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REVIEW

The effect of stabilization-based exercises on kinesiophobia in patients with non-specific chronic low back pain: a systematic review and meta-analysis

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Abstract

Aims This systematic review aimed to evaluate the effectiveness of stabilization-based exercises in reducing kinesiophobia in individuals with non-specific chronic low back pain (NSCLBP).

Methods The literature was searched from inception to August 2024 in PubMed, Web of Science and, Cochrane Library electronic databases. Only randomized controlled trials were included. Quality assessment, risk of bias assessment and meta-analysis were performed. Outcomes were also analysed according to follow up periods as short-term (< 3 months), mid-term (≥ 3 to 12 months) and long-term (> 12 months).

Result This systematic review and meta-analysis included 13 randomized controlled trials including 346 patients with NSCLBP. High evidence showed that stabilization based exercise reduce kinesiophobia in the short term with small effect size. Moderate evidence suggested that stabilization based exercises effects on kinesiophobia in the mid term with with medium effect size. Stabilization based exercise is also effective on kinesiophobia in long term, but level of evidence is very low.

Conclusion In conclusion, stabilization-based exercises are effective on kinesiophobia in the short and mid term in individuals with NSCLBP. However, long-term data is uncertain.

Keywords Kinesiophobia · Stabilization exercise · Motor control exercise · Therapeutic exercises

Introduction

Low back pain (LBP) is currently one of the most prevalent health-related conditions [1]. Low back pain is a prevalent condition that not only affects a significant proportion of the population but also represents a considerable financial burden on healthcare systems. In countries where healthcare expenditure is rapidly increasing in relation to GDP growth, overutilization of healthcare resources is a major concern. In addition to direct monetary healthcare expenditures, low back pain also results in significant opportunity costs. The 2010 Global Burden of Disease study identified low back pain as the leading contributor to disability and work days lost [2].

Non-specific chronic low back pain (NSCLBP), which accounts for approximately 90% of LBP cases, is defined as low back pain lasting 12 weeks or longer that is not attributable to any specific cause, such as infection, tumour, osteoporosis, fracture, spinal deformities or inflammatory diseases [3, 4]. Acute low back pain is affected by biopsychosocial

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factors and therefore becomes a chronic problem in time [5, 6]. In the acute phase, the inflammatory process is activated, marking the onset of tissue healing. The secretion of IL1, IL6 and TNF-a is a consequence of the inflammatory process [7]. As the acute phase persists, the pain thresholds of primary afferent neurons diminish, while substance P increases, thus leading to peripheral sensitisation. In the central nervous system, prolonged nociceptive stimulation results in the secretion of neurotransmitters and the activation of glial cells, leading to the development of central sensitisation [7]. During the transition from acute to chronic pain, patients avoid movement to prevent the pain from increasing. This process involves the development of both allodini and hyperalgesia, which makes the pain more sensitive, and patients become reluctant to make even the slightest movement [8]. This leads to the development of kinesiophobia [5, 6].

As patients avoid movement, aerobic capacity and core muscle endurance decrease, fiber type changes and atrophy occur [9–11]. Since the core muscles are a mechanoreceptor-rich muscle group, afferent stimuli decrease, and therefore the stimuli to the brain decrease [12]. As a result, patients with NSCLP reduce movement more and more. At the same time, the stress, depression and anxiety levels observed in patients with NSCLBP increase in addition to the physical changes [13]. Due to these physical and psychological changes, cardiovascular capacity, muscle endurance and motor control decrease in individuals with low back pain [14]. In addition to these changes in the peripheral region, pain neuromatrix activity increases in the central nervous system, and thus the amygdala, which is the fear memory center, records the movements that cause pain [15, 16]. Thus, the brain acquires a long-term memory of pain, which associates certain movements with danger or threat (kinesiophobia) [15, 16]. It has been reported that kinesiophobia is present in 92% of patients with NSCLBP [17], and therefore treatments to reduce kinesiophobia are needed.

