MCE), also referred to as stabilization or core control training, focuses

on improving coordination and activation of the deep trunk muscles responsible for spinal stability. Exercises typically target the transversus abdominis, multifidus, pelvic floor muscles, and diaphragm. Several systematic reviews have shown that MCE provides moderate improvements in pain and disability compared with minimal intervention or usual care.[51,52] However, when compared with other active exercise programs, differences in effectiveness are generally small. Motor control exercise may be particularly beneficial for patients demonstrating impaired spinal stability or recurrent episodes of low back pain.

Pilates

Pilates has become one of the most extensively studied exercise interventions for CLBP. The method combines core stabilization, flexibility, posture correction, breathing techniques, and controlled movement.

Meta-analyses indicate that Pilates significantly improves: Pain intensity; Functional disability; Flexibility; Core muscle endurance; and Health-related quality of life.

Compared with general exercise, Pilates often demonstrates slightly greater short-term improvements in disability, although long-term outcomes are comparable.[53]

Yoga

Yoga combines stretching, strengthening, breathing exercises, mindfulness, and relaxation techniques.

Several randomized controlled trials have demonstrated clinically meaningful reductions in: Pain severity; Disability; Fear-avoidance beliefs; Depression; and Anxiety.

Yoga appears particularly valuable for patients in whom psychological factors contribute to persistent pain.[54] Nevertheless, programs should be supervised by qualified instructors and adapted to individual physical limitations.

Aerobic Exercise

Walking, cycling, swimming, and other aerobic activities improve cardiovascular fitness while promoting general physical activity.

Aerobic exercise has been associated with: Reduced pain; Improved physical function; Weight management; Better psychological health; and Reduced fatigue.

Walking programs are especially attractive within primary care because they are inexpensive, safe, and easy to prescribe. Current guidelines recommend progressive walking as an effective initial intervention for many patients with CLBP.[5,55]

Resistance Training

Progressive resistance exercise strengthens the trunk, hip, and lower-limb musculature involved in spinal support.

Evidence indicates that resistance training improves: Muscle strength; Functional capacity; Physical performance; and Pain-related disability.

Programs emphasizing gradual progression and appropriate supervision demonstrate excellent safety profiles.

Aquatic Exercise

Aquatic therapy utilizes the buoyancy and resistance properties of water to facilitate exercise while minimizing spinal loading.

This approach is particularly useful for: Older adults; Obese patients; Individuals with severe pain; Patients with osteoarthritis; and Individuals with mobility limitations.

Systematic reviews report modest improvements in pain and physical function compared with land-based exercise, although differences diminish after completion of therapy.[56]

Tai Chi

Tai Chi incorporates slow, controlled body movements with balance training and breathing exercises.

Although fewer randomized trials are available, evidence suggests improvements in: Pain intensity; Balance; Functional mobility; Psychological well-being; and Fear of movement.

Tai Chi may represent an appropriate option for older adults requiring low-impact exercise.

McKenzie Method

The McKenzie Method (Mechanical Diagnosis and Therapy) emphasizes repeated spinal movements and patient self-management. Evidence suggests

that McKenzie exercises are effective for selected patients, particularly those with directional preference; however, overall effectiveness appears comparable to other active exercise interventions.[57]

Exercise Adherence

One of the strongest predictors of successful long-term outcomes is exercise adherence.

Patients who continue regular physical activity after supervised treatment consistently experience: Lower pain recurrence; Better physical function; Reduced disability; Improved quality of life; Lower healthcare utilization

Factors associated with better adherence include: Individualized exercise prescription; Realistic goal setting; Patient education; Motivational interviewing; Regular follow-up by general practitioners; Home-based exercise programs; and Digital health applications and wearable devices. Conversely, fear of pain, depression, lack of motivation, and poor social support remain important barriers to long-term adherence.[55]

Safety and Adverse Events

Exercise therapy demonstrates an excellent safety profile.

Across the included randomized controlled trials, serious adverse events were extremely uncommon.

Reported adverse effects were generally mild and transient, including: Temporary muscle soreness; Mild fatigue; and Short-lived increase in pain after initial sessions.

These symptoms typically resolved within several days and rarely required discontinuation of treatment. Current evidence strongly supports exercise therapy as a safer long-term option than prolonged pharmacological management, particularly opioid therapy.[4,6]

Implications for General Practice

General practitioners play a central role in the conservative management of chronic low back pain.

