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Impact of lumbar support on pain reduction in low back pain patients: A systematic review and meta-analysis of randomized control trials

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Abstract

Low back pain (LBP) is a global health concern, affecting millions and contributing significantly to disability and economic burden. Various non-pharmacological interventions, including lumbar support, have been explored for LBP management. However, its efficacy remains debated due to inconsistent findings. The aim of this study was to evaluate the impact of lumbar support on pain reduction in individuals with LBP and compare its effectiveness to alternative interventions. A systematic search was conducted across multiple databases (PubMed, ScienceDirect, Scopus, SpringerLink, Google Scholar, and ProQuest) for studies published up to 2023. Data from six search engines were searched using inclusion criteria based on the PICO framework. Search terms included low back pain, lumbar support, lumbar orthose and randomized controlled trial, combined using Boolean operators. Sixteen randomized controlled trials (RCTs) were included in the systematic review, with eight studies analyzed in the meta-analysis. Eligible studies focused on adults with non-specific LBP, assessing pain levels using the Visual Analog Scale (VAS). The meta-analysis was assessed using the standardized mean difference (SMD) in the Visual Analog Scale (VAS). The meta-analysis revealed a statistically significant pain reduction with lumbar support compared to other interventions (SMD: 1.33; 95%CI: -2.09–(-0.57)); p=0.0006), though with high heterogeneity (I^2=97%). The findings indicated that lumbar support effectively reduces pain and improves health-related quality of life, particularly in physically demanding occupations or among individuals with severe pain. While efficacy may depend on specific conditions, lumbar support represents a viable non-pharmacological option for LBP management.

Keywords: Pain management, low back pain, lumbar support, systematic review, meta-analysis

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Introduction

World Health Organization (WHO) recognizes low back pain (LBP) as a major global public health concern [1]. LBP is a leading cause of disability worldwide, with a prevalence up to 7.2%, affecting approximately 80% of individuals at some point in their lives [2]. It is often associated with functional impairment and sensory disturbances, manifesting as discomfort or pain in the lower spine [3]. While most cases (up to 85%) are classified as non-specific [4,5], some results

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from serious conditions such as spinal fractures, infections, or inflammatory disorders requiring specialized treatment [6,7]. LBP imposes a significant personal, societal, and economic burden [8] and can also affect adolescents, particularly those with idiopathic scoliosis [9]. Among adults, 80% experience LBP, which is categorized based on symptom duration as acute, subacute, or chronic [10,11]. In emergency settings, LBP is a common complaint, underscoring the need for an improved understanding of its prevalence and impact [12]. However, research on chronic LBP lacks standardization and often fails to distinguish between cervical, thoracic, and lumbar spine-specific pathologies [13].

LBP is broadly classified into non-specific and acute types. Non-specific LBP, which accounts for 60.8% of cases [11], is characterized by pain, muscle tension, or stiffness localized between the lower rib margin and the gluteal fold [14]. Acute LBP is defined by pain radiating from the lower ribs to the buttocks [15,16]. Effective management includes patient education on biopsychosocial contributors to pain and self-management strategies [17]. Various therapeutic approaches, such as physical therapy, including massage, yoga, and spinal manipulation, have demonstrated efficacy in alleviating pain and improving functional outcomes [16]. Additionally, targeted exercise programs have been shown to reduce both pain and lumbar lordosis angles [18]. Behavioral interventions, exercise programs, and patient education remain key strategies for managing LBP [19]. Some studies suggested that tools designed to activate spinal deep muscles enhanced stability and reduced recurrence [18,20]. The mechanism of lumbar support involves external stabilization of the spine, restricting excessive movement to prevent further injury and facilitate healing [21]. A recent study has emphasized the importance of patient activation strategies for self-management of LBP [22].

Personalized treatment approaches, such as prognostic screening tools, have been proposed to categorize non-serious LBP and optimize emergency management [23]. These individualized strategies aim to align interventions with patient risk profiles, emphasizing the need for evolving care models to enhance treatment efficacy [24]. Multidisciplinary approaches integrating physical therapy, targeted exercise, behavioral strategies, and patient education have demonstrated effectiveness in reducing LBP [25,26]. Among these interventions, lumbar support has been widely proposed as a non-invasive treatment option. Its primary function is to provide additional support to the lower back, thereby reducing pain, improving posture, and enhancing spinal stability [24]. Previous studies have highlighted its benefits, particularly among healthcare workers, where lumbar support has been associated with reduced pain intensity and improved functional outcomes [27,28]. Additionally, patients using belt-shaped lumbar supports exhibit lower abdominal muscle activity, suggesting that these devices contribute to spinal stabilization by reducing muscular strain [29]. Several studies support the efficacy of lumbar support in LBP management [18,30,31].