Various interventions such as exercise, spinal manual treatments, electrotherapy applications and pain education are used in the treatment of patients with NSCLBP [18]. Exercise is preferred more over other treatments because it is highly effective, evidence based, cost effective and does not require space [19]. Stabilization-based exercises, which are named differently in the literature such as motor control exercises, core stabilization exercises and therapeutic exercises, are one of the most frequently used treatment methods in the treatment of patients with NSCLBP [20]. Stabilisation exercises; these are exercises designed to stimulate co-contraction of the deep muscles of the trunk, especially the transversus abdominis and lumbar multifidus [21]. Considering that literature shows the importance of an associated biopsychosocial approach [22], it is important to investigate the effect of stabilization, based exercise alone on kinesiophobia. It has been established in the literature that there is a correlation between pain, disability, quality of life and kinesiophobia in patients with NSCLBP. Consequently, these factors have an impact on kinesiophobia [23, 24]. Therefore, stabilisation exercises can be an effective method of reducing the fear of movement by reducing pain and disability, and improving quality of life. A review of the literature reveals that studies have been conducted investigating various factors, including pain, disability and balance, in patients with NSCLBP undergoing stabilisation exercises [20]. However, no review has been identified that specifically addresses the impact of kinesiophobia on the course of treatment and disease. Accordingly, the objective of this study was to assess and categorise the evidence regarding the impact of stabilisation-based exercises, when employed as a standalone intervention, on kinesiophobia in individuals with non-specific chronic low back pain (NSCLBP). The aim is to reveal the evidence and gaps in the literature regarding the short, medium and long-term effects of stabilization-based exercises on kinesiophobia using the evidence gap map.

Methods

The systematic review protocol was developed using guidance from the preferred reporting ıtems for systematic review and meta-analysis (PRISMA) statement[25] and registered in the PROSPERO database (CRD42023426695).

Search strategy

PubMed, Web of Science and the Cochrane Library data bases were searched from inception to June 2023 based on PICO (S) model [26]. In the search strategy, patients with non-specific chronic low back pain were determined as the population type, stabilization based exercise as the intervention type, and kinesiophobia as the outcome measure. Detailed search terms used has been provided in the supplementary.

Eligibility criteria

Randomized controlled trials, written in English, investigated the effect of stabilization-based exercises targeting transversus abdominis and lumbar multifidus co-contraction, only stabilization exercise was used, patient with NSCLBP, investigating the effect of stabilization exercise on kinesiophobia and older than 18 years old were included. Cross-sectional, case–control, prospective cohort, case reports, case series, meetings, letters, editorials, reviews, pilot studies, abstracts, and animal studies were excluded. Studies that

included stabilization-based exercises but were accompanied by physical therapy modalities such as electrotherapy, massage, dry needling, or any treatment were also excluded.

Study selection

All studies identifed by the search strategy were downloaded independently by two authors (FO and AT) into Mendeley Desktop (version 2.95, Mendeley Ltd., London, UK), and duplications were removed. Then, two authors independently screened all titles and abstracts and retained the studies based on the eligibility criteria. The full texts of studies retained during the screening of titles and abstracts were evaluated for fnal inclusion. Any disagreements were resolved at a consensus meeting with a third author (OU). Reference lists and citing articles of retained studies were also checked.

Quality assesment

The methodological quality of the included studies was assessed by independent two authors (FO and AT) using the physiotherapy evidence database (PEDro) checklist [27] with a maximum score of 10. Studies were classifed to be having poor, fair, good, or excellent quality if the PEDro scores were < 4, 4–5, 6–8, or 9–10 respectively [20] (Table 1).

Risk of bias assesment

Two authors (FO and AT) independently conducted the risk of bias (RoB) assesment using the Cochrane RoB 2 tool [28]. Disagreements were resolved through discussion or arbitration with a third author (OU). The RoB assessment was guided by the algorithm and handbook which accompanies the Cochrane RoB2 tool [28]. Five domains were carefully examined, including randomisation process, deviations from the intended intervention (intention-to-treat), missing outcome data, measurement of the outcome and selection of the reported results. Included studies were judged as low risk, some concerns or high risk (Fig. 1).

Data extraction

Descriptive information of the included studies was extracted including publication details (author, year), sample sizes, participant characteristics, intervention groups and outcume measurements (Table 2). The characteristics of the intervention (session duration, number of sessions, exercise type) and type of outcome measurement (Tampa Scale of Kinesiophobia and Fear Avoidance Beliefs Questionanire) were also extracted. The data for each outcome in order to calculate effect sizes (mean and standard deviation) were extracted and corresponding authors contacted for additional data when needed.

Level of evidence

The certainty of the evidence for each outcome was judged based on the grading of recommendation assessment, development and evaluation (GRADE) [29]. There were five key domains as risk of bias, inconsistency, imprecision, indirectness and publication bias to determine the level of evidence [29].

Data analysis and meta analysis

We used the Cochrane Review Manager software (version 5.4. Copenhagen: The Nordic Cochrane Centre, the Cochrane Collaboration, 2014) for the meta-analysis. Standardised mean differences (SMD; Hedges' adjusted g) with 95% confidence intervals (CIs) were calculated for variables of interest as the difference between the pre treatment and post-treatment. Heterogeneity was analysed by using I^2 and was considered as low (< 25), moderate (> 25–50%), high (> 50–75%) or very high (> 75%) [30, 31]. We used fixed (for homogenous data, I2 ≤ 25%) or random (for heterogeneous data, I2 > 25%) effects models for each meta-analysis according to the statistical heterogeneity [32]. The effect size of the results was interpreted as small (d = 0.2), medium (d = 0.5), and large (d ≥ 0.8) [33].

