



Pilates for chronic low back pain: methodological analysis of systematic reviews

Pilates para dor lombar crônica: análise metodológica de revisões sistemáticas

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ABSTRACT

Introduction: Recent studies suggest that Pilates is a promising intervention for chronic low back pain (CLBP); however, it is important to jointly summarize intervention characteristics as well as reporting and methodological transparency. **Objective:** To synthesize systematic reviews that evaluated interventions using Pilates for the treatment of CLBP to identify the types and characteristics of exercises most frequently reported. **Methods:** This is an evidence synthesis conducted through a systematic review, retrieving publications from SciELO, MEDLINE/PubMed, Cochrane Library, and Google Scholar databases. Systematic reviews published between 2013 and 2023 were included, with no language restrictions. The study followed the PRISMA 2020 guidelines. The interventions were analyzed based on the primary studies included in the systematic reviews, whereas the methodological quality of the systematic reviews was assessed using the AMSTAR-2 instrument. **Results:** A total of 1,939 studies were retrieved, and 9 met the eligibility criteria. Despite methodological variability, a pattern emerged: most studies adopted 60-minute sessions, conducted with heterogeneous weekly frequencies ranging from one to seven sessions per week, over 4–12 weeks, using mixed mat Studio Pilates. **Conclusion:** While Pilates demonstrates clinical efficacy for CLBP consistent with evidence-based guidelines, poor methodological transparency in protocol reporting limits reproducibility and optimal clinical application.

Keywords: Low back pain; Physical therapy modalities; Rehabilitation; Exercise movement techniques.

RESUMO

Introdução: Estudos recentes sugerem que o Pilates é uma intervenção promissora para a dor lombar crônica (DLC). No entanto, é importante resumir conjuntamente as características da intervenção, bem como a transparência metodológica e de relato. **Objetivo:** Sintetizar revisões sistemáticas que avaliaram intervenções utilizando Pilates para o tratamento da DLC para identificar os tipos e características dos exercícios mais frequentemente relatados. **Métodos:** Trata-se de uma síntese de evidências conduzida por meio de uma revisão sistemática, com consulta às bases de dados SciELO, MEDLINE/PubMed, Cochrane Library e Google Acadêmico. Foram incluídas revisões sistemáticas publicadas entre 2013 e 2023, sem restrição de idioma. O relato do estudo seguiu as diretrizes PRISMA 2020. As intervenções foram analisadas com base nos estudos primários incluídos nas revisões sistemáticas, enquanto a qualidade metodológica das revisões sistemáticas foi avaliada por meio do instrumento AMSTAR-2. **Resultados:** Um total de 1.939 estudos foram recuperados, e 9 preencheram os critérios de elegibilidade. Apesar da variabilidade metodológica, a maioria dos estudos adotou sessões de 60 minutos, realizadas com frequências semanais heterogêneas variando de uma a sete sessões por semana, ao longo de 4 a 12 semanas, utilizando Pilates misto (solo e aparelhos). **Conclusão:** Embora o Pilates demonstre eficácia clínica para a DLC consistente com as diretrizes baseadas em evidências, a baixa transparência metodológica no relato dos protocolos limita a reprodutibilidade e a aplicação clínica ideal.

Palavras-chave: Dor lombar; Modalidades de fisioterapia; Reabilitação; Técnicas de movimento do exercício.

Introduction

Low back pain is a serious public health problem with worldwide prevalence, standing out as the main musculoskeletal disorder and the leading global cause of physical disability¹⁻⁴. Low back pain is a multifactorial condition that may be associated with structural, functional, and muscular changes, harmful lifestyle (smoking, inadequate diet, sedentary lifestyle)⁵⁻⁷, sociodemographic factors (age, sex, income, and education), in addition to psychosocial disorders (anxiety, stress, depression)^{8,9}. This affects thousands of people, bringing high financial costs, harm to social life, and functional limitations with increased cases of absenteeism and time off work^{4,10,11}. It is estimated that low back pain may affect 65% of people annually and that 11% to 84% of the world's population will experience at least one episode of low back pain in their lives¹², with an average of 40% of these patients developing chronic low back pain (CLBP) after an acute episode³. Furthermore, more than 90% of cases of low back pain do not have a specific diagnostic etiology, due to the multifactorial nature of this condition¹²⁻¹⁴.

