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Original Article

Effects of Latissimus Dorsi–Fascia Stretching, Lower Trapezius Strengthening, and Sham Control on Pain and Function in Thoracolumbar Dysfunction: A Randomized Clinical Trial

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ABSTRACT

Background: Chronic mechanical low back pain is commonly associated with pain, disability, restricted lumbar mobility, and thoracolumbar dysfunction. Altered thoracolumbar fascia mobility, posterior-chain restriction, and impaired postural muscle control may contribute to persistent symptoms, supporting the need for targeted rehabilitation strategies. **Objective:** To compare the effects of latissimus dorsi–thoracolumbar fascia stretching, lower trapezius strengthening, and sham control on pain intensity, functional disability, and lumbar range of motion in adults with chronic mechanical low back pain associated with thoracolumbar dysfunction. **Methods:** This three-arm randomized clinical trial included 198 participants allocated equally into latissimus dorsi–thoracolumbar fascia stretching, lower trapezius strengthening, and sham control groups, with 66 participants in each group. Pain intensity, Oswestry Disability Index, and lumbar range of motion were assessed at baseline and after intervention. Between-group differences were analyzed using inferential statistics, with significance set at $p < 0.05$. **Results:** Pain decreased most in the latissimus dorsi–thoracolumbar fascia stretching group, from 7.42 ± 0.63 to 3.91 ± 0.84, compared with 7.43 ± 0.71 to 4.53 ± 0.91 in the lower trapezius strengthening group and 7.41 ± 0.64 to 6.43 ± 0.74 in the sham control group. Oswestry Disability Index improved from 53.66 ± 6.38 to 35.14 ± 7.12, 53.31 ± 6.61 to 39.23 ± 7.03, and 54.25 ± 6.22 to 48.59 ± 6.77, respectively. Lumbar range of motion increased from 41.22 ± 6.61 to 55.83 ± 7.39, 42.05 ± 6.04 to 53.94 ± 6.08, and 41.45 ± 5.69 to 45.73 ± 5.91, respectively. Between-group differences were significant for all outcomes ($p < 0.001$). **Conclusion:** Latissimus dorsi–thoracolumbar fascia stretching produced the greatest improvement in pain, disability, and lumbar mobility, followed by lower trapezius strengthening, while sham control showed limited benefit. Targeted thoracolumbar rehabilitation may be clinically useful for chronic mechanical low back pain associated with thoracolumbar dysfunction. **Keywords:** Chronic Mechanical Low Back Pain; Thoracolumbar Dysfunction; Latissimus Dorsi; Thoracolumbar Fascia; Lower Trapezius; Oswestry Disability Index; Randomized Clinical Trial.

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INTRODUCTION

Chronic mechanical low back pain is a major musculoskeletal and public health problem that remains one of the leading contributors to disability, reduced mobility, work limitation, and impaired quality of life worldwide. Its clinical burden is not limited to pain intensity alone, because persistent low back pain frequently affects daily function, physical activity, productivity, and long-term participation in social and

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occupational roles. Contemporary evidence increasingly suggests that chronic mechanical low back pain is not usually explained by a single spinal structure, but is more often associated with altered movement control, impaired load transfer, soft-tissue restriction, muscle imbalance, and dysfunction across interconnected kinetic-chain systems (1,2).

The thoracolumbar region is clinically important because it forms a functional bridge between the lumbar spine, pelvis, thorax, shoulder girdle, and upper limb. Within this region, the thoracolumbar fascia acts as a dense connective-tissue network involved in force transmission, trunk stability, and coordinated movement between the posterior chain and lumbopelvic complex. Reduced thoracolumbar fascia mobility and altered shear strain have been reported in individuals with chronic low back pain, suggesting that fascial stiffness may contribute to persistent pain and movement restriction rather than representing only a secondary finding (3,4). Additional evidence indicating increased thoracolumbar fascia thickness and its association with pain intensity further supports the clinical relevance of fascial assessment and treatment in patients with chronic mechanical low back pain (5).