An evidence gap map displaying the level of evidence available in the literature, along with its findings, and identifies areas that require further research was also provided to guide future studies [34]. Outcomes were also analysed according to follow up periods as short-term (< 3 months), mid-term (≥ 3 to 12 months) and long-term (> 12 months) [35].

Results

Study selection and population characteristics

Search results and study selection process are shown in Fig. 2. The total number of participants in 13 randomized controlled trials included in this systematic review was 346. The total number of participants in 12 randomized controlled trials included in this meta-analysis was 329. A total of 178 women (50.85%) were included in the studies, while 144 men (41.15%) and 28 individuals whose gender was not specified (8%) were also included.

Table 1 Results of the quality assessments of the included studies

Criterion	Matarán-Peñarrocha et al. 2020 [44]	İbrahim et al. 2023 [45]	Ogunniran et al. 2023 [46]	Rasmussen-Barr et al. 2009 [40]	de Oliveira Meirelles et al. 2020 [41]	Bodes Pardo et al. 2018 [36]	Turci et al. 2023 [47]	Alrwaily et al. 2019 [37]	Ozsoy et al. 2019 [38]	Unsgaard-Tøndel et al. 2010 [42]	Masroor et al. 2023 [39]	Karaduman et al. 2023 [48]	Gimenez et al. 2024 [43]
Item 1	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Item 2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Item 3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Item 4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Item 5	No	No	Yes	No	No	No	No	No	No	No	No	No	No
Item 6	No	No	Yes	No	No	No	No	No	No	No	No	No	No
Item 7	Yes	Yes	No	No	Yes	No	Yes	No	Yes	No	No	Yes	Yes
Item 8	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Item 9	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	No
Item 10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Item 11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total Points (0–10)	8	8	8	7	7	6	8	6	6	7	6	8	7

PEDro scores: Poor: < 4 Fair: 4–5, Good: 6–8, Excellent: 9–10. Item 1: Eligibility criteria were specified, Item 2: Subjects were randomly allocated to groups, Item 3: Allocation was concealed, Item 4: Groups were similar at baseline regarding the most important prognostic indicators, Item 5: There was blinding of all subjects, Item 6: There was blinding of all therapists who administered the therapy, Item 7: There was blinding of all assessors who measured at least one key outcome, Item 8: Measures obtained from more than 85% of the subjects, Item 9: All subjects for whom outcome measures were available received the treatment, Item 10: Results of between-group statistical comparisons are reported for at least one key outcome, Item 11: Both point measures and measures of variability for at least one key outcome

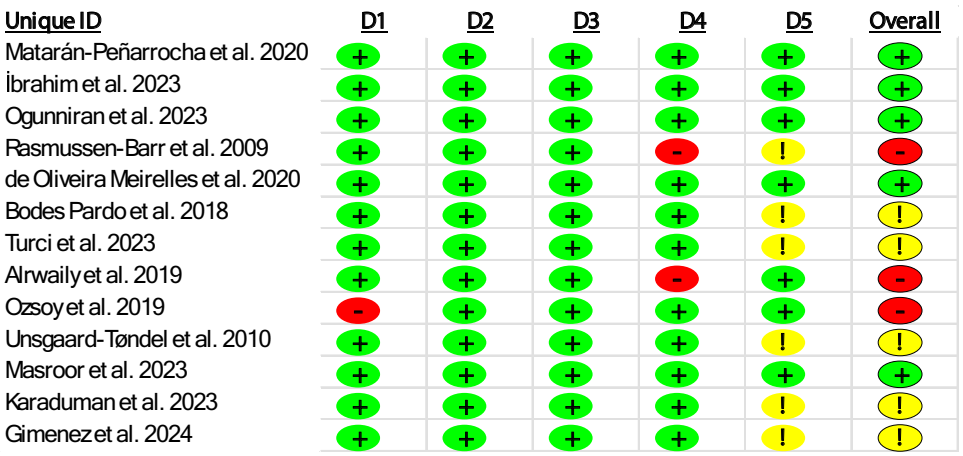

Fig. 1 Results of the risk of bias assessments of the included studies. D1: Randomisation process, D2: Deviations from the intended interventions, D3: Missing outcome data, D4: Measurement of the outcome, D5: Selection of the reported result

Quality assessment

The remaining 13 RCTs scored: 6 [36–39]; 7 [40–43]; and 8 [44–48] out of 10 on the PEDro scale (Table 1). The reviewers demonstrated a high level of consensus throughout the rating process, with no instances of disagreement or contention.