Clinical practice guidelines recommend the following for the management of nonspecific CLBP: staying active, resuming usual activities, and practicing physical exercises that promote improvement in muscle strength and flexibility^{4,15}, exercises that include muscle stretching, strength and resistance training, and motor control exercises in their protocols^{4,15-18}. Physical exercise, whether or not associated with education about low back pain, has been effective in preventing and reducing low back pain and functional disability^{4,19,20}. Among the exercise modalities endorsed by the guidelines, Pilates is considered a feasible intervention for the treatment of low back pain, improving the management of CLBP-related pain and disability. In 2023, a systematic review²¹ indicated that Pilates was effective for the management of CLBP in studies with similar intervention characteristics, having demonstrated good results regarding cost-effectiveness in the management of CLBP^{3,4,15,22}, and these results were corroborated by Miyamoto et al.²³ in 2018, who evaluated parameters of different Pilates protocols applied to CLBP.

The Pilates Method is a comprehensive movement system that combines six fundamental principles: concentration, breathing, control, fluidity, precision and centralization^{24,25}. This approach promotes gains in strength, endurance, flexibility, postural alignment, and body awareness^{24,26-28}. Pilates exercises involve contrac-

tion of the deep abdominal muscles and, when used in physiotherapy rehabilitation practice, may require modifications, such as adaptation and simplification in the traditional method, being described as clinical and adapted exercises¹⁷. These exercises are considered a valuable therapeutic tool in the prevention and rehabilitation of a variety of musculoskeletal injuries, including low back pain²⁹. Studies have shown that when applied to nonspecific low back pain, Pilates-based exercises can significantly reduce functional disability and pain intensity, with symptom relief for at least 12 months^{30,31}.

Educational health technologies are essential to standardize practices and increase the effectiveness of treating conditions such as CLBP, acting as tools that guide therapeutic interventions³². The World Health Organization (WHO) highlights structured and standardized education or counseling as one of the most effective interventions for CLBP, and studies demonstrate the benefits of providing informative and accessible scientific content. Despite the widespread use of Pilates in clinical practice and its recommendation in guidelines for the management of CLBP, there is still a lack of specific guidelines for its systematic application in the rehabilitation of this condition³³⁻³⁵. This scenario highlights deficiencies in the clarity, detail, and methodological rigor of reports of intervention protocols using Pilates available in the scientific literature. The lack of standardized information on exercise selection, progression, and execution compromises the reproducibility of studies, safe clinical application, and generalizability of results.

Therefore, the objective of this study was to synthesize systematic reviews that evaluated interventions using Pilates for the treatment of CLBP to identify the types and characteristics of exercises most frequently reported. Thus, provide scientific support for the development of better structured rehabilitation strategies applicable to clinical practice.

Methods

A synthesis of systematic reviews published in journals was conducted, covering the literature of the last ten years, with the aim of fully exploring the research question.

This synthesis was previously registered on the AGHUse Pesquisa platform (Porto Alegre Clinical Hospital, protocol #2023-0216) and followed the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to ensure methodological rigor and transparency. The full PRIS-

MA checklist is available as supplementary material. The raw data used in the research are publicly available in the Center for Open Science (OSF) repository and can be accessed at: https://osf.io/hj6fc/overview?view_only=4ff106b59b884d5bbabef4b7b1037f7.

Ethical aspects

This study was submitted to the *Aplicativos para Gestão dos Hospitais Universitários* (AGHUse pesquisa) platform of the Porto Alegre Clinical Hospital³⁶ under code number 2023-0216. The scientific findings from the literature review were presented objectively and free of bias, ensuring proper attribution of authorship for the articles reviewed and accurately describing the techniques, procedures, equipment, and necessary materials related to the method.

Search strategies

The search strategies according to the databases consulted are described in Table 1.

