NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Quality in Sport. eISSN 2450-3118.

Journal Home Page
https://apcz.umk.pl/QS/index

ŻUKOWSKI, Marcel Artur, DACHOWSKA, Sandra, HARAJ, Jan, BIENIEK, Maciej, WOŹNIAK, Kinga, SOBKOWIAK, Marcin, NAMYSŁ, Maria, and MATCZAK, Simon. Exercise Therapy Versus Pharmacological Management in Nonspecific Chronic Low Back Pain: A Narrative Review of Clinical Evidence and Recommendations. Quality in Sport. 2026;55:70943. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.55.70943

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 16.04.2026. Revised: 25.04.2026. Accepted: 3.05.2026. Published: 8.05.2026.

Exercise Therapy versus Pharmacological Management in Nonspecific Chronic Low Back Pain: A Narrative Review of Clinical Evidence and Recommendations

Marcel Artur Żukowski[1]

ORCID: https://orcid.org/0009-0001-9126-9579

E-mail: marcel.artur.zukowski@gmail.com

[1]Poznan University of Medical Sciences, Poznan, Poland

Sandra Dachowska[1]
ORCID: https://orcid.org/0009-0009-0828-3053
E-mail: san.dachowska@gmail.com
[1]Poznan University of Medical Sciences, Poznan, Poland

Jan Haraj[1]
ORCID: https://orcid.org/0009-0007-4847-6576
E-mail: jan.haraj.praca@gmail.com
[1]Poznan University of Medical Sciences, Poznan, Poland

Maciej Bieniek[1]
ORCID: https://orcid.org/0009-0008-2432-1980
E-mail: macijbieniek99@gmail.com
[1]Poznan University of Medical Sciences, Poznan, Poland

Kinga Woźniak[1]
ORCID: https://orcid.org/0009-0008-0218-994X
E-mail: kwump85@gmail.com
[1]Poznan University of Medical Sciences, Poznan, Poland

Marcin Sobkowiak[1]
ORCID: https://orcid.org/0009-0008-3053-5213
E-mail: sobkowiakkonin@gmail.com
[1]Poznan University of Medical Sciences, Poznan, Poland

Maria Namysł[1]
ORCID: https://orcid.org/0009-0009-8682-1718
E-mail: missnamysl@gmail.com
[1]Poznan University of Medical Sciences, Poznan, Poland

Simon Matczak[1]
ORCID: https://orcid.org/0009-0000-9191-6847
E-mail: szymon.matczak00@gmail.com
[1]Poznan University of Medical Sciences, Poznan, Poland

Corresponding Author

Sandra Dachowska[1], ORCID: https://orcid.org/0009-0009-0828-3053

E-mail: san.dachowska@gmail.com

[1]Poznan University of Medical Sciences, Poznan, Poland

Abstract

Chronic non-specific low back pain (NSCLBP) is defined as pain and discomfort lasting at least 12 weeks that cannot be clearly attributed to a specific structural pathology after excluding specific causes of back pain. It is a significant health problem with a major impact on patients' functioning, reducing quality of life, limiting mobility and increasing the number of comorbidities. NSCLBP is also associated with a higher risk of mortality. This is a global problem, it is estimated that chronic lower back pain affects around 8% of the adult population, providing a therapeutic challenge for physicians of many specialties across several continents. The treatment protocol for NSCLBP includes pharmacological and non-pharmacological interventions, which involve a variety of exercises that differ in terms of difficulty and effectiveness. Exercise-based therapies vary in type, intensity and clinical efficacy, ranging from core stabilization exercises, stretching and strength training to aerobic activities such as walking or swimming. Exercise is a key component in the treatment of NSCLBP, as evidenced by data showing significant reductions in pain and disability. Medication helps with the flare-ups, but cannot replace physical activity when it comes to achieving a genuine, lasting recovery and a return to normal activity.

Keywords: chronic non-specific low back pain, exercise therapy, pharmacological management, non-pharmacological treatment, rehabilitation, aerobic exercise, NSAIDs, opioids, pain reduction

Content

1. Introduction

Chronic low back pain (CLBP) is a significant health problem with a major impact on patients' functioning. This condition leads to a reduced quality of life, limited mobility, and an increased number of comorbidities, and is also associated with a higher risk of mortality compared to people without pain. It is estimated that CLBP affects approximately 8% of the adult population and remains the most common cause of disability worldwide. (1,2) The non-specific form of pain accounts for approximately 90% of all cases of low back pain. (1) Chronic non-specific low back pain (NSCLBP) is defined as pain and discomfort lasting at least 12 weeks that cannot be clearly attributed to a specific structural pathology after excluding specific causes of back pain. (3) Current treatment strategies include both non-pharmacological interventions, in particular exercise therapy aimed at improving muscle strength, flexibility, and postural control, as well as pharmacological treatment aimed at alleviating symptoms, including non-steroidal anti-inflammatory drugs and analgesics. At the same time, the effectiveness of pharmacotherapy in the long-term treatment of NSCLBP is limited, and its use is associated with the risk of adverse effects, such as gastrointestinal and cardiovascular complications or the development of dependence on analgesics. (4) Despite numerous studies, the optimal choice and sequencing of therapeutic interventions remains under debate. This narrative review endeavors to synthesize the prevailing scientific data concerning the comparative effectiveness of exercise therapy and pharmacological interventions in adult individuals experiencing NSCLBP, while also highlighting practical clinical ramifications and pinpointing areas necessitating additional investigation.