Different types of lumbar support devices exist, each designed to provide varying levels of stabilization and pain relief. Soft lumbar orthoses, commonly made of elastic materials, are frequently used for non-specific LBP, helping to limit the adverse effects of bed rest while enabling mobility [32]. Semi-rigid orthoses restrict excessive spinal movement, offering intermediate stabilization [33]. Rigid orthoses, typically used for acute injuries, provide maximal restriction of spinal motion to alleviate pain [34].

The aim of this systematic review and meta-analysis was to evaluate the effectiveness of lumbar support in managing low back pain by synthesizing data from randomized controlled trials (RCTs). The present study sought to standardize pain measurement tools, addressed study heterogeneity, and integrated new findings to provide a clearer understanding of lumbar support's impact on pain reduction. By comparing lumbar support to alternative treatments, this study is expected to enhance the evidence base for its role in optimizing low back pain management and improving patient outcomes.

Methods

Study design

The present study employed a meta-analysis of RCTs to evaluate the effectiveness of lumbar support in managing LBP compared to non-lumbar support interventions such as physical therapy, training, Kinesio tape placement, and other conventional interventions. The meta-analysis was conducted in accordance with PRISMA guidelines [35] and the analysis focused on various orthotic devices, including lumbar braces, lumbosacral corsets, soft lumbar orthoses, and lumbar belt orthoses. The objective was to determine their impact on quality of life based on pain reduction.

Study eligibility criteria

This systematic review and meta-analysis applied the population, intervention, comparison, and outcome (PICO) framework to define study eligibility. The population included adults aged 18 years and older diagnosed with non-specific low back pain (NSLBP). NSLBP was defined as pain localized between the lower rib cage and pelvis, persisting for at least four weeks. To ensure consistency, eligible studies had to specify that participants reported pain levels using validated scales or diagnostic criteria. The intervention of interest was lumbar support, including various types of lumbar orthoses such as soft lumbar supports, lumbar braces, and lumbosacral corsets. The comparison groups consisted of alternative conservative treatments, such as exercise therapy, education, ergonomic modifications, and lifestyle adjustments. The primary outcome was the improvement in quality of life, assessed through pain reduction measured using the Visual Analog Scale (VAS). Studies were required to provide numerical data on mean and standard deviation values before and after the intervention. A reduction in pain was considered clinically significant if it met or exceeded the minimum clinically important difference (MCID) as reported in the literature.

Additionally, only randomized controlled trials (RCTs) were included. Non-experimental studies, secondary research (systematic reviews, meta-analyses), non-peer-reviewed publications, non-English articles, and grey literature (conference abstracts, dissertations, preprints) were excluded.

Search strategy

A literature search was conducted across six electronic databases: PubMed, ScienceDirect, Scopus, Google Scholar, SpringerLink, and ProQuest. The search covered publications from 2007 to 2023, with the search completed by July 30, 2023. Search terms included "low back pain" "lumbar support", "lumbar orthose", and "randomized controlled trial," combined using Boolean operators. MeSH terms, where applicable, were used to refine the search.

Data extraction

Prior to the evaluation, the articles were screened based on language, and types of articles by three independent investigators (MSA, YT, and MA). Furthermore, the articles were screened based on the title and abstract and evaluated using predetermined inclusion criteria. Any differences in assessment were resolved through discussion. Furthermore, two authors (MSA and MS) performed the data extraction from each selected study, including the author's name, country, study design, setting, age of samples, sample sizes, intervention and control group, intervention (frequency and duration of intervention), comparative methods, and outcomes.

Quality assessment

Two authors (MSA and DA) conducted the quality analysis using the JBI Critical Appraisal Checklist for Randomized Control Trials, available on JBI Global (Joanna Briggs Institute) [36] to assess the quality of included article and risk of bias in each study. The tool assesses several domains of study quality, including randomization, allocation concealment, baseline similarity, and blinding of participants, treatment providers, and outcome assessors. It also evaluates treatment consistency, completeness of follow-up, intention-to-treat analysis, outcome measurement reliability, and statistical analysis appropriateness. Additionally, the tool considers whether the trial design aligns with standard RCT methods and accounts for any deviations.

Data analysis

This systematic review synthesized studies on lumbar orthosis for LBP, focusing on pain relief, functional outcomes, and quality of life. A meta-analysis was performed using Review Manager 5.4 (Cochrane Collaboration, Oxford, UK) to assess effect size (mean difference and standard deviation) and evaluate the impact of lumbar support. A random-effects model was used to estimate mean differences with 95% confidence intervals (CIs). Heterogeneity was assessed with the Cochrane Q test and I^2 statistic, categorized as low heterogeneity (0%–40%), moderate (30%–60%), substantial (50%–90%), and considerable (75%–100%) [37-39]. Random effects were applied for heterogeneous data, and funnel plots were examined for publication bias [40].