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Study eligibility

Full articles inserted in four search platforms using the search strategies shown in Table 1 were considered eligible for the study. The initial selection included articles that included the active search terms: “low back pain” and “Pilates Method” in their title and text. Articles published within the last 10 years, with no language restrictions, were considered eligible. The selection of studies took into account the PICOS criteria: P (population), I (intervention), C (comparison), O (outcome), and S (study) (Table 2).

Articles that presented only abstracts were excluded from the study, as were articles that defined low back pain as acute and/or subacute. Finally, articles that did not meet the criteria required by the PICOS method (Table 2) were excluded.

Table 1 – Description of search strategies according to the databases consulted.

Database	Search Strategy	Limits
Pubmed - last access Sep/23	((“Low Back Pain”) OR (backache)) AND ((Physiotherapy) OR (Rehabilitation) OR (pilates)) AND (randomized controlled trial) OR (controlled clinical trial) OR (randomized controlled trials) OR (random allocation) OR (double-blind method) OR (single-blind method) OR (clinicaltrial) OR (clinicaltrials)) AND ((mask OR blind) OR (“latin square”) OR (placebos) OR (placebo) OR (random) OR (research design) OR (“follow-up studies”) OR (“prospective studies”) OR (“cross-over studies”) OR (control) OR (prospective) OR (volunteer)) NOT ((animal)))	Clinical trials + Systematic reviews + 10 years
SciELO - last access Sep/23	“(Physiotherapy) OR (Physical Therapy) OR (Rehabilitation) OR (Pilates) AND (Low Back Pain)”	Clinical trials + Systematic reviews + 10 years
Cochrane - last access Sep/23	low back pain AND (pilates) OR (rehabilitation) OR (Physiotherapy) OR (Physical Therapy)	Clinical trials + Systematic reviews + 10 years
Google Scholar - last access Sep/23	“Pilates” OR “mat pilates” OR “low back pain” OR backache	Clinical trials + Systematic reviews + 10 years + first hundred

Table 2 – Description of the PICOS strategy for developing the research question and criteria for inclusion and exclusion in the selection of studies for review.

Acronym	Component	Inclusion criteria	Exclusion criteria
P	Population	Studies that included human participants aged 18 to 80 years with chronic low back pain.	Patients with musculoskeletal disorders, rheumatic and neurological diseases (scoliosis, herniated disc, fractures, arthritis, fibromyalgia, sclerosis).
I	Intervention	Studies that evaluated exercises based on the Pilates method (Mat Pilates /Studio Pilates) as an intervention in the treatment of low back pain.	Studies that included other methods of physical activity and exercises in their interventions.
C	Comparison or Control	No or minimal intervention and/or other protocols used for the treatment and/or prevention of low back pain.	Studies that did not perform comparisons between the Pilates method and other assessment methods.
O	Outcomes	Studies that evaluated the results of the Pilates method in relieving low back pain, improving functionality, and physical disability.	Studies that evaluated cognitive, anthropometric, and balance outcomes.
S	Studies	Systematic reviews with or without meta-analysis of randomized or non-randomized, controlled or uncontrolled clinical trials were considered eligible.	Studies such as umbrella reviews, observational studies, longitudinal studies, and clinical trials were excluded.

Study selection

Systematic review studies of clinical trials were selected. The initial screening of the studies was conducted by two independent reviewers (LPS, VAF, LXNS, FDM) based on the title, abstract, and keywords. In the second stage, the studies were fully assessed by two independent reviewers (LPS, NMB, ACI, VAF, LXNS, FDM) to determine which met the eligibility criteria for inclusion. In cases of disagreement, a third reviewer (DU, LFCA) was consulted to reach a consensus.

Data extraction

Data extraction from the included studies was conducted using standardized spreadsheets in Google Sheets, describing the year of publication, authors, study design, presentation, and description of interventions, demographic data of participants (age, sex, ethnicity, etc.), and primary and secondary outcomes.