Exercise protocol

The studies included a variety of repetition, set and duration variables. For the entire duration of the intervention, the least was 4 weeks and the highest being 12 weeks. The entire treatment duration of other included studies was 4 weeks [39, 48], 5 weeks [41], 6 weeks [37, 38], 8 weeks [40, 42, 44–47], and 12 weeks [36, 43]. The total number of exercise sessions ranged from 10 to 84.

Kinesophobia parameters

The tampa kinesiophobia scale (TSK) [36, 38, 41, 43, 44, 46, 48] was employed in seven studies, while the fear avoidance beliefs questionnaire (FABQ) [37, 39, 40, 42, 45, 47] was utilised in six studies.

Meta-analysis

In the short term (< 12 weeks), all studies measured kinesiophobia [36–42, 44–48]. Stabilization based exercises ($I^2 = 38\%$, effect size (Cohen's d) = 0.44, effect size (Hedges'g) = 0.439, 95% confidence interval (CI) = 0.24–0.65, $p < 0.0001$) (Fig. 3A) are effective on kinesiophobia in the short term with a high level of evidence, but effect size is small (Fig. 4) (Table 3). Additionally, Ogunniran et al. [46]. reported that stabilization-based exercises reduced kinesiophobia after 4 weeks of treatment, but no data were given. The study conducted by Blanco-Giménez et al. [43] revealed that stabilisation exercises resulted in a reduction in kinesiophobia at the 3rd and 6th weeks.

In the mid term, kinesiophobia was measured in five studies [36, 40, 44, 45, 47]. Stabilization based exercises ($I^2 = 68\%$, effect size (Cohen's d) = 0.66, effect size (Hedges'g) = 0.658 95%CI = 0.30–1.02, $p = 0.0003$) (Fig. 3B) are effective on kinesiophobia with medium effect size in the mid term with a moderate level of evidence (Fig. 4) (Table 3). Additionally, Turci et al.[47]. reported that stabilization-based exercises reduced kinesiophobia after 13 weeks of treatment, but no data were given. The study conducted by Blanco-Giménez et al. [43] revealed that stabilisation exercises resulted in a reduction in kinesiophobia at the 12th weeks.

Only one study measured kinesiophobia in the long term [40]. They reported that stabilization based exercises reduced kinesiophobia between 12 and 36 months, but no data were given [40]. Thus, level of evidence is very low (Fig. 4).

Discussion

The aim of this systematic review and meta analysis was to determine the level of evidence in the literature regarding the effect of stabilisation-based exercises alone on kinesiophobia in patients with NSCLBP. The systematic review included 346 patients with NSCLBP from 13 randomized controlled studies. The meta analysis included 329 patients with NSCLBP from 12 randomized controlled studies. In all studies, only stabilization exercise was used, and kinesiophobia was evaluated with TKS and FABQ. The effectiveness of stabilization-based exercises was evaluated over three periods: short term (< 3 months), mid term (≥ 3 to 12 months), and long term (≥ 12 months). The systematic review and meta analysis found that stabilization-based exercises are effective in reducing kinesiophobia in the short term with