Results

Study selection process

The systematic searches yielded a total of 728 articles and 67 duplicates were identified and excluded, leaving 661 articles for pre-screening. Moreover, 481 irrelevant articles were excluded, resulting in 180 full-text articles for further evaluation. A total of 16 articles met the eligibility criteria for qualitative systematic review, and eight were included in a meta-analysis. The summary of the conducted study can be found in **Figure 1**.

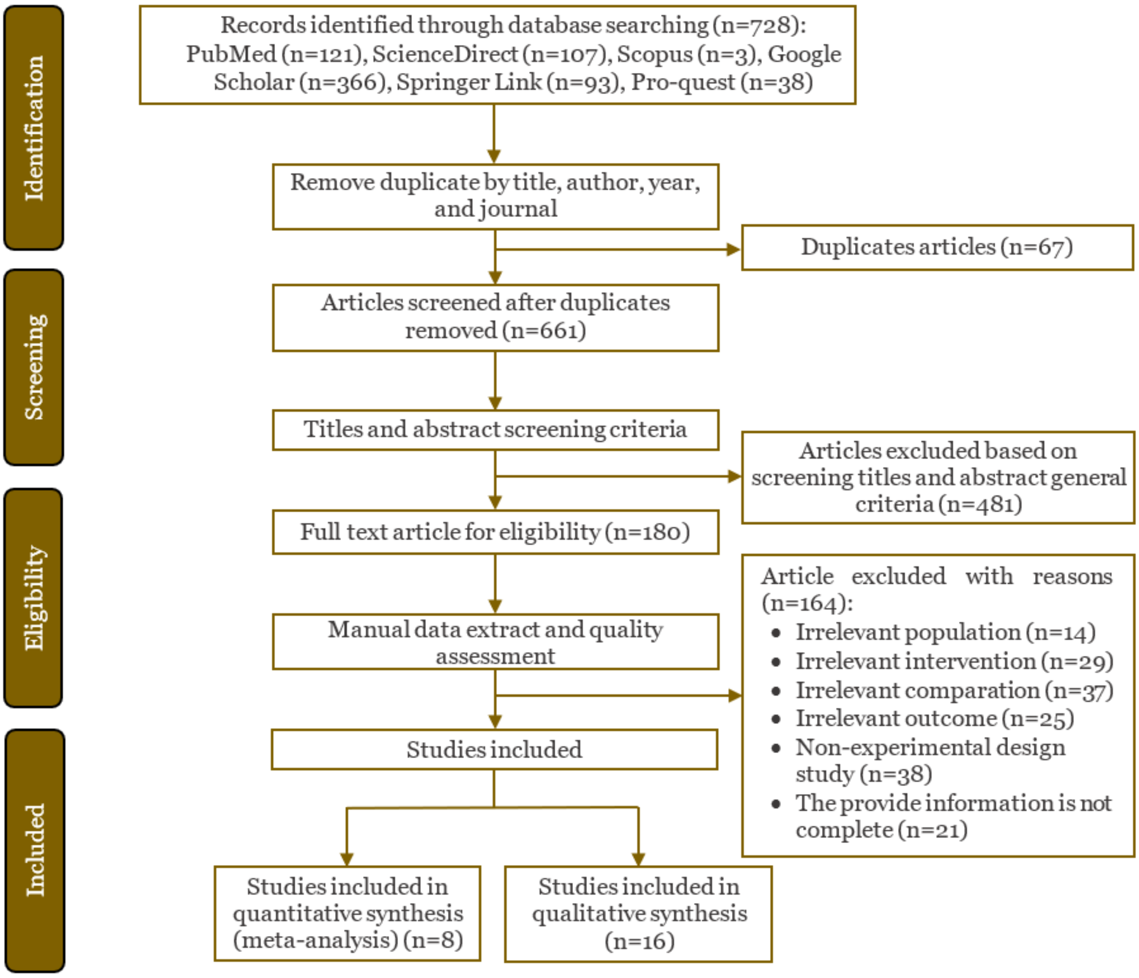

Figure 1. The PRISMA flowchart of the study selection processes.

Characteristics of included studies

The included studies were published between 2007 and 2022, conducted across various countries, including the USA, France, the Netherlands, Bangladesh, Canada, the Republic of Korea, Iran, Japan, China, Sweden, and Spain (**Table 1**). These studies examined the effects of different types of lumbar and lumbosacral orthoses in diverse settings such as hospitals, rehabilitation centers, universities, and community-based environments. Sample sizes varied widely, ranging from 14 to 222 participants, with intervention durations spanning 2 to 120 weeks. Notably, no dropouts occurred during the intervention period in any of the included studies.