The review process was conducted in pairs by independent reviewers (LPS, NMB, ACI, VAF, LXNS, FDM). A pilot screening of at least two articles was conducted to standardize the eligibility criteria. Subsequently, the full text of these potentially eligible studies was retrieved and evaluated by independent reviewers (LPS, NMB, ACI, VAF, LXNS, DKS, FDM). The extraction of pre-established methodological elements and outcomes was then conducted, including identification of the article, authors, outcomes evaluated, interventions performed, interventions compared, weekly frequency, duration (in minutes), and length (in weeks) of the interventions, protocol applied, results, and assessment of the quality of the articles (AMSTAR-2)³⁷. The data were synthesized in Google Sheets tables to present the results clearly and in an organized manner.

Any disagreements during the data extraction process were resolved through discussion, analytical reasoning, and/or referral to a third reviewer, if necessary (DU, LFCA).

Results

Our database search identified 1,939 articles, of which nine met the inclusion criteria. A flowchart of the selection process is shown in Figure 1. Based on the assessment of included reviews, the overall findings indicate that Pilates, delivered via mat, Studio, or in combination, resulted in reductions in pain and functional disability compared to minimal interventions or usual care in individuals with low back pain. However, the AMSTAR-2 assessment indicated that the method-

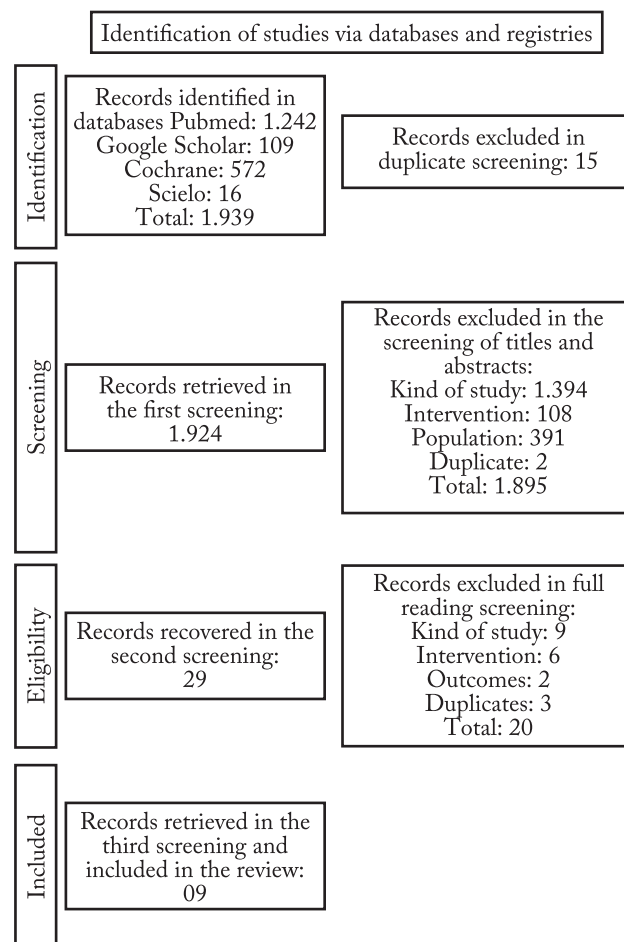
ological quality of the included reviews was predominantly low or critically low (Table 3). In addition, the methodological characteristics of the primary studies included by the reviews revealed that intervention protocols were highly diverse, with large ranges in session durations (15 to 70 minutes per session), frequencies (1 to 7 times per week), and program lengths (1 to 24 weeks). Limited methodological transparency was also observed, as most studies did not provide detailed descriptions of the exercises performed.

Discussion

The results showed diverse adherence in the protocols adopted by the clinical trials in systematic reviews addressing CLBP treatment. The findings align with clinical guidelines, scientific studies, and expert consensus recommending physical exercise for CLBP management^{15-18,38-42}.