The latissimus dorsi has a direct anatomical and functional relationship with the thoracolumbar fascia and may therefore influence lumbopelvic mechanics through posterior-chain force transmission. Dysfunction, tightness, or altered activation of the latissimus dorsi may increase fascial tension, reduce trunk mobility, and disturb coordinated load transfer between the upper limb, spine, pelvis, and contralateral lower limb. Studies evaluating myofascial force transmission and muscle activation patterns have shown that chronic low back pain may be associated with altered interaction between the latissimus dorsi and gluteal musculature, supporting the relevance of this muscle-fascial pathway in rehabilitation planning (6,7). On this basis, targeted stretching of the latissimus dorsi–thoracolumbar fascia complex may improve tissue extensibility, movement tolerance, and pain-related function in patients with thoracolumbar dysfunction.

The lower trapezius is also relevant within this kinetic-chain framework because of its contribution to scapular positioning, thoracic posture, postural control, and upper-quarter stability. Although most direct interventional evidence for lower trapezius strengthening has been generated in neck pain and scapulothoracic dysfunction, improvements in pain, posture, muscle performance, and functional outcomes after lower trapezius strengthening suggest that this muscle may influence broader postural and neuromuscular control mechanisms (8). Because thoracic alignment, scapular control, and trunk mechanics are biomechanically linked, lower trapezius dysfunction may indirectly contribute to altered thoracolumbar loading and persistent mechanical low back symptoms. Strengthening this muscle may therefore represent a clinically plausible intervention for improving postural control and reducing pain-related disability in patients with chronic mechanical low back pain associated with thoracolumbar dysfunction.

Exercise therapy is widely recommended for chronic low back pain, but the most effective therapeutic target may vary according to the patient's dominant dysfunction. General exercise approaches may reduce symptoms, yet they may be insufficient when specific fascial restriction, posterior-chain dysfunction, or postural muscle impairment contributes to the clinical presentation. Despite growing evidence supporting the role of thoracolumbar fascia mobility, latissimus dorsi force transmission, and lower trapezius function in musculoskeletal rehabilitation, direct comparative evidence evaluating fascia-focused stretching and postural strengthening within the same randomized clinical trial remains limited. This gap is particularly relevant in outpatient physiotherapy settings, where clinicians require practical evidence to determine whether targeted thoracolumbar interventions offer superior benefits compared with control or usual-care approaches.

Therefore, the present study was designed using a PICO framework in which the population comprised adults with chronic mechanical low back pain associated with thoracolumbar dysfunction; the interventions were latissimus dorsi–thoracolumbar fascia complex stretching and lower trapezius strengthening; the comparator was a control intervention; and the outcomes were pain intensity, functional disability, and lumbar range of motion. The objective of this randomized clinical trial was to compare the effects of latissimus dorsi–thoracolumbar fascia stretching, lower trapezius strengthening, and control treatment on pain, disability, and lumbar mobility in patients with chronic mechanical low back pain due to thoracolumbar dysfunction. The study hypothesized that targeted latissimus dorsi–thoracolumbar fascia stretching and lower trapezius strengthening would produce greater improvements in pain-related outcomes than control treatment, with a potential difference in treatment response between the two active interventions.

MATERIALS AND METHODS

This study was designed as a three-arm, parallel-group randomized clinical trial to compare the effects of latissimus dorsi–thoracolumbar fascia complex stretching, lower trapezius strengthening, and a sham control intervention on pain, functional disability, and lumbar range of motion in adults with chronic mechanical low back pain associated with thoracolumbar dysfunction. A randomized controlled design was selected because it provides a rigorous methodological framework for comparing therapeutic interventions while reducing selection bias and balancing measured and unmeasured prognostic factors across treatment groups (9). The trial followed a 1:1:1 allocation ratio, with participants assigned to one of three groups: latissimus dorsi–thoracolumbar fascia stretching, lower trapezius strengthening, or sham control. The study was conducted in outpatient physiotherapy and rehabilitation settings in Karachi, Pakistan, including Jinnah Postgraduate Medical Centre, BAWS Health Facility, and AR Rehman Ar Raheem Health Care Center, where patients with musculoskeletal and spinal complaints routinely receive clinical assessment and rehabilitation care. Participants were recruited from eligible patients presenting to these centers with chronic mechanical low back pain, and baseline assessment was completed before randomization.