Table 1. Characteristics of the included randomized controlled trials in qualitative analysis

Author, year	Country	Setting	Mean age (years) I/C group	Sample size	Intervention duration (week)	Intervention	Comparison	Study endpoints	Outcomes
Oleske *et al.*, 2007 [41]	USA	Community	46/46	222	48	Back support orthosis	Education	Evaluated the change in mental health, physical health, neurogenic symptoms, lost work time, low back pain scores, and Oswestry back pain disability scores	The result showed there was no difference between the study groups in terms of mental or physical health, low back pain, back pain disability, neurogenic symptoms, lost work time, and the likelihood of a back disorder. However, it demonstrated a considerable decrease in low back discomfort.
Minon *et al.*, 2008 [42]	France	Personal	22/29	20	3	Lumbar orthosis	Without orthosis	Evaluated the effect of lumbar support in isokinetic muscle strength, and isometric muscle strength	These results showed there was no change in isokinetic and isometric strength. Furthermore, this result indicated no negative effects on muscle strength, however, it needs a more customized prescription of lumbar orthosis based on the subject's perspective of muscle strength.
Calmels *et al.*, 2009 [43]	France	Family	43/43	102	6	Lumbar belt orthosis	Did not receive the belt	Evaluated the effects of an elastic lumbar belt on VAS score	This study emphasized the potential advantage of lumbar support as a supplemental and nonpharmacologic treatment for low back pain, in addition to standard medicine.
Roelofs *et al.*, 2010 [44]	Netherlands	Community	42/42	183	48	Lumbar orthosis	Lumbar training	Evaluated the reduction degree of low back pain, and its correlation in cost-effective ratio	The use of lumbar support resulted in -5.0 days of sick leave, which resulted in pain reduction. Furthermore, the use of lumbar support could decrease the rehabilitation cost compared to other treatment.
Shakoor *et al.*, 2015 [45]	Bangladesh	Physical medicine & rehabilitation center	43/40	42	4	Lumbosacral corset (orthosis)	Activities of daily living (ADL) instruction training	Evaluated the change of pain intensity, disability, and physical impairment were done by using a visual analog scale	Wearing a lumbar corset effectively decreases chronic LBP and lowers the pain intensity. A lumbar corset is used as an addition to NSAID therapy for pain management, and the maximal study indicated higher tolerance and improvement.
Kawchuk *et al.*, 2015 [46]	Canada	Personal	39/19	19	2	Lumbar brace	Without brace	Evaluated the change in Oswestry disability index, spinal	The Oswestry score decreased significantly for the brace group treatment. Moreover, the Sorensen

Author, year	Country	Setting	Mean age (years) I/C group	Sample size	Intervention duration (week)	Intervention	Comparison	Study endpoints	Outcomes
								stiffness, and muscle endurance	test was also significantly increased in the brace group. However, the spinal stiffness did not change.
Kang *et al.*, 2016 [47]	Republic of Korea	University	59/57	10	4	Soft lumbar orthosis	Rigid lumbar orthosis	Evaluated about effect of lumbar support on pain index and postural control	The comparison between groups showed a significant difference in the group using soft orthoses (p<0.01). The results showed that using soft orthoses was more successful in relieving pain and postural balance than wearing hard orthoses.
Azadinia *et al.*, 2017 [48]	Iran	Rehabilitation center	27/27	20	4	Lumbosacral orthosis	Physical therapy	Measured pain intensity, functional disability, fear of movement/ (re)injury, and postural stability	After 4 weeks of treatment, it showed a decreased intensity in pain, Oswestry index, and Tampa scale in the group with lumbar orthosis and physical therapy. However, there was a significant difference in functional disability.
Hagiwara *et al.*, 2017 [27]	Japan	General hospital	45/45	54	12	Lumbosacral orthosis	Spine training	Evaluated the effect of lumbar support on low back pain measured by VAS, along with good posture, shoulder discomfort, knee pain, numbness, shoulder pain, neck pain, back pain, headache	The use of lumbar support resulted in decreased VAS and somatosensory application scale (SSAS) scores, lumbar spinal range of motion (ROM), low back discomfort, and neck pain. This proved that lumbar support significantly reduced low back discomfort in healthcare professionals.
Mi *et al.*, 2018 [49]	China	Hospital	59/61	28	28	Lumbosacral orthosis	Physical activity	Evaluated the effect of lumbosacral orthosis on postural control in patients	A lumbar support orthosis appeared to improve postural stability in patients with non-specific low back pain while standing on an unstable surface.
Alin *et al.*, 2019 [50]	Sweden	Community	78/73	35	24	Spinal Orthosis	Training	Evaluation of the effect of spinal orthoses on the change of back pain and back extensor strength	Following six months of treatment with an activating spinal orthosis, there was no significant difference in back pain, back extensor strength, or kyphosis index between the three groups. Low back discomfort decreased marginally in the spinal orthosis group, while back extensor strength rose by