2. Methods

For the purpose of this narrative review, a literature search was conducted in the PubMed database to identify studies addressing exercise therapy and pharmacological management in adults with NSCLBP. The search strategy included the following query applied to titles and abstracts: ("nonspecific low back pain"[Title/Abstract] OR NSCLBP[Title/Abstract]) AND (exercise[Title/Abstract] OR "exercise therapy"[Title/Abstract] OR rehabilitation[Title/Abstract] OR "physical therapy"[Title/Abstract] OR "physical activity"[Title/Abstract]) AND (pharmacological[Title/Abstract] OR medication[Title/Abstract] OR drug[Title/Abstract] OR NSAID[Title/Abstract] OR analgesic[Title/Abstract] OR "pain medication"[Title/Abstract] OR treatment[Title/Abstract]). Additional filters were applied to limit results to articles published within the last ten years, studies written in English, and research conducted in human populations. The review primarily included randomized controlled trials (RCTs), clinical trials, systematic reviews, and meta-analyses evaluating exercise-based or pharmacological interventions for NSCLBP. Studies focusing on specific structural causes of low back pain (e.g., fractures, infections, malignancies), surgical interventions, or pediatric populations were excluded. Relevant publications were also identified through manual screening of the reference lists of selected articles to ensure comprehensive coverage of key evidence related to exercise therapy and pharmacological management in NSCLBP.

3. Pathophysiology

NSCLBP is a clinical entity with a heterogeneous presentation and variable prognosis. Its etiology is considered multifactorial, as the source of pain cannot be clearly attributed to a specific anatomical structure or tissue. (5) The pathophysiology of this condition remains poorly understood, which is why the diagnosis is one of exclusion. In the diagnostic process, it is necessary to exclude other causes of spinal complaints for which there are clearly defined diagnostic criteria. (6) Several concepts explaining the pathomechanisms of NSCLBP have been described in the literature, including biomechanical, neurophysiological models, and theories of motor control dysfunction. One of the main concepts of NSCLBP pathophysiology interprets the causes of pain within the biopsychosocial (BPS) model. This model is based on the interaction of biological factors (e.g., central sensitization, inflammatory processes, motor control, and spinal stabilizing muscle dysfunction), psychological factors (e.g., stress, pain

catastrophizing), and social factors. Pain is understood as a complex neurobiological and behavioral response to perceived threat, and its nature may depend on cognitive, emotional, and environmental factors. (5)

3.1 Inflammatory mechanisms

Inflammatory mechanisms may contribute to NSCLBP even when a specific anatomical source cannot be identified. In a cross-sectional study with a control group, profiles of inflammatory mediators in patients with acute and CLBP were analyzed and compared with those of healthy individuals. Patients with NSCLBP show increased cytokine levels and an imbalance between pro- and anti-inflammatory mediators, suggesting a role for inflammatory processes in the pathophysiology of the condition. (6) At the same time, the results suggest that inflammatory mechanisms may only apply to certain subgroups of patients, and the data remain inconclusive. (7)

3.2 Central sensitization

Neurological mechanisms, including central sensitization (CS), may contribute to the pathophysiology of NSCLBP. This theory proposes that nociceptive neurons in the central nervous system become more sensitive to normal or subthreshold stimuli, leading to a reduced pain threshold and heightened reactivity. (8,9) It has been suggested that in patients with NSCLBP, CS mechanisms may also be associated with evening chronotype, although data in this area remain limited. (10)

3.3 Motor control dysfunction

The biological mechanisms of the BPS model include the Motor Control Model, in which disorders of the muscles stabilizing the spine and motor control are observed. In particular, the function of the transversus abdominis (TrA) and multifidus (MF) muscles is emphasized. In patients with NSCLBP, diagnostic tests such as the Abdominal Drawing-In Maneuver (ADIM) and postural loads cause reduced and uncoordinated activation of the TrA and MF muscles. Such results may indicate spinal instability. (11) Motor control disorders lead to adaptive changes in body posture and stabilization strategies, which, in the absence of appropriate rehabilitation, can exacerbate functional and structural changes. (12) There is some evidence

suggesting that interventions targeting these dysfunctions, including core stabilization exercises and regenerative neurostimulation, may improve MF function, lumbopelvic stability, and pain; however, these approaches are discussed in detail in the treatment section. (13–16)

3.4 Psychosocial factors

Posture and muscle strength control depend largely on physical activity, which is why a sedentary lifestyle can affect function and pain intensity in patients with NSCLBP. Regular physical activity can help reduce pain and improve overall health, while knowledge about its impact on inflammatory mechanisms leaves room for further research. (17,18) Studies on long-term treatment outcomes have shown that significant factors include pain levels, disability, emotional stress, pain catastrophizing, expectations regarding recovery, and physical demands at work. (5)

4. Non-pharmacological management - exercise therapy

4.1 Core stability

Core stability therapy in NSCLBP is based on targeted training of the deep trunk muscles, primarily the TrA and the MF muscles, often including the diaphragm and pelvic floor muscles. (19) RCTs demonstrated that core stability exercises (CSE) was superior for pain reduction and disability improvement compared to general exercise. It was noted that CSE may enhance trunk stability by increasing intra-abdominal pressure through activation of the TrA and MF muscles, addressing delayed muscle activation patterns observed in a group of patients suffering from low back pain. (20)

4.2 Stretching

Hamstring tightness is associated with NSCLBP and patients with low back pain often present shortened hamstrings with restricted flexibility. (21) Consequence of tightened hamstrings is altering lumbar-pelvic rhythm, which increases bending stresses on lumbar intervertebral discs and overall spinal load, which can lead to pain occurrence. A systematic review with meta-analysis examined the effects of hamstring stretching exercises on pain intensity and function in low back pain patients across 14 RCTs (n=735). Hamstring stretching significantly reduced

pain intensity and improved function as measured by the Oswestry Disability Index (ODI), compared to standard care in various NSCLBP subtypes. The greatest improvements in straight leg raise range of motion were seen in low back pain with radiation. Hamstring stretching appears particularly beneficial for patients with tight hamstrings, enhancing lumbar flexibility and reducing lumbar load in nonspecific chronic lower back pain, warranting its consideration as a therapeutic exercise modality. (22)