The target population consisted of adults aged 18 to 60 years with chronic mechanical low back pain lasting at least 12 weeks and clinical evidence of thoracolumbar dysfunction. Thoracolumbar dysfunction was operationally defined as restriction, impaired movement control, soft-tissue tightness, or muscle imbalance involving the thoracolumbar region, identified through clinical physiotherapy assessment. Participants were eligible if they had mechanically provoked low back pain without signs of serious spinal pathology, were able to participate in an exercise-based rehabilitation program, and provided written informed consent. Participants were excluded if they had lumbar radiculopathy, progressive neurological deficit, spinal fracture, infection, malignancy, inflammatory spinal disease, previous spinal surgery, pregnancy, severe systemic illness, contraindications to therapeutic exercise, or concurrent intensive physiotherapy for the same condition. Consecutive sampling was used to identify eligible participants as they presented to the participating clinical sites, after which random allocation was performed to preserve internal validity.

After eligibility confirmation and informed consent, demographic and clinical information was collected using a structured assessment form. Baseline variables included age, sex, body mass index, duration of symptoms, pain intensity, functional disability, and lumbar range of motion. Pain intensity was measured using a numerical pain rating scale, with higher scores indicating greater pain severity. Functional disability was assessed using the Oswestry Disability Index, a widely used instrument for measuring low back pain–related disability. Lumbar range of motion was assessed using a standardized clinical measurement procedure, and the same assessment method was applied at baseline and after completion of the intervention period to ensure consistency. All outcome assessments were performed by trained assessors using standardized instructions and recording procedures. Where feasible, assessors were kept unaware of group allocation to reduce measurement bias.

Participants allocated to the latissimus dorsi–thoracolumbar fascia stretching group received a targeted stretching program directed at the latissimus dorsi and its fascial continuity with the thoracolumbar fascia. The intervention was delivered under physiotherapist supervision and focused on improving tissue extensibility, reducing posterior-chain restriction, and enhancing thoracolumbar mobility. Stretching was performed in standardized positions designed to place controlled tension through the latissimus dorsi–thoracolumbar fascia complex while maintaining safe spinal alignment. Participants allocated to the lower trapezius strengthening group received supervised strengthening exercises emphasizing lower trapezius activation, scapular control, thoracic postural alignment, and progressive neuromuscular control. Exercises were progressed according to participant tolerance, movement quality, and ability to complete the prescribed activity without symptom exacerbation. Participants in the sham control group received a time-matched low-intensity control procedure that avoided specific therapeutic loading of the latissimus dorsi–thoracolumbar fascia complex or lower trapezius while maintaining comparable therapist interaction. All groups received standardized safety instructions, and participants were advised to avoid initiating additional intensive physiotherapy programs during the study period.

The primary outcomes were change in pain intensity and functional disability from baseline to post-intervention. Lumbar range of motion was evaluated as a secondary outcome because improvement in mobility was clinically relevant to thoracolumbar dysfunction and mechanical low back pain. Pain intensity, Oswestry Disability Index score, and lumbar range of motion were treated as continuous variables. The main exposure variable was treatment group allocation, categorized as latissimus dorsi–thoracolumbar fascia stretching, lower trapezius strengthening, or sham control. Potential confounding variables included age, sex, body mass index, baseline pain severity, baseline disability, baseline range of motion, and duration of symptoms. Random allocation was used to minimize confounding, while baseline comparability across groups was assessed statistically and clinically before interpretation of treatment effects.

The sample size was calculated for comparison of continuous outcomes across three independent groups. Because the study compared three intervention arms and the primary outcomes were continuous, the sample size framework was based on analysis of variance principles for multi-group clinical trials. Using a medium effect size, two-sided alpha level of 0.05, and 80% statistical power, the minimum estimated sample size was 159 participants, corresponding to 53 participants per group. To compensate for an anticipated 20% attrition rate, the sample size was inflated to 198 participants, with 66 participants assigned to each group. This approach was consistent with standard recommendations that clinical trial sample size estimation should account for expected effect size, statistical power, type I error, number of comparison groups, and anticipated dropout (10,11).