Author, year	Country	Setting	Mean age (years) I/C group	Sample size	Intervention duration (week)	Intervention	Comparison	Study endpoints	Outcomes
									26.9%, indicating that spinal orthoses could be used as an alternate training strategy.
Azadinia *et al.*, 2019 [51]	Iran	University	27/27	22	4	Lumbosacral orthosis	Physical therapy	Evaluated the changes in postural control behavior	The results showed that 4 weeks of treatment with lumbosacral orthoses and physical therapy did not affect the temporal structure of postural sways in patients with nonspecific low back pain.
Cervero *et al.*, 2019 [52]	Spain	Community	43/41	14	8	Lumbar support	Kinesiotape placement	Evaluated the effect of lumbar support on functionality and disability	The findings revealed that wearing flexible lumbar support did not enhance lumbar functionality or disability in assembly-line workers who had previously taken sick absence owing to LBP, as compared to workers who received a placebo intervention.
Samani *et al.*, 2019 [53]	Iran	Rehabilitation center	36/35	14	4	Lumbar brace orthosis	Muscle strength training	Evaluated the effect of lumbar support on motor function and clinical outcome (pain and disability)	Long-term usage of lumbosacral orthoses had no discernible effect on motor function or clinical variables in patients with chronic low back pain. Tightening the lumbosacral orthosis may increase motor function and clinical efficacy, and could be efficient with non-chronic low back pain.
Annaswamy *et al.*, 2021 [19]	Texas	Hospital	48/50	25	120	Back brace	Exercise	Evaluated the effect of back bracing on the pain intensity, pain disability, and quality of life	In patients with chronic low back pain, a back brace combined with education and exercise instruction provided no different effect on pain disability compared to education and exercise instruction alone.
Lee *et al.*, 2022 [54]	USA	Hospital	57/57	17	2	The sacroiliac belt during the first week and the lumbar orthosis during the second week	Lumbar orthosis during the first week and the sacroiliac belt during the second week	Evaluated the effect of lumbar support on user satisfaction and functional disability status	When compared to the lumbar orthosis, the sacroiliac belt provided much higher user satisfaction which resulted in an improvement in functional disability status. It has been proven that using lumbar support (belt) could enhance the quality of life.

I/C group: intervention group/control group

The primary interventions involved various spinal support devices, including lumbar belts, lumbosacral corsets, and back braces, compared against controls such as education, physical therapy, muscle training, or the absence of orthotic support (**Table 1**). Study endpoints assessed a range of clinical outcomes, including pain intensity (measured by Visual Analog Scales), functional disability (evaluated through the Oswestry Disability Index), muscle strength, postural control, spinal stiffness, and quality of life. The findings contribute to understanding the efficacy of orthotic interventions in managing low back pain, disability, and postural stability (**Table 1**).

The included studies demonstrated heterogeneity in the effectiveness of lumbar support for managing LBP. While some trials reported improvements in pain, function, and stability, others showed minimal, or no benefit compared to other treatments. These differences were likely due to factors such as the type of lumbar support, duration of use, patient characteristics, and additional interventions. A meta-analysis was performed using standardized pain measures, VAS, to assess the overall efficacy of lumbar support in pain reduction (**Table 1**).

Quality assessment

The quality assessment of the included studies revealed a low risk of bias across all analyzed trials, with a substantial proportion meeting the criteria outlined in the JBI critical appraisal. The evaluation utilized a randomized controlled trial appraisal tool, which comprises 13 key inquiries, as presented in **Table 2**. All studies scored 50% or higher on the quality assessment. A detailed summary of the bias risk for each study is provided in **Table 2**.

Table 2. Risk of bias quality assessment based on the Joanna Bring Institute (JBI) critical appraisal tools

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Risk
Alin *et al.*, 2019 [50]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low
Hagiwara *et al.*, 2017 [27]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low
Roelofs *et al.*, 2010 [44]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low
Samani *et al.*, 2019 [53]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low
Shakoor *et al.*, 2015 [45]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low
Calmels *et al.*, 2009 [43]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low
Kang *et al.*, 2016 [47]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low
Oleske *et al.*, 2007 [41]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Low

Q1 Did the study employ randomization to allocate participants to treatment groups?
Q2 Was allocation to treatment groups concealed?
Q3 Were the treatment group similar at the baseline?
Q4 Were participants blind to the treatment assignment?
Q5 Were those delivering treatment blind to the treatment assignment?
Q6 Were outcomes assessors blind to the treatment assignment?
Q7 Were treatment groups treated identically, other than the intervention of interest?
Q8 Was the follow-up complete, and if not, were the differences between groups in terms of their follow-up adequately described and analyzed?
Q9 Were participants analyzed in the groups to which they were randomized?
Q10 Were outcomes measured in the same way for the treatment group?
Q11 Were outcomes measured in a reliable way?
Q12 Was appropriate statistical analysis used?
Q13 Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trials?