4.3 Strength training

A RCT (n=26 patients) incorporated hamstring strength training as part of a combined balance and hamstring intervention. The hamstring training combined stretching with strength exercises, including isometric straight leg raises using a resistance band and myofascial release with a foam roller. Sessions lasted 45 minutes, performed 3 times per week for 6 weeks; the control group received no strength training. The experimental group showed significant improvements in hamstring strength, measured isometrically via Back Check, along with enhanced back strength, abdominal endurance, and back endurance with reduced pain on Visual Analog Scale (VAS). Strength training targets weak hamstrings, reducing lumbar compensation and enhancing stability, but the lack of flexibility gains highlights the need for longer interventions. (21) Isolated lumbar extension strength training (ILEX), which targets erector spinae and paravertebral muscles in NSCLBP treatment, was evaluated in a systematic review and meta-analysis. ILEX significantly reduced pain intensity versus true controls with individual reductions ranging from 14.7% to 64.8%. Non-significant favorable effects emerged for disability and isometric lumbar strength. ILEX's high-intensity, low-volume protocol (1 session/week, 1 set to failure) offers targeted lumbar strengthening with low disc strain for NSCLBP rehabilitation. (23)

4.4 Aerobic activities

Progressive aerobic training (PAT) demonstrates moderate effectiveness in the management of NSCLBP. A systematic review and meta-analysis of six RCTs involving 333 participants (mean age 44 years with pain duration of about 7 years) found that PAT significantly reduced pain intensity versus control groups, though the effect was not always clinically significant. While PAT showed trends toward improved disability and quality of life, it was not superior to progressive resistance training (PRT) in direct comparisons, with both approaches offering

comparable benefits for pain relief in supervised programs lasting 6-16 weeks at 2-3 sessions per week. (24) Water-based exercises, including swimming and aquatic aerobics, offer significant benefits for patients with NSCLBP, as demonstrated in a systematic review with meta-analysis of 15 RCTs involving 524 participants. Short-term interventions (≤8 weeks) led to large reductions in pain intensity, disability, and flexibility improvement with effects comparable to land-based therapies. (25) Separate meta-analysis of 13 RCTs (n=597) confirms the effectiveness of these exercises, showing that aquatic physical therapy significantly alleviates pain, enhances physical and mental quality of life, and reduces disability. (26) These findings support aquatic exercises as an effective, low-impact aerobic option for pain management and functional recovery in NSCLBP.

5. Pharmacological management - categories of drugs

5.1 Paracetamol and non-steroidal anti-inflammatory drugs

The efficacy and safety of paracetamol for NSCLBP was evaluated in a systematic review, based on two placebo-controlled RCTs involving 1785 participants, predominantly with acute low back pain. High-quality evidence from the large PACE trial demonstrates no clinically meaningful difference between paracetamol (up to 4 g/day) and placebo for pain intensity or disability. Secondary outcomes, including quality of life, function, sleep quality, global recovery, adherence, and rescue medication use, also showed no significant benefits with similar adverse event rates. Notably, no trials addressed subacute or chronic low back pain, underscoring the lack of direct evidence for paracetamol's role in NSCLBP management. (27,28)
The efficacy of non-steroidal anti-inflammatory drugs (NSAIDs) for NSCLBP was investigated in 13 RCTs involving 4807 participants. NSAIDs provide a small benefit over placebo for pain intensity and disability at intermediate-term follow-up (>3 to ≤12 months). The risk of adverse events was not increased and side reactions were similar between groups, but the short follow-up period and small sample size likely underestimate long-term gastrointestinal or cardiovascular risks. No differences emerged between selective COX-2 inhibitors and non-selective NSAIDs, or versus paracetamol; one trial favored exercise over NSAIDs for disability. Authors conclude NSAIDs offer minor short-term relief but lack high-quality evidence for safety or superiority in NSCLBP. (28,29)

5.2 Opioids

Opioids offer only modest short-term benefits for non-malignant CLBP in highly selected patients. Across 21 placebo-controlled RCTs (7650 participants, 4–15 weeks), opioids generally failed to achieve clinically relevant ≥50% pain relief in standard parallel and cross-over designs but did yield a clinically important reduction in disability compared with placebo. In contrast, enriched enrolment randomized withdrawal trials showed the opposite pattern: clinically relevant ≥50% pain relief but no meaningful improvement in disability. Overall, opioids provided a clinically relevant ≥30% pain reduction and some functional gain compared with placebo, with no increase in serious adverse events or deaths, but with a notable risk of treatment discontinuation due to side effects and incomplete data on abuse and addiction, underscoring that any opioid trial in CLBP should be time-limited and restricted to carefully selected patients. (30) According to a meta-analysis of RCTs for NSCLBP, oxymorphone, tapentadol, and fentanyl are ranked as the most effective opioids for pain reduction on the Numeric Rating Scale. Analyzing data from 2933 patients (mean age 53.3 years, symptom duration ~95 months, follow-up ~3.3 months), these compounds demonstrated superior efficacy compared to morphine, oxycodone, buprenorphine, and tramadol. The authors emphasize considering individual patient factors, different formulations, and pharmacokinetic profiles when selecting opioids, given the variability in clinical scenarios. (31)