Table 2 Study characteristics

Authors, year	Partipicants	Intervention groups	Outcome measurements	Result
Matarán-Peñarrocha et al. 2020 [44]	54.3 ± 7.9 years Male: 15 Female: 17	Supervised core exercise group: 3*10–15 repetitions, three times per week for eight weeks, 24 sessions	Tampa Scale of Kinesiophobia	Supervised physical therapy exercises are statistically superior to non-supervised home program for improving pain, functionality, fear of movement or quality of life of patients with NSCLBP
İbrahim et al. 2023 [45]	45.1 ± 13.1 years Male: 26 Female: 14	Motor control exercises: 30 min per session, three stages, two times per week for eight weeks, 16 sessions	Fear Avoidance of Belief Questionnaire	Motor control exercises performed together with patient education are more effective than motor control exercises performed alone
Ogunniran et al. 2023 [46]	45.29 ± 10.79 years n: 17	Core stabilization group: 30 min per session, two times per week for eight weeks, 16 sessions	Tampa Scale of Kinesiophobia	The findings of this study concluded that the use of kinesiology taping combined with CSE, CSE only and kinesiology taping only reduced pain-intensity, kinesiophobia in patients with NSCLBP at the end of 8th week intervention
Rasmussen-Barr et al. 2009 [40]	37.0 ± 10.0 years Male: 18 Female: 18	Stabilization exercise group: 45 min per day, everyday for 8 weeks, 56 sessions	Fear Avoidance of Belief Questionnaire	A graded exercise intervention emphasizing stabilizing exercises seems to improve perceived disability and health parameters in short and long terms in patients with recurrent LBP
de Oliveira Meirelles et al. 2020 [41]	50.1 ± 9.3 years Male: 6 Female: 12	Therapeutic exercise: Two per week for a total of five weeks, 10 sessions	Tampa Scale of Kinesiophobia	Therapeutic exercise is effective on functional capacity, kinesiophobia and depression
Bodes Pardo et al. 2018 [36]	49.2 ± 10.5 years Male: 6 Female: 22	Therapeutic exercises: Home exercise, every day for 12 weeks, 84 sessions	Tampa Scale of Kinesiophobia	Pain Neuroscience education and exercise are more effective at reducing fear of movement than exercise alone
Turci et al. 2023 [47]	37.0 ± 12.0 years Male: 19 Female: 31	Motor control exercise: 40 min per session, every day for week, for 8 weeks, 56 sessions	Fear Avoidance of Belief Questionnaire	In people with NSCLBP, self stretching exercises had very similar effects to MCE on pain intensity, disability, fear of movement up to 18 weeks beyond the end of an 8-week program
Alrwaily et al. 2019 [37]	38.33 ± 11.3 years Male: 4 Female: 11	Stabilization exercise: 20 min per session, 2 times per week, for 6 weeks, 12 sessions	Fear Avoidance of Belief Questionnaire	Stabilization exercises are effective in improving pain and fear of movement
Ozsoy et al. 2019 [38]	68.14 ± 2.57 years Male: 15 Female: 6	Core stability exercise groups: 60 miunutes per session, 3 times per week, for 6 week, 18 sessions	Tampa Scale of Kinesiophobia	CSE + Myofascial Release Technique is more effective than CSE in terms of a greater increase in core stability endurance and spinal mobility in patients with NSLBP. However, CSE has no effect on fear of movement

Table 2 (continued)

Authors, year	Partipicants	Intervention groups	Outcome measurements	Result
Unsgaard-Tøndel et al. 2010 [42]	40.9 ± 11.5 years Male: 7 Female: 29	Motor control exercises: 40 min per session, total 8 weeks	Fear Avoidance of Belief Questionnaire	No significant group differences were found in pain and fear of movement after 8 weeks of MCE, sling exercises, and general exercises in patients with NSCLBP. However, MCE has no effect on fear of movement
Masroor et al. 2023 [39]	25.6 ± 4.2 years n: 11	Core stabilization exercises: The session included 5 min of stationary cycling warm-up, 20 min of CSE involving 10 s holds, 10 repetitions, 3 to 4 s so frest between each contraction, and doing 3 sets. The session was wound up with 5 min of cool down by stationary cycling. Treatment was done for 4 weeks	Fear Avoidance of Belief Questionnaire	Diaphragmatic breathing exercises with traditional CSE improved muscle activation and chest expansion. At the same time, CSE alone also improves fear of movement
Karaduman et al. 2023 [48]	46.5 ± 12.73 years Male: 20 Female: 9	Stabilization exercises: The exercise protocol was implemented for 20–30 min, three days a week, over a period of four weeks (a total of 12 sessions) for CSE	Tampa Scale of Kinesiophobia	Supervised CSE alone improves fear of movement
Gimenez et al. 2024 [43]	41.75 ± 15.28 years Male: 8 Female: 9	Core stabilization exercises: A core stabilization exercise program, composed of three sets of specific lumbopelvic exercises, was performed. All subjects carried out the same sessions (twenty-four), two times (approximately 60 min) a week on alternate days. Treatment was done for 12 weeks	Tampa Scale of Kinesiophobia	CSE alone is an effective technique for reducing disability, the addition of the passive Manuel therapy technique produces a on disability and kinesiophobia, decrease after 12 weeks across both isolated and combined exercise