Effect of lumbar support on pain reduction

After a qualitative review, a meta-analysis was conducted to quantify the effect of lumbar support on pain reduction, using VAS as the primary outcome measure. Of the 16 identified studies, eight were excluded due to the absence of primary VAS data, leaving a total of 650 participants for analysis. A random-effects model was employed to account for potential variability across studies. The results demonstrated a significant reduction in pain associated with lumbar support compared to alternative interventions, with an overall standardized mean difference (SMD) of -1.33 (95%CI: -2.09–(-0.57); p=0.0006). Despite substantial heterogeneity (I^2=97%), the findings suggested that lumbar support effectively alleviated pain in individuals with LBP (**Figure 2**). Four studies (Alin *et al.* [50], Roelofs *et al.* [44], Calmels *et al.* [43], and Oleske *et al.* [41]) had confidence intervals crossing the zero line, indicating no significant difference between lumbar orthosis and other interventions. In contrast, studies by Hagiwara *et al.* [27], Samani *et al.* [53], Shakoor *et al.* [45], and Kang *et al.* [47] showed confidence intervals entirely in the negative range, suggesting a statistically significant reduction in pain levels with lumbar support (**Figure 2**).

The funnel plot, as shown in **Figure 3**, further assessed potential publication bias. Additionally, the overall effect SMD of -1.33 (95%CI: -2.09–(-0.57)) falls within the negative range of the forest plot, confirming a statistically significant negative effect [55]. Since VAS is a widely accepted tool for evaluating pain [56], its application in this analysis reinforces the validity of the findings. Despite the observed heterogeneity, the results indicate that lumbar support significantly alleviates pain in individuals with LBP.

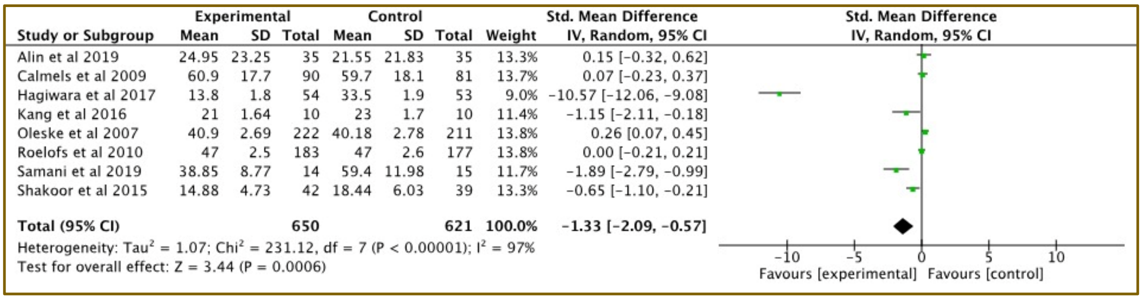

Figure 2. Forest plot showing the effectiveness of lumbar support (experimental column) in reducing pain based on the Visual Analog Scale (VAS) compared to other treatments in low back pain (LBP) patients.

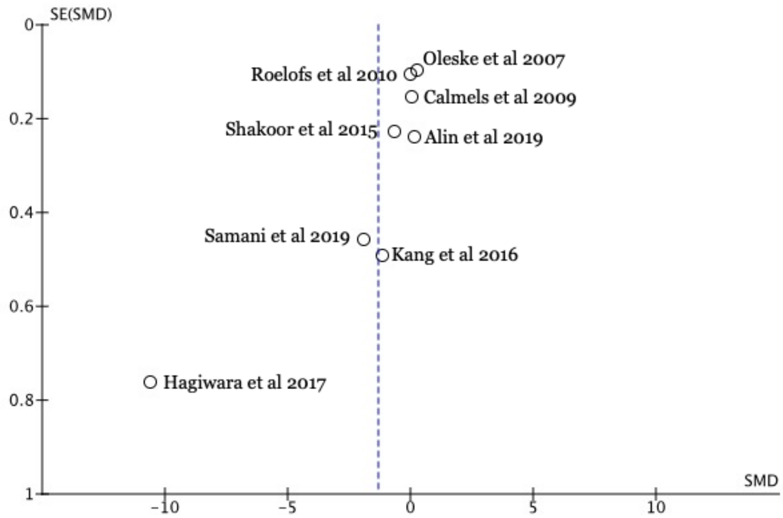

Figure 3. Funnel plot of publications bias of the included studies assessing the effectiveness of lumbar support in reducing pain based on the Visual Analog Scale (VAS) compared to other treatments in low back pain (LBP) patients.