5.3 Antidepressants

The efficacy and safety of antidepressants for NSCLBP was evaluated across nine RCTs involving 1758 patients. Duloxetine at 60 mg/day significantly reduced pain intensity and improved quality of life compared to placebo, with tolerable side effects, while higher doses (120 mg) increased adverse events without additional benefits. Escitalopram showed modest effects, so it could be considered as third-line therapy. Amitriptyline, bupropion, and imipramine. Desipramine demonstrated inconsistent or limited efficacy and notable adverse effects. In conclusion, duloxetine should be seen as the most advantageous option among antidepressants for NSCLBP management. (32)

5.4 Anticonvulsants

Data on the efficacy and tolerability of anticonvulsants (gabapentin, pregabalin and topiramate) in the treatment of NSCLBP are based on nine RCTs involving 859 participants. Gabapentinoids showed no clinically meaningful effect on pain or disability in CLBP, and the use of topiramate was associated with minor short-term pain relief without disability benefit. (33) As described in a randomized, double-blind, placebo-controlled trial involving 108 patients, gabapentin has no significant analgesic efficacy in NSCLBP. Intake up to 3600 mg/day for 12 weeks did not show any difference compared to placebo in pain intensity reduction or disability. No correlation was found between plasma gabapentin levels and pain intensity. Anticonvulsant drugs cause more adverse effects, including fatigue, dry mouth, concentration issues, drowsiness, dizziness, and nausea, leading to the conclusion that they are ineffective and not recommended for this condition. (33,34)

5.5 Muscle relaxants

Muscle relaxants, particularly non-benzodiazepine antispasmodics, provide only small, non-clinically important reductions in pain intensity for acute low back pain at $\leq$2 weeks. They show no benefits for disability or longer-term outcomes (3-13 weeks) and increase adverse event risk. For NSCLBP, evidence is limited and uncertain, with no clear efficacy across muscle relaxant classes, urging caution due to sedation and bias risks in trials. (35)

5.6 Treatment summary

Management of NSCLBP emphasizes nonpharmacological approaches over medications, which offer limited benefits. Core stability and stretching exercises provide short-term pain relief and functional gains by targeting muscle imbalances, while strength training and aerobic activities moderately reduce pain and disability with low risk. Pharmacologically, paracetamol shows no benefit, NSAIDs yield small short-term effects, opioids and anticonvulsants are ineffective long-term, antidepressants offer modest gains, and muscle relaxants provide negligible relief with higher adverse events - prioritizing exercises first aligns with evidence for sustainable outcomes.

6. Clinical Outcomes Comparison

A growing body of evidence suggests that exercise-based interventions are more effective than pharmacological treatments in reducing pain among individuals with NSCLBP. Evidence from pooled analyses of RCTs shows that structured exercise programs, including yoga and Pilates, are associated with meaningful reductions in pain intensity. By contrast, opioids appear to offer limited long-term benefit in this population. (4,36,37)

Other forms of exercise therapy, including directional preference training and stabilization exercises, have also demonstrated greater effectiveness in pain reduction than standard pharmacological management. In this evidence, many contemporary clinical guidelines recommend exercise therapy as the preferred first-line treatment for CLBP. (36,38)

A systematic review and meta-analysis that included 21 RCTs reported significant reductions in both pain intensity and disability in participants undergoing exercise therapy compared with those receiving minimal intervention, placebo, or no treatment. Importantly, these benefits were observed to persist for up to 12 months following intervention. (39) Similarly, guidelines issued by the World Health Organization emphasize non-pharmacological approaches, particularly exercise, as a cornerstone of long-term management for persistent low back pain. (1)

7. Functional Improvements

In addition to reducing pain, exercise interventions appear to contribute to meaningful improvements in physical functioning. Functional outcomes in patients with NSCLBP are most commonly assessed using instruments such as the Roland-Morris Disability Questionnaire (RMDQ) or the ODI. Evidence suggests that programs focusing on core stabilization or yoga tend to produce greater improvements in disability scores than standard care alone. Some studies also indicate that stabilization-based exercise may yield slightly greater short-term improvements in ODI scores than general exercise programs. (37,40–42)

Pharmacological treatments, while often effective in providing short-term symptom relief, generally do not appear to translate into sustained improvements in physical functioning. (4,43)

The previously mentioned meta-analysis also identified moderate reductions in functional disability, particularly in interventions emphasizing motor control and strengthening of the trunk musculature. (39)

8. Return to Daily and Occupational Activities

Restoring the ability to perform everyday activities and maintain employment is a key objective in the management of CLBP. Exercise-based rehabilitation, particularly programs focusing on motor control training or progressive resistance exercise, has been associated with improved recovery and a greater likelihood of maintaining normal daily routines. Stabilization exercises, in particular, are frequently highlighted as one of the more effective approaches for facilitating functional recovery. (36,38,44)

Evidence further suggests that supervised rehabilitation programs tend to produce more durable outcomes than reliance on pharmacological pain management alone. (40,41,43) In addition, the World Health Organization has emphasized that exercise interventions may positively influence psychosocial factors associated with chronic pain, thereby supporting long-term recovery and return-to-work outcomes. (1)

9. Practical Recommendations

Current clinical recommendations consistently support exercise therapy as the primary intervention for individuals with NSCLBP. Structured and supervised programs, including directional preference exercises, stabilization training, yoga, and Pilates, have demonstrated consistent benefits of both pain reduction and functional improvement. (36–38,40,41) Pharmacological treatment may still be considered, particularly during episodes of acute pain exacerbation when symptoms temporarily limit participation in exercise. In such cases, short-term use of NSAIDs and occasionally opioids may be considered. However, these medications should typically be used as supportive measures due to their limited long-term effectiveness and potential adverse effects. (4,38,43) The World Health Organization also recommends integrating regular physical activity into long-term management plans. In practice, this often involves approximately 150 minutes per week of moderate-intensity aerobic activity together with muscle-strengthening exercises, adapted to the patient's physical capacity and tolerance. (1)