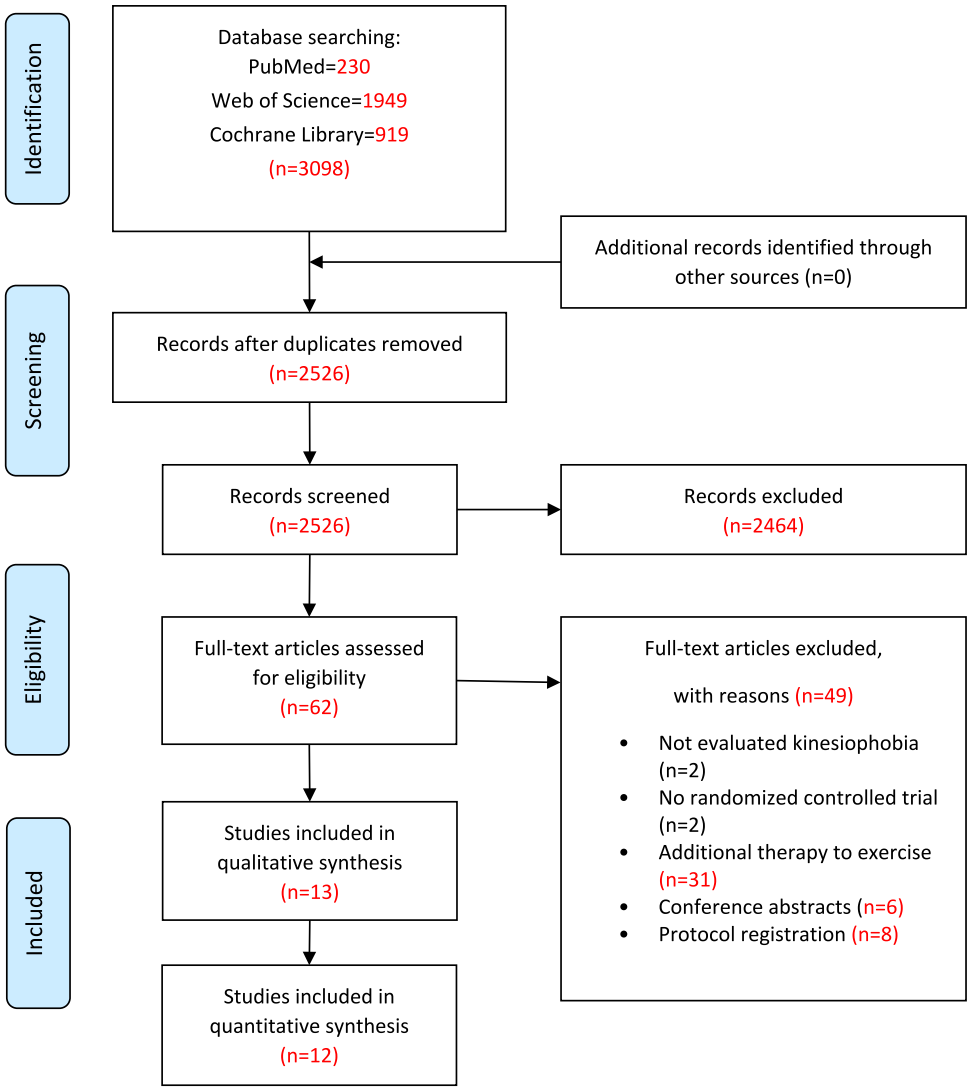

Fig. 2 PRISMA flow chart

high-level evidence, in the medium term with moderate level evidence, and in the long term with very low-level evidence.

All studies included in the study were at a good quality level according to the Pedro Scale. None of the studies in the present review was of excellent quality. The mean PEDro score of the ten eligible studies came out to be 7.07 thus refecting a good overall quality of the thirteen studies. In six of the studies [36, 37, 39, 40, 42, 46], the assessor was not blinded, and in twelve studies, neither the patient nor the therapist was blinded. Consequently, there is a possibility of bias in the results.

Furthermore, the existence of two different kinesiophobia scales presents a challenge when attempting to quantitatively synthesise data from multiple studies. In the process of synthesising the findings of selected studies, the authors of the present study encountered a range of protocols and dosages of exercise in terms of the duration of a single treatment session, the number of days of treatment per week, and the total duration of the intervention (the total number of weeks). These variations make it challenging to conduct a meaningful comparison. The studies exhibit considerable variation in sample size, gender distribution and age range. Consequently, the level of heterogeneity is perceived to be high within the study.

In patients with acute pain, it is recommended to avoid activities that may increase pain. This phenomenon is explained by the fear-avoidance model [49]. Patients limit their movement due to the fear of pain, which can lead to the development of chronic pain. This can result in high levels of psychological anxiety, potentially depressive symptoms, increased pain intensity, and greater fear of movement, ultimately leading to worse clinical outcomes and a reduced quality of life [50]. Increased fear of pain can heighten susceptibility to new pain attacks, and patients may experience poorer motor control due to fear of movement. These behaviours can lead to dysfunction of the lumbar muscles