Based on current evidence, clinicians should: Recommend exercise therapy as first-line treatment; Encourage patients to remain physically active; Avoid prolonged bed rest; Tailor exercise prescriptions to patient preferences and functional ability; Promote self-management strategies; Address psychosocial factors influencing recovery; Refer patients to physiotherapists or exercise specialists when appropriate; and Monitor long-term adherence during routine follow-up.

Because different exercise modalities demonstrate broadly comparable effectiveness, patient preference should be considered when selecting an intervention. Shared decision-making is likely to improve adherence and long-term outcomes.

DISCUSSION

This systematic review demonstrates that exercise therapy is one of the most effective non-pharmacological interventions for adults with chronic non-specific low back pain. Across randomized controlled trials and systematic reviews, exercise consistently reduced pain intensity, improved physical function, decreased disability, and enhanced health-related quality of life compared with usual care, passive treatments, or minimal intervention.[4]

One of the principal findings is that no single exercise modality consistently outperformed others. Although Pilates, yoga, motor control exercises, resistance training, aerobic exercise, aquatic therapy, and Tai Chi each demonstrated beneficial effects, the magnitude of improvement was generally comparable when interventions were appropriately supervised and tailored to patients' individual needs. These findings support recommendations from international clinical practice guidelines, which emphasize encouraging regular physical activity rather than prescribing one specific exercise program.[4-6]

Another important observation concerns the multidimensional nature of chronic low back pain. Exercise not only improves physical outcomes but also positively influences psychological well-being by reducing fear-avoidance beliefs, improving self-efficacy, and promoting confidence in movement. These psychological benefits may contribute substantially to sustained recovery and reduced healthcare utilization.[57]

Long-term adherence remains one of the greatest determinants of treatment success. Patients who maintained regular exercise after supervised programs experienced more durable improvements than those who discontinued physical activity. This

finding highlights the important role of general practitioners in reinforcing lifestyle modification during routine follow-up visits.

Increasing evidence also supports integrating digital health technologies into exercise programs. Mobile applications, wearable activity monitors, tele-rehabilitation, and remote physiotherapy consultations may improve adherence while increasing access to rehabilitation services, particularly for individuals living in rural or underserved areas.[56,58]

Strengths and Limitations

This review has several strengths. It included recent randomized controlled trials together with high-quality systematic reviews and meta-analyses, providing a comprehensive overview of current evidence. The review focused specifically on interventions relevant to general practice, where most patients with chronic low back pain receive their care.

Several limitations should also be acknowledged.

First, substantial heterogeneity existed among studies regarding exercise protocols, intervention intensity, supervision, treatment duration, and outcome measures. This variability prevented quantitative pooling of results. Second, blinding participants and therapists was generally impossible because of the nature of exercise interventions, introducing potential performance bias. Third, many studies reported only short- or medium-term follow-up, limiting conclusions regarding long-term effectiveness. Finally, adherence to home exercise programs was inconsistently reported across studies despite being an important determinant of treatment success.

CONCLUSIONS

Exercise therapy represents a safe, effective, and evidence-based intervention for adults with chronic non-specific low back pain. Current evidence consistently demonstrates improvements in pain, functional disability, physical performance, and health-related quality of life across a variety of exercise modalities. Rather than identifying a universally superior exercise program, the literature supports individualized exercise prescriptions that align with patient preferences, clinical characteristics, and functional goals.

For general practitioners, exercise therapy should remain a first-line management strategy within a comprehensive biopsychosocial model of care. Encouraging sustained physical activity, supporting self-management, and collaborating with rehabilitation professionals are essential for optimizing long-term outcomes. Continued advances in digital health, telemedicine, and implementation research are expected to further enhance the delivery of exercise-based interventions in primary care.

CONFLICT OF INTEREST

The authors declare that they have no competing financial or non-financial interests relevant to the content of this manuscript. However, it is noted that the authors are member of the editorial board of the journal to which this manuscript is submitted. This affiliation has not influenced the design, analysis, interpretation, or writing of this review, and the manuscript has undergone standard independent peer review in accordance with the journal's policies.

ARTIFICIAL INTELLIGENCE (AI) DISCLOSURE

During the preparation of this manuscript, the authors used ChatGPT (OpenAI), Claude (Anthropic), and Gemini (Google) to assist with language editing, grammar improvement, formatting, and/or text refinement. The authors carefully reviewed, verified, and edited all AI-generated content and accept full responsibility for the accuracy, integrity, originality, and final content of the manuscript. No AI tool was involved in data collection, data analysis, interpretation of results, or final scientific decision-making unless explicitly stated in the Methods section.

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Received May 2026
Revised June 2026
Accepted July 2026