9.1 Combined Strategies

In clinical practice, combining exercise therapy with appropriately selected pharmacological support may provide the most balanced treatment approach. Treatment decisions should

consider several factors, including the severity of pain, functional limitations, and the presence of comorbid conditions. Evidence from network meta-analyses suggests that integrated treatment strategies may lead to better overall outcomes. (36,37) Exercise programs are typically performed two to three times per week and often follow a gradual progression. Initial phases often focus on stabilization and motor control exercises, followed by a transition to more demanding resistance-based training over approximately 8–12 weeks. Monitoring progress using validated measures, such as VAS or Numerical Pain Rating Scale for pain and RMDQ or ODI for functional status, can help guide ongoing adjustments to the rehabilitation program. (40,41,44)

9.2 Patient Education

Education plays an important role in the management of NSCLBP. Patients are generally encouraged to remain active and gradually increase their level of physical activity rather than avoid movement due to pain. Emphasizing regular participation in therapeutic exercise, rather than relying solely on medication, has been associated with reduced disability and improved return-to-work outcomes. (4,36,38,43) Encouraging patients to monitor their activity levels and maintain consistent exercise routines may further support adherence to rehabilitation programs. Overall, approaches that promote active participation in recovery tend to result in better long-term outcomes than passive treatment strategies focused primarily on medication. (37,40)

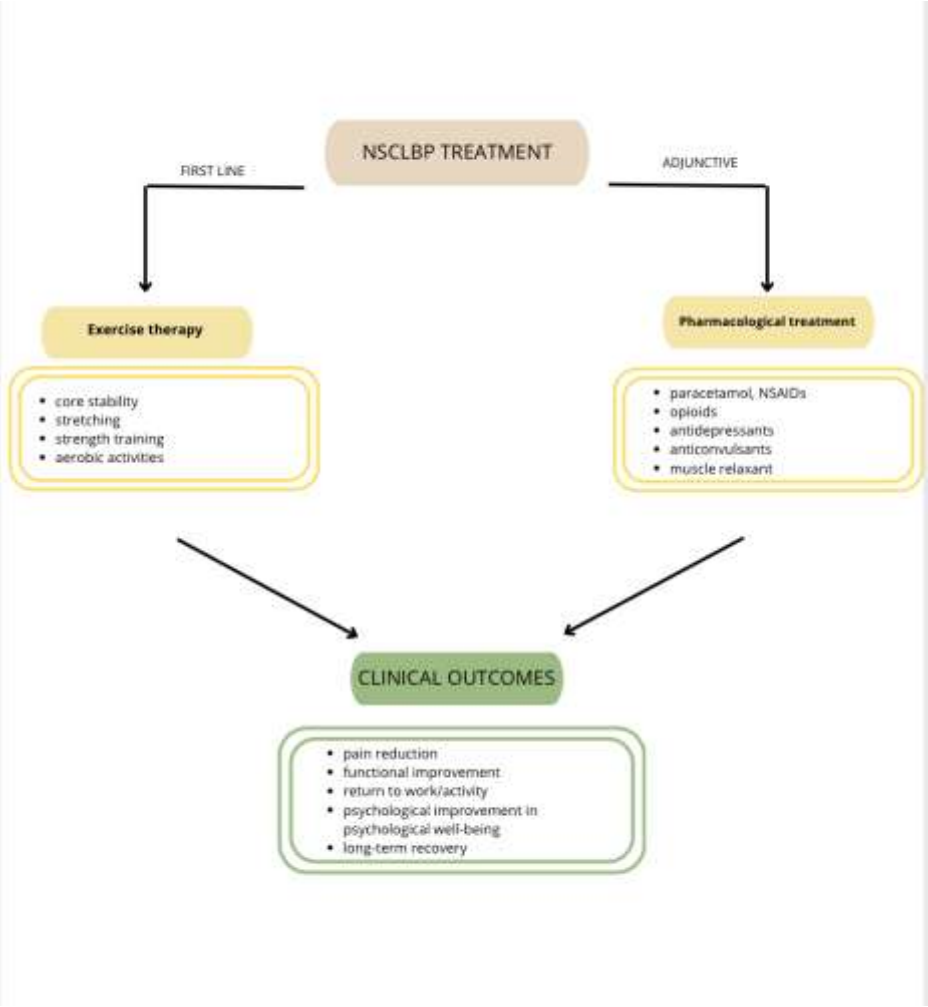

Figure 1. Treatment strategies for NSCLBP

10. Limitations

Despite the overall consistency of findings, several limitations should be acknowledged. Exercise interventions vary considerably in type, intensity, duration, and supervision, which complicates direct comparisons between different approaches. (36,37,40) Additionally, many studies include relatively small participant samples and follow-up periods shorter than 12 months, limiting conclusions regarding the long-term sustainability of treatment effects.