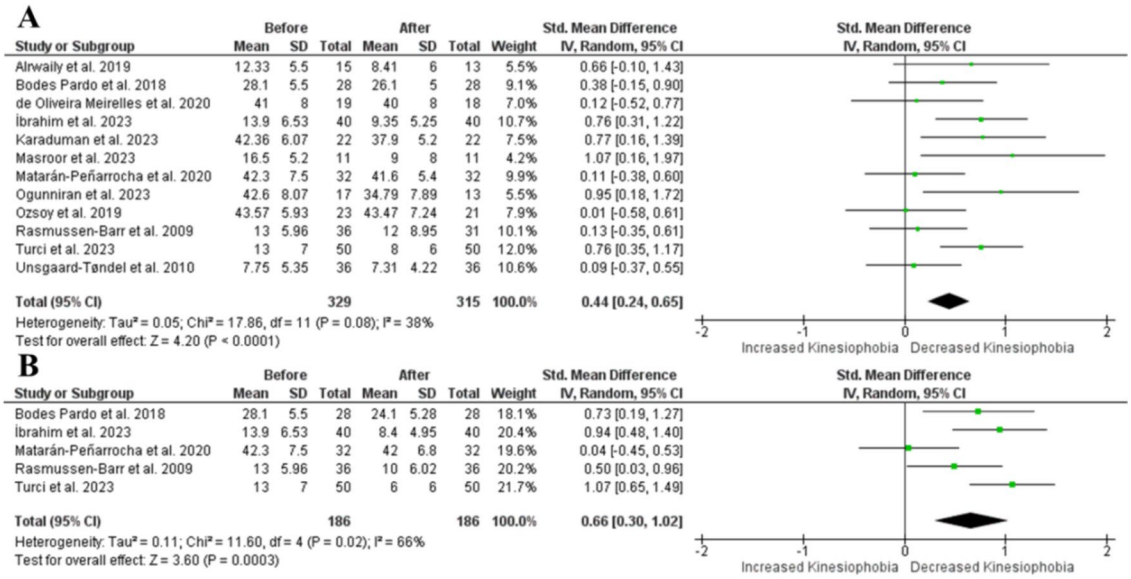

Fig. 3 Meta analysis. **A** Effects of stabilization based exercises on kinesiophobia in short term, **B** Effects of stabilization based exercises on kinesiophobia in mid term,

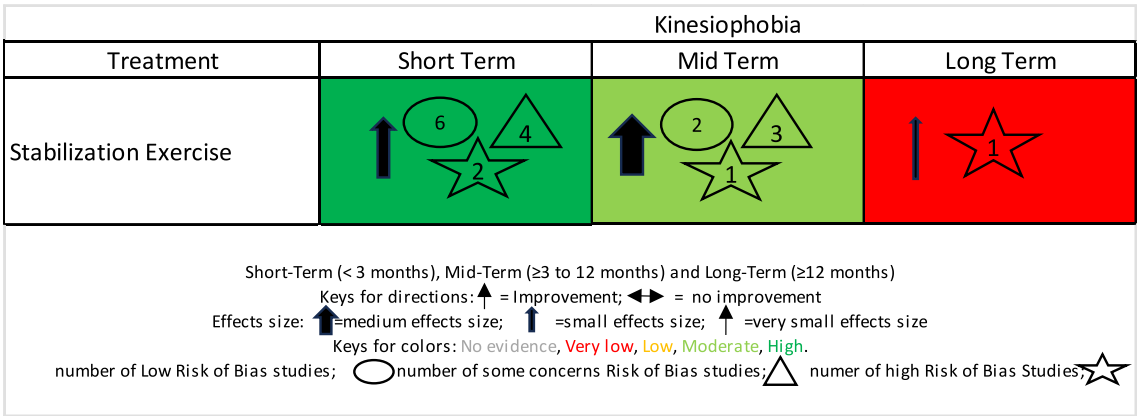

Fig. 4 Evidence gap-map

[51]. Kinesiophobia can also result in a condition known as 'disuse syndrome'. In other words, fear of pain can cause physical deterioration and the development of abnormal movement patterns, which are often observed in patients with chronic pain [52]. The fear of movement cannot only affect one's activity levels but also lead to physical weakness [52]. Overcoming this fear and reducing pain is crucial in managing chronic pain.

High-moderate level of evidence showed that stabilization based exercises had a positive effect on kinesiophobia in the short and mid term. Stabilization based exercises are commonly used in order to treat NSCLBP. Unlike resistive exercises, stabilization based exercises are easy to do at home without requiring any equipment, hence increases the patient's self-management [45]. The aim of stabilization based exercise are to activate the deep trunk muscles and restore the control and coordination during exercises, and progressing to more complex and functional tasks by integrating the activation of deep and global trunk muscles [35]. This strategy could explain how stabilization based exercise reduce pain and disability as it was found in another meta-analysis [35]. Higher pain severity and disability were shown to increase kinesiophobia in patients with NSCLBP [17]. Therefore, it was thought that stabilzation based exercise has a positive effect on kinesiophobia by reducing pain intensity and disability as a potential mechanism.