There was significant variation across studies in several aspects, such as the weekly frequency of interven-

Figure 1 – Flowchart describing the selection process of studies listed for this review.



tions, session duration, total treatment period, and the detailed description of exercises, including their execution. This variation may impact the reproducibility, practicality, and efficacy of Pilates in treating low back pain. A 2014 editorial in the *Science Journal* addressed the importance of methodological reproducibility and transparency, essential for advancing science through

reliable research⁴³. Valdez et al. state that rigor, reproducibility, and transparency are the pillars of accurate and objective science⁴⁴. Similarly, Wallach et al. analyzed 149 biomedical articles and found that a lack of transparency was a significant issue⁴⁵.

This lack of standardization can be attributed to the scarcity of accessible documents to guide professionals

Table 3 – Characteristics of the included studies.

Authors	Outcomes assessed	Intervention	Results	AMSTAR-2 Evaluation
Miyamoto et al. ²²	Pain and disability	Mat Pilates, Studio Pilates, other	The results suggested that Pilates method exercises were more effective than minimal intervention in improving pain and disability in the short term and that they were comparable with other types of exercise in reducing pain.	Low
Yamato et al. ⁵¹	Pain, functional disability, global impression of recovery, and quality of life.	Not informed	No definitive conclusions or recommendations can be made due to the lack of high-quality evidence for pain and disability outcomes. However, a small effect favoring other exercises was found for function at medium-term follow-up. Moderate evidence was found that exercise probably provides a small benefit for pain outcomes in the treatment of chronic low back pain, compared with no treatment comparison (including usual care and placebo). A small treatment effect on functional limitations was observed and was not considered clinically important. A small positive effect on pain and functional limitations outcomes related to exercise treatments compared with other conservative treatments was also observed; however, this was not considered clinically important. It was not possible to make recommendations on specific types of exercise based on the results of this review, nor on the work of others to date; however, a related publication by this team will address this topic. Due to insufficient reporting of adverse events in the included trials, we cannot confirm the safety or harms related to exercise treatment for chronic low back pain; however, the trials that measured adverse events reported few and mostly minor adverse events, such as muscle pain.	High
Hayden et al. ³⁸	Pain and functional limitation	Mat Pilates, Studio Pilates	The authors stated that it is difficult to make a definitive and pragmatic recommendation regarding Pilates exercises for patients with low back pain, due to the variation in exercises used in the studies, duration of exercise programs, progression criteria, muscles activated, and the type of feedback used during the interventions.	Low
Romão et al. ¹⁸	Pain and electromyographic variables	Not informed	The authors concluded that Pilates Method has significant positive effects in the treatment of low back pain.	Critically low
Cordeiro et al. ³⁹	Pain and functional disability	Mat Pilates, Studio Pilates	There was moderate-quality evidence that Pilates exercise could reduce pregnancy-related low back pain more than usual prenatal exercise or no exercise.	Low
Ferraz et al. ¹⁷	Pain, weight gain during pregnancy, adverse effects, safety of Pilates exercises, quality of life during pregnancy.	Mat Pilates, Studio Pilates	It was concluded that Pilates Method, as treatment for people with low back pain, is effective, indicating significant improvement in reducing the intensity of pain and disability, improving flexibility, and greater activation of the deep muscles of the trunk.	Low
Passarelli et al. ⁴²	Pain and functional disability	Not informed	Pilates Method has been shown to be effective in reducing the functional disability of individuals with nonspecific chronic low back pain (NCLBP). In addition, it was possible to note that it has positive effects in reducing pain, kinesiophobia, and improving flexibility.	Critically low
Oliveira et al. ⁶	Functional disability	Mat Pilates, Studio Pilates	The authors concluded that Pilates Method was effective in the treatment of low back pain in the economically active population, preventing these individuals from being absent from their work activities.	Critically low
Dos Santos et al. ⁵²	Pain, Functional disability, Quality of life	Mat Pilates, Studio Pilates		

Table 4 – Characteristics of interventions.