Discussion

LBP is a health condition influenced by various factors such as muscle control dysfunction [57], muscle strain [58], and vertebral fractures [59]. Understanding these mechanisms is essential for developing effective treatment and management strategies. One potential approach to addressing this issue is the use of lumbar support. In this study, a systematic review and meta-analysis on lumbar support revealed a statistically significant negative effect compared to other interventions. This was indicated by the 95%CI of the treatment effect overlapping the null effect [60], with a total SMD of -1.33. These findings support the hypothesis and demonstrate an overall reduction in pain, suggesting that lumbar support is more effective in alleviating pain levels than alternative interventions. This aligns with a previous study, which has shown that lumbar support can help reduce pain by enhancing spinal stabilization [61], prompting muscle relaxation [62], and improving postural control [63,64]. Collectively, these findings suggested that lumbar support may be a valuable intervention for individuals with LBP. The results further indicate that lumbar orthoses can alleviate pain and enhance functional outcomes in this patient population. Additionally, studies have demonstrated that lumbar orthoses significantly reduce pain levels [27,48,49,65], leading to an overall improvement in health-related quality of life [66].

The reduction in pain levels with the use of lumbar orthoses helps maintain proper posture [67] by offloading the paraspinal muscles (**Figure 3**). This, in turn, decreases muscular strain [68] by applying corrective forces, potentially preventing muscle fatigue and tension [69], both of which contribute to LBP. A study by Saito *et al.* (2014) found that long-term use of lumbar support did not increase muscle fatigue [28], indicating that it can effectively reduce pain by promoting proper spinal posture during daily activities [38]. Furthermore, studies by Alin *et al.* [50] and Hagiwara *et al.* [27] demonstrated that wearing lumbar support reduces pain levels by minimizing compensatory movement patterns and enhancing muscle relaxation [27,50]. Lumbar support functions as an internal stabilizing system for the spine by increasing intra-abdominal pressure. This mechanism is similar to that of weightlifting belts, which are primarily designed to protect the spine during heavy lifting [4]. The findings suggested that appropriate lumbar support can reduce lumbar muscle fatigue [69], facilitating faster recovery compared to conditions without support.