A biopsychosocial effect in patients with chronic low back pain has been reported in the literatüre. Fear of movement has been found to be higher in patients with LBP who have depression [53]. It has been reported in the literature

Table 3 GRADE level of evidence for studies

Certainty assessment							Summary of findings				
Participants (studies) follow-up	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence	Study event rates (%)		Relative effect (95% CI)	Anticipated absolute effects	
							With Pre-Treatment	With Post-Treatment		Risk with Post- Treatment	Risk difference with Pre- Treatment
Kinesiophobia											
315 (12 RCTs)	Not serious	Not serious	Not serious	Serious[a]	Strong association all plausible residual confounding would reduce the demonstrated effect dose response gradient	⨁⨁⨁⨁ High	329	315	–	–	SMD 0.44 SD higher (0.24 higher to 0.65 higher)
Kinesiophobia											
186 (5 RCTs)	Serious	Serious[b]	Not serious	Serious[c]	All plausible residual confounding would suggest spurious effect, while no effect was observed dose response gradient	⨁⨁⨁◯ Moderate	186	186	–	–	SMD 0.66 higher (0.3 higher to 1.02 higher)

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

GRADE Working Group grades of evidence

CI confidence interval; *SMD* standardised mean difference

[a]The population is under 400, [b]Inconsistency: the certainty of the evidence was downgraded if there was a significant heterogeneity (I2 > 50%) or a large difference in the estimate of effects, [c]The population is under 400

that pain severity, functional disability, presence of metabolic syndrome, pain catastrophizing, anxiety, depression, low educational level and short sleep duration are factors contributing to kinesiophobia in chronic shoulder pain [54]. It has also been reported that there is a high degree of association between kinesiophobia and pain catastrophizing in chronic whiplash and that kinesiophobia contributes to pain severity and disability levels [55]. It has been reported in the literature that kinesiophobia is present in many chronic musculoskeletal conditions and that kinesiophobia affects pain and disability levels [56, 57].

This study found that stabilisation exercises were effective in reducing kinesiophobia. Stabilisation exercises are effective in the long term for pain and disability [58]. In addition, it has been reported in the literature that stabilisation exercises are also effective in improving balance parameters [20]. Physical function in patients with NSCLBP improves with stabilisation exercises [59]. Stabilisation exercises are effective in improving pain, disability, functional capacity and kinesiophobia in patients with NSCLBP.

It has been reported in the literature that kinesiophobia in patients with chronic pain can be reduced by pain neuroscience education in addition to exercise [60, 61]. The Pilates method has also been reported to reduce kinesiophobia in patients with NSCLBP [15]. Virtual reality can reduce kinesiophobia in people with chronic low back pain [62]. The same study reported that non-immersive virtual reality is more effective and reduces kinesiophobia better when used with exercise [62]. Exercises other than stabilisation have been reported to reduce kinesiophobia in patients with NSCLBP [63]. Repetitive peripheral magnetic stimulation has been reported to have no effect on kinesiophobia in people with chronic low back pain [64]. There are treatments in the literature that reduce kinesiophobia in patients with chronic pain and NSCLBP. Stabilisation-based exercise is a treatment that reduces kinesiophobia in the short, medium and long term. It may be considered before other treatments because of its advantages, such as the fact that patients can do it at home and it does not require equipment or a special place.

There were some limitations in this systematic review. The long term effect of stabilization-based exercises on kinesiophobia is absent, only one study with high risk of bias investigated long term effect at 1- and 3-year. Thus, there is a need of randomised controlled trials with long term follow-ups. Future studies would also benefit from using similar exercise programs with the same duration of treatment, number of repetitions and exercises to interpret the results in the short, medium and long term in order to reach a consensus with a higher level of evidence in the literature. Additionally, there is no consensus in the literature on the terminology of the naming performed exercises which increases the difficulty of identifying them correctly. For instance, stabilization exercise, core stabilization exercise and lumbopelvic stabilization generally used interchangeably even though they are similar [65, 66]. Another limitation in the literature was the absence of biopsychosocial measurements both in the baseline and follow-ups as only one study [36] reported depression. This limited the interpretation of the findings in terms of direct relation to biopsychosocial factors. Thus, kinesiophobia would be understood more clearly in patients with NSCLBP.

Conclusion

Stabilisation exercises are effective in reducing kinesiophobia in patients with NSCLBP in the short and mid-term. Future studies that use the same exercise programmes and compare different stabilization based exercise duration are needed. Follow-up studies of more than 1 year are also needed.

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Declarations

Conflict of interest The authors have no competing of interest to declare.

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