Authors	Pilates Intervention (Mat Pilates and Studio Pilates)	Comparative Intervention	Frequency of Interventions (x/weeks)	Duration of Interventions (minutes)	Treatment Time (weeks)	Applied Protocol
Miyamoto et al. ²²	Mat Pilates, Studio Pilates, other	Primary care, no exercise or treatment, educational booklet McKenzie method, general exercises (stationary cycle, stretching, and resistance training), minimal intervention.	1-7	30-60	4 - 8	Exercises based on the Pilates Method (Mat Pilates, Studio Pilates).
Yamato et al. ⁵¹	Not informed	Minimal or no intervention, general exercises, McKenzie Method.	1-7	50-60	4 -12	Not informed
Hayden et al. ³⁸	Mat Pilates, Studio Pilates	No treatment, usual care, placebo, or other conservative treatments.	1-7	15-60	4-14	Exercises based on the Pilates Method for warming up, stretching, and cooling down.
Romão et al. ¹⁸	Not informed	Not informed	2-3	50-60	8-16	Exercises based on the Pilates method focusing on mobility, stability, and abdominal strength.
Cordeiro et al. ³⁹	Mat Pilates, Studio Pilates	No or minimal intervention, defined usual care (consult a doctor and other specialists and health professionals), Conventional physiotherapy (transcutaneous electrical stimulation, massage, manual therapy, analgesics, stretching of the lumbar region, joint mobilization), Guidance through leaflets, Postural re-education, Strengthening exercises, Muscle relaxation, Antisteroids, postural recommendation.	2-3	45-60	12	Treatment protocol consisting of training on a reformer and mat Pilates with accessories such as fit balls, magic rings and TheraBands (exercises not detailed), flexibility and joint mobility exercises, posture control, correction tasks and breathing exercises. The exercises described were: Transverse activation of the abdomen, Spinal stretch, Spinal twist, The hundred, One-legged circle, Plank, Pull the front of the leg, Swimming, Swing, Saw, Mermaid, Unilateral stretch, Leg stretch, Cross, Swan dive, Double leg kick, One-legged circle, Side kick, Flexibility exercises of the lumbar muscles, Strengthening exercises covering progression with load and isometrics, Strengthening exercises, muscle flexibility, stabilization of the pelvic floor. The exercises applied are based on the Pilates Method : spinal stretch, spinal twist, saw, mermaid, chest expansion, shoulder bridge, side kick – front and back, leg – small circles, scissors and leg adduction, chest stretch, swimmer, one-arm circles, two-arm circles, cat, lateral rotation, soldier, push-up, curl up and down, one-leg stretch, both-arm stretch, and plank. The review described how the only two included studies employed the protocol progression. In one primary study, progression was based on the number of repetitions, and the position of each exercise evolved from beginner to intermediate and advanced. In another primary study, the protocol progressed in a similar way, starting with two sets of 3-5 repetitions, reaching three sets of 8-12 repetitions.
Ferraz et al. ¹⁷	Mat Pilates	Conventional treatment (regular prenatal care with medical and nursing assistance).	2	50-70	8-12	The review described how the only two included studies employed the protocol progression. In one primary study, progression was based on the number of repetitions, and the position of each exercise evolved from beginner to intermediate and advanced. In another primary study, the protocol progressed in a similar way, starting with two sets of 3-5 repetitions, reaching three sets of 8-12 repetitions.
Passarelli et al. ⁴²	Not informed	Information in leaflet form.	1-3	20-60	6-14	Pilates Exercises
Oliveira et al. ⁶	Mat Pilates, Studio Pilates	No or minimal intervention, walking, stretching exercises.	1-3	50-60	4-12	Exercises based on the Pilates Method in Mat Pilates and Studio Pilates.
Dos Santos et al. ⁵²	Mat Pilates, Studio Pilates	No or minimal intervention, interferential current	3-5	60	4-24	Not informed

using the method, such as standardized protocols for various injuries and pathologies. Echer et al³³. suggest that

standardized protocols can help professionals working with the method by standardizing treatments and im-

proving guidance in the recovery process. In 2019, a team of researchers from the School of Public Health at Indiana University - Bloomington discussed whether tools to assist in preparing research reports could enhance their comprehensiveness and clarity, as well as improve the rigor, reproducibility, and transparency of studies⁴⁴.