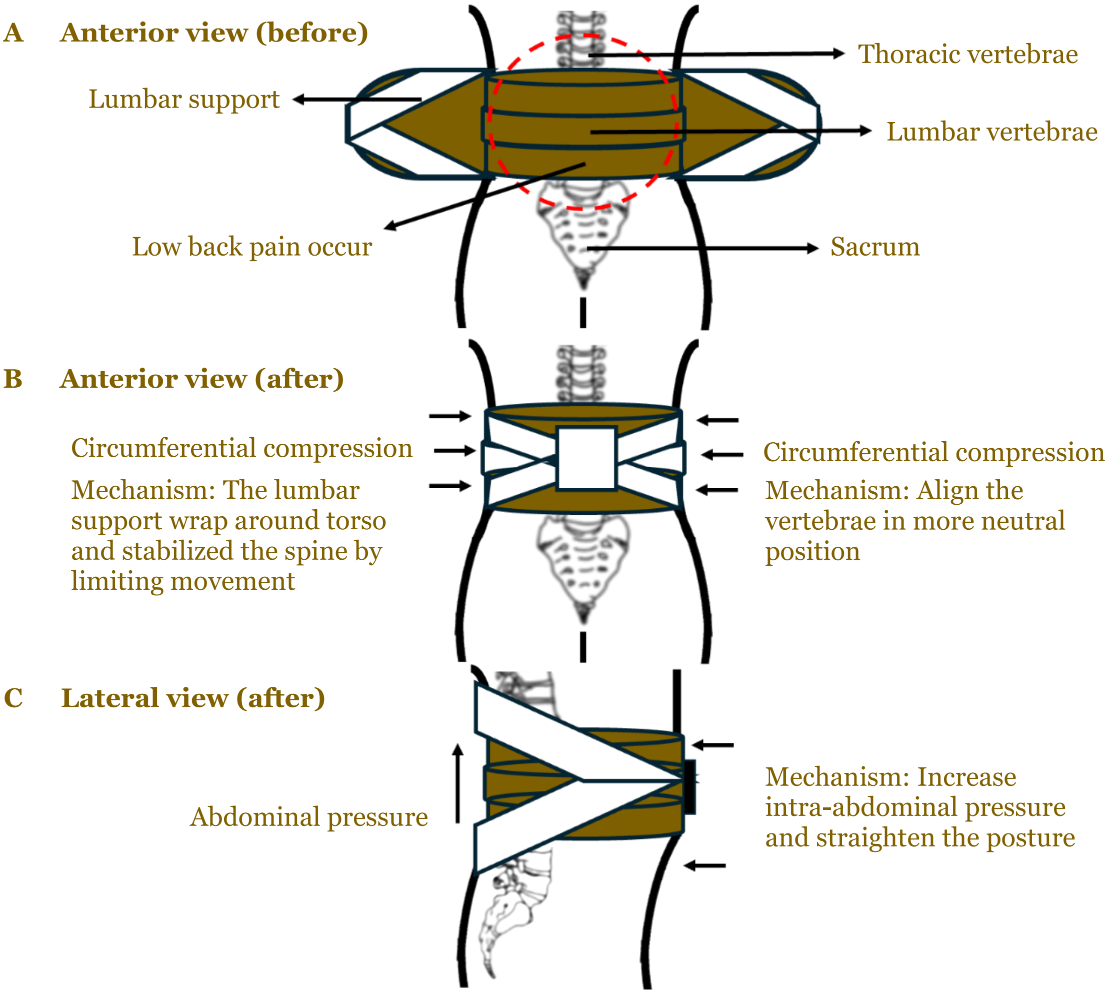

Figure 3. Mechanisms of how lumbar support reduce low back pain (LBP) on pathophysiological lens: (A) anterior view of body before wearing lumbar support, (B) anterior view after wearing lumbar support, and (C) lateral view after using lumbar support.

However, in qualitative analysis, lumbar support did not always yield better results than other treatment methods. This variation may have been influenced by factors such as the intervention setting, workplace environment, and type of back pain. Individuals engaged in physically demanding jobs, such as healthcare professionals who performed frequent lifting and strenuous tasks, may have found lumbar support particularly beneficial. A study in 2020 found that lumbar orthoses decreased work absenteeism and improved quality of life for individuals in physically demanding occupations [70]. The use of lumbar support resulted in reduced pain levels, which was essential for maintaining a good quality of life [71]. This effect was attributed to the dual benefits of lumbar support, providing both immediate pain relief and long-term stabilization by actively limiting excessive spinal motion while being worn [72]. In contrast, spinal training alone did not offer continuous stabilization and failed to restrict excessive spinal movement over extended periods [31].

The mechanisms of lumbar support included spinal stabilization, reduced strain, muscle offloading, postural correction, increased intra-abdominal pressure, and proprioceptive feedback. In healthcare settings, these mechanisms helped prevent potentially harmful movements, such as lifting, bending, or assisting patients, that could have exacerbated LBP or led to injury [27]. Additionally, patients with chronic LBP, who often experienced persistent discomfort and required sustained pain relief to facilitate movement during daily activities, also benefited from lumbar support. This aligns with findings from previous study which demonstrated that lumbar support in patients with chronic LBP improved functional capacity and reduced muscle tension [73].

Moreover, despite the functional advantage, lumbar support was also found to reduce treatment costs associated with this prevalent condition. Several studies explored cost-effectiveness, demonstrating that lumbar supports reduced both direct and indirect costs related to managing LBP[28,44,74,75]. This suggested that lumbar support contributed to lowering overall healthcare costs in the long-term management of LBP [62]. Early intervention with lumbar support led to significant long-term cost savings [61] by preventing the progression of acute low back pain into chronic conditions. In chronic cases, LBP often required more advanced treatments, such as surgical interventions [76], which were typically more costly [77].

This study had several limitations. First, the use of multiple pain measurement tools across various studies required re-evaluation and standardization to ensure the comparability of results. Second, subjective assessments in some studies led to a wide range of reported values, potentially affecting the reliability of the findings. Third, the high heterogeneity among the studies suggested that the outcomes were influenced by various factors, such as patient characteristics, study settings, the type of support used, study endpoints, and compliance during treatment. Additionally, limitations such as variations in sample size, search bias, and limited data availability may have also influenced the outcomes of this meta-analysis. Addressing these limitations in future research is crucial for enhancing the reliability and generalizability of findings related to lumbar support for LBP.

Conclusion

The meta-analysis confirmed that lumbar support significantly reduces pain in LBP. By limiting excessive spinal motion and stabilizing the spine, lumbar support alleviates strain, promotes proper posture, and prevents further injury. These findings reinforce its role in pain management and highlight the need for further research on specific populations and standardized assessment tools to enhance result reliability.

Ethics approval

Not required

Acknowledgments

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Competing interests

No conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

Declaration of artificial intelligence use

This study used artificial intelligence (AI) tools and methodologies in the following capacities: AI-based language models, Quillbot, was employed to language refinement (improving grammar, sentence structure, and readability of the manuscript). We confirm that all AI-assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

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