Randomization was performed after baseline assessment using a computer-generated random allocation sequence. Allocation concealment was maintained through sealed, opaque, sequentially numbered envelopes prepared before participant enrollment. Each envelope was opened only after the participant had completed baseline assessment and was confirmed eligible for allocation. This process was used to prevent foreknowledge of group assignment and reduce allocation bias. Standardized intervention protocols, assessor training, consistent timing of assessments, and uniform data collection forms were used to improve reproducibility and reduce performance and measurement bias. Participants' attendance and completion of supervised sessions were recorded to monitor adherence, and any symptom aggravation or adverse event reported during the intervention period was documented.

Data were entered into a password-protected database and checked for completeness, range errors, and internal consistency before statistical analysis. Each participant was assigned a unique study code to maintain confidentiality and support reproducible data management. Continuous variables were summarized using means and standard deviations when approximately normally distributed, while categorical variables were summarized using frequencies and percentages. Baseline comparability among the three groups was assessed using one-way analysis of variance for continuous variables and chi-square tests for categorical variables. The main treatment effect was evaluated by comparing pre- to post-intervention changes in pain intensity, Oswestry Disability Index score, and lumbar range of motion among the three groups. For primary analysis, analysis of covariance was planned for each outcome, with post-intervention score as the dependent variable, treatment group as the independent variable, and baseline value of the corresponding outcome as a covariate. This approach was selected because adjustment for baseline outcome values improves precision and reduces bias in randomized trials with continuous outcomes. Pairwise comparisons were performed for latissimus dorsi–thoracolumbar fascia stretching versus lower trapezius strengthening, latissimus dorsi–thoracolumbar fascia stretching versus sham control, and lower trapezius strengthening versus sham control, with adjustment for multiple comparisons. Results were reported as mean differences with 95% confidence intervals and p-values. A p-value less than 0.05 was considered statistically significant.

Missing data were assessed for frequency, pattern, and likely mechanism before final analysis. When outcome data were missing, the primary analysis followed the intention-to-treat principle as far as the available data permitted, and sensitivity analysis was planned to examine the robustness of findings under alternative assumptions. Normality, homogeneity of variance, linearity, and influential observations were evaluated before interpreting parametric models. If model assumptions were substantially violated, appropriate non-parametric or robust alternatives were considered. Statistical analysis was performed using SPSS or equivalent validated statistical software. Data integrity was maintained through double-checking of entered values, restricted access to the analysis file, preservation of original assessment forms, and documentation of all data-cleaning and analysis decisions.

The study was conducted in accordance with ethical principles for human-participant research. Eligible participants were informed about the purpose of the study, intervention procedures, potential benefits, possible risks, voluntary participation, and their right to withdraw at any stage without affecting their clinical care. Written informed consent was obtained before enrollment. Participant confidentiality was maintained by using coded data and limiting access to identifiable information. Ethical approval was obtained from the relevant institutional review body before initiation of data collection, and all intervention procedures were delivered within the scope of physiotherapy practice and participant safety monitoring.

RESULTS

A total of 198 participants were included in the final analysis, with equal allocation across the three study arms: latissimus dorsi–thoracolumbar fascia stretching, lower trapezius strengthening, and sham control, with 66 participants in each group. Baseline demographic and clinical characteristics were comparable across groups, supporting successful randomization. Mean age ranged from 36.71 ± 7.78 years in the latissimus dorsi–thoracolumbar fascia stretching group to 38.36 ± 7.77 years in the sham control group, while mean BMI ranged from 26.83 ± 2.68 to 27.94 ± 3.04 kg/m². Mean pain duration was also similar across groups, ranging from 14.67 ± 3.93 to 15.57 ± 4.20 months. No statistically significant baseline differences were observed for age, BMI, pain duration, or sex distribution, indicating that the three groups were clinically and statistically comparable before intervention.

Table 1. Baseline Characteristics of Participants by Treatment Group

Variable	LD-Fascia Stretching (n = 66)	LT Strengthening (n = 66)	Sham Control (n = 66)	Test Statistic	p-Value
Age, years	36.71 ± 7.78	38.02 ± 8.28	38.36 ± 7.77	F = 0.79	0.454
BMI, kg/m²	27.94 ± 3.04	27.01 ± 3.29	26.83 ± 2.68	F = 2.58	0.078
Pain duration, months	15.57 ± 4.20	14.90 ± 4.69	14.67 ± 3.93	F = 0.79	0.457
Male, n (%)	24 (36.4)	30 (45.5)	26 (39.4)	χ^2 = 1.17	0.556
Female, n (%)	42 (63.6)	36 (54.5)	40 (60.6)		

Values are presented as mean ± standard deviation unless otherwise stated. LD-Fascia = latissimus dorsi–thoracolumbar fascia; LT = lower trapezius.