Beyond the details of intervention protocols, another important aspect of transparency and applicability that was fully absent in the evaluated systematic reviews is ethnicity. The appropriate selection of participant groups should consider factors such as geographic location, disease prevalence, and other population characteristics. Consequently, it is crucial to include different ethnic groups to ensure that the results are relevant and generalizable to a diverse population^{46,47}.

Although not standardized, a trend in researchers' preferences regarding variables such as treatment time, intervention duration, and weekly frequency can be observed in the studies, as well as the modality of Mat Pilates or Pilates on equipment (Studio Pilates). Studies like that of Miyamoto et al.³ suggest that the effectiveness and cost-effectiveness of different weekly frequencies of Pilates for CLBP are similar whether performed two or three times a week, in terms of pain and functional disability outcomes. This is supported by the WHO, which recognizes the benefits of physical exercise for health⁴¹ and provides important recommendations on muscle-strengthening activities in its guideline for non-surgical treatment of primary CLBP in adults in primary and community care settings⁴⁸. The study by Lima et al. and the WHO recommend that young people and adults engage in 75 to 300 minutes of physical activity per week^{41,49,50}. The results of this research showed that most studies found benefits in managing low back pain with 120 minutes of physical activity per week. The variation in researchers' preferences for Pilates-based protocols is evident in the choice of exercises: only 47% of the 134 identified in this synthesis were mentioned in more than one study.

This review synthesizes evidence from clinical research on the Pilates Method for treating CLBP and may serve as a resource for researchers designing new studies and practitioners developing treatment protocols. Despite Pilates widespread use in CLBP management, AMSTAR analysis revealed substantial limitations in methodological reporting transparency. Exercise protocols lacked sufficient detail regarding frequency, intensity, progression criteria, and specific exercise selection rationale. This reporting gap hinders

protocol replication, clinical implementation, and the establishment of evidence-based consensus on optimal Pilates-based interventions for CLBP treatment.

Some limitations must be acknowledged in our study. First, the search was restricted to studies with full texts available, potentially excluding other relevant studies. Second, we did not systematically evaluate the primary studies included in the included reviews, which would allow us to better discriminate whether the lack of transparency derived from the primary trials, reviews, or both. Finally, we did not register this review in PROSPERO or other publicly available platforms, which is a research transparency standard we did not fulfill.

As a final consideration, the use of standardized protocols based on scientific findings and well-defined methodologies is important for decision-making, supports health professionals, and more effectively guides the promotion of individuals' health and well-being. The present study contributes to a deeper understanding of intervention approaches to low back pain through Pilates, which can drive new research exploring the topic and fills the gaps in the literature.

This study analyzed and summarized the definitions and treatment protocols for CLBP using the Pilates Method in research. The authors declare no conflicting interests that could affect the results and conclusions, reaffirming their commitment to transparency and impartiality. The analysis and discussion were based solely on available scientific evidence. Data from the research can be accessed upon request from the corresponding author. Thus, we reaffirm our commitment to scientific integrity and objectivity.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Silva LP: Conceptualization; Methodology; Software; Validation; Formal analysis; Investigation; Resources; Data curation; Supervision; Project administration; Visualization; Funding acquisition; Writing – original draft; Writing – review & editing;

Approval of the final version. Fronza VA: Formal analysis; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Selau DK, Barbosa NM, Ignacio AC, Massierer FD, Silva LXN: Validation; Formal analysis; Investigation; Writing – original draft; Approval of the final version. Umpierre D: Conceptualization; Methodology; Software; Validation; Formal analysis; Investigation; Resources; Data curation; Supervision; Project administration; Visualization; Writing – original draft; Writing – review & editing; Approval of the final version. Alvarenga LF: Conceptualization; Methodology; Software; Validation; Formal analysis; Supervision; Project administration; Funding acquisition; Writing – original draft; Writing – review & editing; Approval of the final version.

Availability of research data and other materials

The content is available from: <https://osf.io/hj6fe>

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Reviewers' assessment

The authors and/or reviewers did not authorize the publication of either of the two reviews.