Variability in study design, differences in pharmacological treatment protocols, and the possibility of publication bias may also influence the available evidence. Furthermore, some

differences between clinical guidelines likely reflect variations in how the evidence is interpreted, as well as differences in healthcare systems and cultural approaches to treatment. (4,38,41,44) The 2018 systematic review also reported considerable heterogeneity among included studies, which limits strong conclusions regarding the superiority of specific exercise subtypes. (39)

11. Conclusions

Overall, current evidence supports exercise therapy as a central component of treatment for NSCLBP. Exercise interventions, including yoga and directional preference exercises, have been associated with meaningful reductions in pain and disability when compared with minimal care or placebo interventions (36,37,40). Although pharmacological treatments may provide short-term symptom relief during periods of increased pain, they are unlikely to replace exercise-based rehabilitation in achieving sustained improvements in physical function and long-term symptom control (4,43). A treatment approach that combines exercise with appropriately selected pharmacological support may therefore provide the most comprehensive strategy for managing NSCLBP and facilitating return to daily and occupational activities. This perspective aligns closely with current international guideline recommendations, which emphasize exercise as the foundation of long-term management. (1,36,38,41) To obtain more reliable and generalizable results, more long-term experimental studies should be conducted. These studies should incorporate standardized exercises and direct matchups between the evaluated approaches. Such a research design would enable a more precise assessment of their relative effectiveness and provide a stronger empirical basis for formulating practical recommendations. (37,40,44)

Disclosure

Supplementary materials
Not applicable.

Author Contributions:
Conceptualization: S. D.
Methodology: M. B., M. S.

Software: M. A. Ż.

Check: J. H., M. B., M. S.

Formal analysis: M. N., S. M.

Investigation: K. W., S. D.

Resources: M. S., M. A. Ż.

Data curation: M. N., S. M.

Writing - rough preparation: K. W., M. B., J. H.

Writing - review and editing: S. D., M. A. Ż.

Visualization: M. N., S. M.

Supervision: M. A. Ż.

Project administration: J. H.

All authors have read and agreed with the published version of the manuscript.

Funding

The study did not receive external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Acknowledgements

Not applicable.

Conflict of Interest Statement

The authors declare no conflicts of interest.

Declaration of generative AI and AI-assisted technologies in the writing process.

In preparing this work, the authors used ChatGPT (GPT-5, OpenAI) for the purpose of assisting in drafting text, suggesting phrasing, and improving language clarity. After using this tool/service, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

References

1. WHO guideline for non-surgical management of chronic primary low back pain in adults in primary and community care settings [Internet]. [cited 2026 Mar 12]. Available from: https://www.who.int/publications/i/item/9789240081789
2. Ferreira ML, Luca K de, Haile LM, Steinmetz JD, Culbreth GT, Cross M, et al. Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. Lancet Rheumatol. 2023 Jun 1;5(6):e316–29. doi:10.1016/S2665-9913(23)00098-X PubMed PMID: 37273833.
3. Ma K, Zhuang ZG, Wang L, Liu XG, Lu LJ, Yang XQ, et al. The Chinese Association for the Study of Pain (CASP): Consensus on the Assessment and Management of Chronic Nonspecific Low Back Pain. Pain Res Manag. 2019;2019(1):8957847. doi:10.1155/2019/8957847
4. Soares Fonseca L, Pereira Silva J, Bastos Souza M, Gabrich Moraes Campos M, de Oliveira Mascarenhas R, de Jesus Silva H, et al. Effectiveness of pharmacological and non-pharmacological therapy on pain intensity and disability in older people with chronic nonspecific low back pain: a systematic review with meta-analysis. Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc. 2023 Sep;32(9):3245–71. doi:10.1007/s00586-023-07857-4 PubMed PMID: 37464184.
5. Otero-Ketterer E, Peñacoba-Puente C, Ferreira Pinheiro-Araujo C, Valera-Calero JA, Ortega-Santiago R. Biopsychosocial Factors for Chronicity in Individuals with Non-Specific Low Back Pain: An Umbrella Review. Int J Environ Res Public Health. 2022 Aug 16;19(16):10145. doi:10.3390/ijerph191610145 PubMed PMID: 36011780; PubMed Central PMCID: PMC9408093.
6. Teodorczyk-Injeyan JA, Triano JJ, Injeyan HS. Nonspecific Low Back Pain. Clin J Pain. 2019 Oct;35(10):818–25. doi:10.1097/AJP.0000000000000745 PubMed PMID: 31283548; PubMed Central PMCID: PMC6735949.

7. Pinto EM, Neves JR, Laranjeira M, Reis J. The importance of inflammatory biomarkers in non-specific acute and chronic low back pain: a systematic review. Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc. 2023 Sep;32(9):3230–44. doi:10.1007/s00586-023-07717-1 PubMed PMID: 37195364.
8. Opara JA, Saulicz E, Szczygieł JW, Szczygieł K. Is the Central Sensitization in Chronic Nonspecific Low Back Pain Structural Phenomenon or Psychological Reaction? A Narrative Review. J Clin Med. 2025 Jan;14(2):577. doi:10.3390/jcm14020577
9. Andrada Alonso M, Mateo Guarch N, Alfonso Olmos-García M, Modol CS, Doménech Fernández J, Llombart-Blanco R. Central Sensitization of Pain in Patients Presenting with Low Back Pain and Foot/Ankle Disorders. BioMed. 2025 Dec;5(4):28. doi:10.3390/biomed5040028
10. Uçkun AÇ, Doğan N, İnce B, Akçay Ş, Kaya T, Karatepe AG. Association between chronotype and central sensitization in patients with non-specific low back pain. Chronobiol Int. 2025 Jul;42(7):913–20. doi:10.1080/07420528.2025.2515990 PubMed PMID: 40488541.
11. Muscle Thickness and Function of Transversus Abdominis and Gluteus Medius in Individuals with Chronic Non-Specific Low Back Pain [Internet]. [cited 2026 Mar 12]. Available from: https://www.mdpi.com/2077-0383/15/2/666?utm_source=chatgpt.com
12. Yojana E, Zahari Z, Bukry SA. Factors that influence motor control in individuals with nonspecific low back pain: A scoping review. Med J Malaysia. 2024 Mar;79(Suppl 1):209–14. PubMed PMID: 38555907.
13. Güler MA, Demirdel E, Gezer İA, Nayman A, Tezcan EA. Effect of core stabilization exercises on lumbar multifidus morphology and functional outcomes in chronic non-specific low back pain: a randomized controlled trial. BMC Musculoskelet Disord. 2025 Dec 28;27(1):83. doi:10.1186/s12891-025-09433-x
14. Abd-Elsayed A, Kurt E, Kollenburg L, Hasoon J, Wahezi SE, Storlie NR. Lumbar Multifidus Dysfunction and Chronic Low Back Pain: Overview, Therapies, and an Update on the Evidence. Pain Pract Off J World Inst Pain. 2025 Jun;25(5):e70044. doi:10.1111/papr.70044 PubMed PMID: 40361257.
15. Capel-Alcaraz AM, Castro-Sánchez AM, Matarán-Peñarrocha GA, Antequera-Soler E, Lara-Palomo IC. Effects of Motor Control Exercises in Patients With Chronic Nonspecific Low Back Pain: A Systematic Review and Meta-Analysis. Clin J Sport Med Off J Can Acad Sport Med. 2023 Nov 1;33(6):579–97. doi:10.1097/JSM.0000000000001175 PubMed PMID: 37432388.