Pain intensity decreased in all three groups after intervention, but the magnitude of improvement differed substantially between groups. The LD-Fascia stretching group showed the largest reduction in pain, decreasing from 7.42 ± 0.63 at baseline to 3.91 ± 0.84 after treatment, with a mean change of 3.51 ± 0.45 points. The LT strengthening group improved from 7.43 ± 0.71 to 4.53 ± 0.91, with a mean change of 2.91 ± 0.49 points. The sham control group showed only a modest reduction from 7.41 ± 0.64 to 6.43 ±

0.74, with a mean change of 0.98 ± 0.33 points. The overall between-group difference in pain reduction was statistically significant, with a large treatment effect.

Table 2. Pain Intensity Before and After Intervention

Group	Baseline Pain Score	Post-Intervention Pain Score	Mean Change	Group Test	Effect Size	p-Value
LD-Fascia Stretching	7.42 ± 0.63	3.91 ± 0.84	3.51 ± 0.45	F = 627.44	η² = 0.866	<0.001
LT Strengthening	7.43 ± 0.71	4.53 ± 0.91	2.91 ± 0.49			
Sham Control	7.41 ± 0.64	6.43 ± 0.74	0.98 ± 0.33			

Values are presented as mean ± standard deviation. Mean change indicates improvement from baseline to post-intervention.

Functional disability also improved in all groups, with the greatest reduction observed in the LD-Fascia stretching group. The Oswestry Disability Index decreased from 53.66 ± 6.38 to 35.14 ± 7.12 in the LD-Fascia group, giving a mean improvement of 18.52 ± 2.61 points. In the LT strengthening group, ODI decreased from 53.31 ± 6.61 to 39.23 ± 7.03, with a mean improvement of 14.08 ± 2.26 points. The sham control group improved from 54.25 ± 6.22 to 48.59 ± 6.77, with a smaller mean change of 5.66 ± 1.93 points. The between-group difference in ODI improvement was statistically significant, indicating that both active interventions produced greater disability reduction than sham control, with the strongest effect in the LD-Fascia group.

Table 3. Oswestry Disability Index Before and After Intervention

Group	Baseline ODI Score	Post-Intervention ODI Score	Mean Change	Overall-Group Test	Effect Size	p-Value
LD-Fascia Stretching	53.66 ± 6.38	35.14 ± 7.12	18.52 ± 2.61	F = 539.97	η² = 0.847	<0.001
LT Strengthening	53.31 ± 6.61	39.23 ± 7.03	14.08 ± 2.26	—	—	—
Sham Control	54.25 ± 6.22	48.59 ± 6.77	5.66 ± 1.93	—	—	—

Values are presented as mean ± standard deviation. ODI = Oswestry Disability Index.

Lumbar range of motion increased after treatment in all groups, again showing the greatest improvement in the LD-Fascia stretching group. Mean lumbar ROM increased from 41.22 ± 6.61 to 55.83 ± 7.39 in the LD-Fascia group, corresponding to a mean gain of 14.62 ± 2.79. The LT strengthening group increased from 42.05 ± 6.04 to 53.94 ± 6.08, with a mean gain of 11.89 ± 2.25. The sham control group increased from 41.45 ± 5.69 to 45.73 ± 5.91, with a smaller mean gain of 4.28 ± 2.27. The between-group difference in ROM improvement was statistically significant, showing that targeted intervention improved mobility more than sham control.

Table 4. Lumbar Range of Motion Before and After Intervention

Group	Baseline ROM	Post-Intervention ROM	Mean Change	Overall Between-Group Test	Effect Size	p-Value
LD-Fascia Stretching	41.22 ± 6.61	55.83 ± 7.39	14.62 ± 2.79	F = 315.86	η² = 0.764	<0.001
LT Strengthening	42.05 ± 6.04	53.94 ± 6.08	11.89 ± 2.25	—	—	—
Sham Control	41.45 ± 5.69	45.73 ± 5.91	4.28 ± 2.27	—	—	—

Values are presented as mean ± standard deviation. ROM = lumbar range of motion.