16. Saragiotto BT, Maher CG, Yamato TP, Costa LOP, Costa LCM, Ostelo RWJG, et al. Motor Control Exercise for Nonspecific Low Back Pain: A Cochrane Review. Spine. 2016 Aug 15;41(16):1284–95. doi:10.1097/BRS.0000000000001645 PubMed PMID: 27128390.
17. Alonso-Sal A, Alonso-Perez JL, Sosa-Reina MD, García-Noblejas-Fernández JA, Balani-Balani VG, Rossettini G, et al. Effectiveness of Physical Activity in the Management of Nonspecific Low Back Pain: A Systematic Review. Medicina (Mex). 2024 Dec 16;60(12):2065. doi:10.3390/medicina60122065 PubMed PMID: 39768944; PubMed Central PMCID: PMC11678838.
18. Alsufiany MB, Lohman EB, Daher NS, Gang GR, Shallan AI, Jaber HM. Non-specific chronic low back pain and physical activity: A comparison of postural control and hip muscle isometric strength: A cross-sectional study. Medicine (Baltimore). 2020 Jan;99(5):e18544. doi:10.1097/MD.0000000000018544
19. Smrcina Z, Woelfel S, Burcal C. A Systematic Review of the Effectiveness of Core Stability Exercises in Patients with Non-Specific Low Back Pain. Int J Sports Phys Ther. 2022 Aug 1;17(5). doi:10.26603/001c.37251
20. Coulombe BJ, Games KE, Neil ER, Eberman LE. Core Stability Exercise Versus General Exercise for Chronic Low Back Pain. J Athl Train. 2017 Jan;52(1):71–2. doi:10.4085/1062-6050-51.11.16 PubMed PMID: 27849389; PubMed Central PMCID: PMC5293521.
21. Chen Z, Wang X. Effects of balance and hamstring training on nonspecific low back pain: A randomized controlled trial. Sci Rep. 2025 Feb 28;15(1):7116. doi:10.1038/s41598-025-91076-y PubMed PMID: 40016482; PubMed Central PMCID: PMC11868419.
22. Gou Y, Lei H, Chen X, Wang X. The effects of hamstring stretching exercises on pain intensity and function in low back pain patients: A systematic review with meta-analysis of randomized controlled trials. SAGE Open Med. 2024 Jan;12:20503121241252251. doi:10.1177/20503121241252251
23. Trybulski R, Michał W, Małgorzata S, Bogdański B, Bichowska-Pawęska M, Ryszkiel I, et al. Impact of isolated lumbar extension strength training on reducing nonspecific low back pain, disability, and improving function: a systematic review and meta-analysis. Sci Rep. 2025 Feb 21;15(1):6426. doi:10.1038/s41598-025-90699-5
24. Wewege MA, Booth J, Parmenter BJ. Aerobic vs. resistance exercise for chronic non-specific low back pain: A systematic review and meta-analysis. J Back Musculoskelet Rehabil. 2018 Oct 25;31(5):889–99. doi:10.3233/BMR-170920