Pairwise comparisons showed that LD-Fascia stretching was significantly superior to LT strengthening and sham control for all outcomes. For pain reduction, LD-Fascia stretching exceeded LT strengthening by 0.60 points and sham control by 2.53 points. For ODI improvement, LD-Fascia stretching exceeded LT strengthening by 4.44 points and sham control by 12.86 points.

Table 5. Pairwise Comparison of Mean Change Scores Between Treatment Groups

Outcome	Comparison	Mean Difference in Change	95% CI	Cohen's d	p-Value
Pain score	LD-Fascia vs LT Strengthening	0.60	0.44 to 0.76	1.28	<0.001
Pain score	LD-Fascia vs Sham Control	2.53	2.39 to 2.67	6.41	<0.001
Pain score	LT Strengthening vs Sham Control	1.93	1.79 to 2.07	4.62	<0.001
ODI score	LD-Fascia vs LT Strengthening	4.44	3.60 to 5.28	1.82	<0.001
ODI score	LD-Fascia vs Sham Control	12.86	12.07 to 13.65	5.60	<0.001
ODI score	LT Strengthening vs Sham Control	8.42	7.70 to 9.14	4.01	<0.001
Lumbar ROM	LD-Fascia vs LT Strengthening	2.73	1.86 to 3.60	1.08	<0.001
Lumbar ROM	LD-Fascia vs Sham Control	10.34	9.46 to 11.22	4.07	<0.001
Lumbar ROM	LT Strengthening vs Sham Control	7.61	6.83 to 8.39	3.37	<0.001

Mean differences are based on change scores. Positive values favor the first-listed group. CI = confidence interval; ODI = Oswestry Disability Index; ROM = lumbar range of motion.

For lumbar ROM improvement, LD-Fascia stretching exceeded LT strengthening by 2.73 and sham control by 10.34. LT strengthening was also significantly superior to sham control for pain, ODI, and ROM, confirming that both active treatments were clinically and statistically more effective than the sham intervention.

Overall, the results demonstrated a consistent treatment gradient across all clinical outcomes. LD-Fascia stretching produced the greatest improvements in pain, disability, and lumbar mobility, followed by LT strengthening, while the sham control group showed only modest change. Pain reduction in the LD-Fascia group was approximately 3.6 times greater than in the sham control group, while ODI improvement was more than three times greater and ROM gain was more than threefold higher. These findings indicate that targeted thoracolumbar rehabilitation produced clinically meaningful improvements beyond nonspecific sham intervention, with the latissimus dorsi–thoracolumbar fascia stretching protocol showing the strongest overall response.

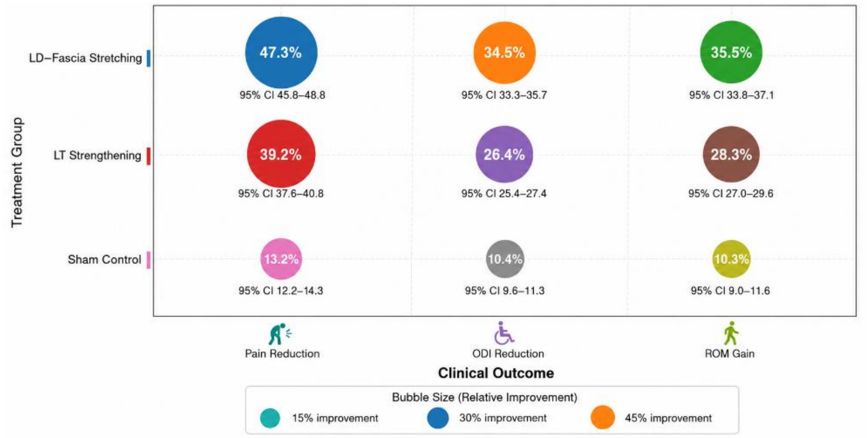

Figure 1. Relative Clinical Improvement Across Pain, Disability, and Lumbar Mobility

The relative improvement pattern showed a clear clinical gradient across all outcomes, with the LD-Fascia stretching group demonstrating the largest proportional gains: pain decreased by 47.3% from baseline, ODI improved by 34.5%, and lumbar ROM increased by 35.5%. The LT strengthening group showed moderate but clinically meaningful improvement, with 39.2% pain reduction, 26.4% ODI reduction, and 28.3% ROM gain. In contrast, the sham control group showed limited improvement across domains, with only 13.2% pain reduction, 10.4% ODI reduction, and 10.3% ROM gain. The separation between active interventions and sham control was most pronounced for pain reduction and ROM gain, supporting the clinical relevance of targeted thoracolumbar rehabilitation, particularly latissimus dorsi–thoracolumbar fascia stretching, for improving pain-related function and mobility.

DISCUSSION

The present randomized clinical trial demonstrated that both active rehabilitation strategies produced greater improvements in pain intensity, functional disability, and lumbar range of motion than the sham control intervention in adults with chronic mechanical low back pain associated with thoracolumbar dysfunction. The most consistent and clinically meaningful response was observed in the latissimus dorsi–thoracolumbar fascia stretching group, followed by the lower trapezius strengthening group, while the sham control group showed only modest improvement. Pain intensity decreased by 3.51 points in the latissimus dorsi–thoracolumbar fascia stretching group, compared with 2.91 points in the lower trapezius strengthening group and 0.98 points in the sham control group. A similar pattern was observed for disability, where the Oswestry Disability Index improved by 18.52 points, 14.08 points, and 5.66 points, respectively. Lumbar range of motion also improved most in the latissimus dorsi–thoracolumbar fascia stretching group, with a mean gain of 14.62, compared with 11.89 in the lower trapezius strengthening group and 4.28 in the sham control group. These findings support the study hypothesis that targeted thoracolumbar rehabilitation produces superior clinical improvement compared with nonspecific sham intervention, with the fascia-focused stretching approach showing the strongest overall treatment response. The manuscript's original results also identify the same intervention gradient across pain, ODI, and ROM outcomes.

The superiority of latissimus dorsi–thoracolumbar fascia stretching may be explained by the anatomical and biomechanical continuity between the latissimus dorsi, thoracolumbar fascia, lumbar spine, pelvis, and contralateral posterior chain. The thoracolumbar fascia contributes to trunk stability, load transfer, and coordination between upper-limb and lumbopelvic movement, and altered fascial mobility has been associated with chronic low back pain. Previous studies have reported reduced thoracolumbar fascia shear strain and altered fascial mobility in individuals with chronic low back pain, suggesting that fascial restriction may contribute to persistent pain and impaired movement tolerance (12,13). In the present trial, the greater improvement in both pain and lumbar mobility after latissimus dorsi–thoracolumbar fascia stretching is consistent with this mechanism. Although fascial mobility was not directly measured in the current study, the parallel reduction in pain and increase in ROM suggests that reducing posterior-chain restriction may have improved movement efficiency and reduced mechanical sensitivity in the thoracolumbar region.

The magnitude of improvement in the latissimus dorsi–thoracolumbar fascia stretching group is clinically important. A 3.51-point reduction in pain represents a substantial improvement from a baseline pain score above 7, and the reduction in ODI from 53.66 to 35.14 indicates meaningful recovery in pain-related function. The ROM gain from 41.22 to 55.83 further suggests that the intervention affected not only symptom perception but also mechanical movement capacity. This combined improvement across pain, disability, and mobility strengthens the interpretation that fascia-focused stretching may be particularly useful in patients whose chronic mechanical low back pain is associated with thoracolumbar soft-tissue restriction. These findings are also biologically plausible because altered latissimus dorsi activation and impaired myofascial force transmission between the latissimus dorsi and contralateral gluteal musculature have been reported in chronic low back pain populations (14,15). Therefore, targeting the latissimus dorsi–thoracolumbar fascia complex may address a clinically relevant component of posterior-chain dysfunction rather than acting only as a general flexibility exercise.