25. Babiloni-Lopez C, Fritz N, Ramirez-Campillo R, Colado JC. Water-Based Exercise in Patients With Nonspecific Chronic Low-Back Pain: A Systematic Review With Meta-Analysis. J Strength Cond Res. 2024 Jan;38(1):206–19. doi:10.1519/JSC.0000000000004635
26. Ma J, Zhang T, He Y, Li X, Chen H, Zhao Q. Effect of aquatic physical therapy on chronic low back pain: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2022 Dec 2;23(1):1050. doi:10.1186/s12891-022-05981-8 PubMed PMID: 36460993; PubMed Central PMCID: PMC9717486.
27. Saragiotto BT, Machado GC, Ferreira ML, Pinheiro MB, Abdel Shaheed C, Maher CG. Paracetamol for low back pain. Cochrane Back and Neck Group, editor. Cochrane Database Syst Rev. 2016 Jun 6;2019(1). doi:10.1002/14651858.CD012230
28. Cashin AG, Wand BM, O'Connell NE, Lee H, Rizzo RR, Bagg MK, et al. Pharmacological treatments for low back pain in adults: an overview of Cochrane Reviews. Cochrane Back and Neck Group, Cochrane Musculoskeletal Group, editors. Cochrane Database Syst Rev. 2023 Apr 4;2023(4). doi:10.1002/14651858.CD013815.pub2
29. Enthoven WTM, Roelofs PDDM, Deyo RA, van Tulder MW, Koes BW. Non-steroidal anti-inflammatory drugs for chronic low back pain. Cochrane Database Syst Rev. 2016 Feb 10;2(2):CD012087. doi:10.1002/14651858.CD012087 PubMed PMID: 26863524; PubMed Central PMCID: PMC7104791.
30. Petzke F, Klose P, Welsch P, Sommer C, Häuser W. Opioids for chronic low back pain: An updated systematic review and meta-analysis of efficacy, tolerability and safety in randomized placebo-controlled studies of at least 4 weeks of double-blind duration. Eur J Pain. 2020 Mar;24(3):497–517. doi:10.1002/ejp.1519
31. Migliorini F, Maffulli N, Baroncini A, Eschweiler J, Tingart M, Quack V. Opioids for chronic low back pain management: a Bayesian network meta-analysis. Expert Rev Clin Pharmacol. 2021 May 4;14(5):635–41. doi:10.1080/17512433.2021.1903316
32. Leão Nunes Filho MJ, Barreto ESR, Antunes Júnior CR, Alencar VB, Falcão Lins-Kusterer LE, Azi LMTDA, et al. Efficacy of antidepressants in the treatment of chronic nonspecific low back pain: a systematic review and meta-analysis. Pain Manag. 2024 Aug 2;14(8):437–51. doi:10.1080/17581869.2024.2408215
33. Enke O, New HA, New CH, Mathieson S, McLachlan AJ, Latimer J, et al. Anticonvulsants in the treatment of low back pain and lumbar radicular pain: a systematic

review and meta-analysis. Can Med Assoc J. 2018 Jul 3;190(26):E786–93. doi:10.1503/cmaj.171333

34. Atkinson JH, Slater MA, Capparelli EV, Patel SM, Wolfson T, Gamst A, et al. A randomized controlled trial of gabapentin for chronic low back pain with and without a radiating component. Pain. 2016 Jul;157(7):1499–507. doi:10.1097/j.pain.0000000000000554 PubMed PMID: 26963844; PubMed Central PMCID: PMC5001843.
35. Cashin AG, Folly T, Bagg MK, Wewege MA, Jones MD, Ferraro MC, et al. Efficacy, acceptability, and safety of muscle relaxants for adults with non-specific low back pain: systematic review and meta-analysis. BMJ. 2021 Jul 7;n1446. doi:10.1136/bmj.n1446
36. Li Y, Yan L, Hou L, Zhang X, Zhao H, Yan C, et al. Exercise intervention for patients with chronic low back pain: a systematic review and network meta-analysis. Front Public Health. 2023 Nov 17;11:1155225. doi:10.3389/fpubh.2023.1155225 PubMed PMID: 38035307; PubMed Central PMCID: PMC10687566.
37. Hayden JA, Ogilvie R, Kashif S, Singh S, Boulos L, Stewart SA, et al. Exercise treatments for chronic low back pain: a network meta-analysis. Cochrane Database Syst Rev. 2023 Jun 7;2023(6):CD015608. doi:10.1002/14651858.CD015608 PubMed PMID: null; PubMed Central PMCID: PMC10250000.
38. Zhou T, Salman D, McGregor AlisonH. Recent clinical practice guidelines for the management of low back pain: a global comparison. BMC Musculoskelet Disord. 2024 May 1;25:344. doi:10.1186/s12891-024-07468-0 PubMed PMID: 38693474; PubMed Central PMCID: PMC11061926.
39. Oliveira CB, Maher CG, Pinto RZ, Traeger AC, Lin CWC, Chenot JF, et al. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. Eur Spine J. 2018 Nov 1;27(11):2791–803. doi:10.1007/s00586-018-5673-2
40. Hayden JA, Ellis J, Ogilvie R, Malmivaara A, Tulder MW. Exercise therapy for chronic low back pain. Cochrane Database Syst Rev. 2021 Sep 28;2021(9):CD009790. doi:10.1002/14651858.CD009790.pub2 PubMed PMID: 34580864; PubMed Central PMCID: PMC8477273.
41. Owen PJ, Miller CT, Mundell NL, Verswijveren SJJM, Tagliaferri SD, Brisby H, et al. Which specific modes of exercise training are most effective for treating low back pain? Network meta-analysis. Br J Sports Med. 2020 Nov;54(21):1279–87.

doi:10.1136/bjsports-2019-100886 PubMed PMID: 31666220; PubMed Central PMCID: PMC7588406.

42. Coulombe BJ, Games KE, Neil ER, Eberman LE. Core Stability Exercise Versus General Exercise for Chronic Low Back Pain. J Athl Train. 2017 Jan;52(1):71–2. doi:10.4085/1062-6050-51.11.16 PubMed PMID: 27849389; PubMed Central PMCID: PMC5293521.

43. Ketenci A, Zure M. Pharmacological and non-pharmacological treatment approaches to chronic lumbar back pain. Turk J Phys Med Rehabil. 2021 Mar 4;67(1):1–10. doi:10.5606/tftrd.2021.8216 PubMed PMID: 33948537; PubMed Central PMCID: PMC8088811.

44. Chenot JF, Greitemann B, Kladny B, Petzke F, Pfingsten M, Gabriele Schorr S. Non-Specific Low Back Pain. Dtsch Ärztebl Int. 2017 Dec;114(51–52):883–90. doi:10.3238/arztebl.2017.0883 PubMed PMID: 29321099; PubMed Central PMCID: PMC5769319.