Lower trapezius strengthening also produced statistically and clinically meaningful improvements, although its effects were smaller than those observed with latissimus dorsi–thoracolumbar fascia stretching. Pain decreased by 2.91 points, ODI improved by 14.08 points, and lumbar ROM increased by 11.89 in the lower trapezius strengthening group. These changes suggest that postural strengthening and scapulothoracic control may influence symptoms in chronic mechanical low back pain associated with thoracolumbar dysfunction. The lower trapezius contributes to scapular stabilization, thoracic posture, and coordinated upper-quarter mechanics, all of which may affect trunk loading and movement control. Previous randomized evidence has shown that lower trapezius strengthening can improve pain, dysfunction, posture alignment, muscle thickness, and contraction performance in musculoskeletal rehabilitation, supporting its role in improving postural control and neuromuscular efficiency (16). The current findings extend this rationale to a low back pain population by showing that lower trapezius strengthening may improve pain-related outcomes beyond sham intervention.

The difference between the two active interventions may reflect their primary therapeutic targets. Latissimus dorsi–thoracolumbar fascia stretching directly addressed a structure anatomically continuous with the thoracolumbar fascia and posterior lumbopelvic chain, whereas lower trapezius strengthening likely acted through indirect mechanisms such as improved thoracic alignment, scapular stability, and postural motor control. This may explain why both interventions improved outcomes, but the fascia-focused intervention produced larger reductions in pain and disability and greater gains in lumbar ROM. The difference was particularly relevant for ROM, where the LD-Fascia group improved by 14.62 compared with 11.89 in the LT strengthening group and 4.28 in the sham control group. This pattern suggests that when mobility restriction is a prominent feature of thoracolumbar dysfunction, an intervention directly targeting the latissimus dorsi–thoracolumbar fascia complex may provide greater mechanical benefit.

The sham control group showed smaller but measurable improvements across all outcomes, with pain decreasing by 0.98 points, ODI improving by 5.66 points, and ROM increasing by 4.28. These changes may reflect nonspecific therapeutic effects, participant expectation, therapist contact, natural symptom fluctuation, or low-intensity movement exposure. However, the magnitude of improvement was substantially lower than in both active groups, indicating that nonspecific intervention alone was insufficient to produce comparable clinical recovery. This contrast strengthens the interpretation that the observed improvements in the active groups were not merely due to attention or repeated assessment, but were likely related to the specific therapeutic content of the interventions. In chronic low back pain rehabilitation, this distinction is important because general exercise or nonspecific care may not adequately address the dominant mechanical or neuromuscular impairment in all patients.

The findings are consistent with the broader evidence that chronic low back pain is a multidimensional condition involving more than localized lumbar pain. Global burden studies have consistently identified low back pain as one of the leading causes of disability worldwide, emphasizing the need for effective, scalable, and clinically targeted rehabilitation strategies (17,18). Current international guidance also supports non-surgical management and active rehabilitation for chronic primary low back pain, while encouraging individualized care based on clinical presentation and functional limitation (19). The present trial contributes to this evidence base by suggesting that targeted intervention directed toward thoracolumbar fascia mobility and postural muscle control may offer additional benefit in patients with thoracolumbar dysfunction-related chronic mechanical low back pain.

From a clinical perspective, these results support a more specific assessment-driven approach to physiotherapy management. Patients with chronic mechanical low back pain should not be treated as a homogeneous group, because different impairments may contribute to persistent symptoms. When clinical examination suggests latissimus dorsi tightness, posterior-chain restriction, or thoracolumbar fascial stiffness, latissimus dorsi–thoracolumbar fascia stretching may be a useful treatment priority. When postural control deficits, scapular dyskinesia, thoracic alignment impairments, or poor lower trapezius activation are present, lower trapezius strengthening may provide additional benefit. The comparative findings suggest that both interventions can be clinically valuable, but the strongest response may occur when the intervention directly targets the dominant mechanical restriction.

The study has several strengths. The randomized three-arm design allowed direct comparison of two active rehabilitation strategies against a sham control condition, improving the interpretability of treatment effects. Equal allocation across groups strengthened comparability, while baseline demographic and clinical similarity reduced the likelihood that post-treatment differences were explained by initial group imbalance. The use of clinically relevant outcomes, including pain intensity, ODI, and lumbar ROM, also improves the practical relevance of the findings for outpatient physiotherapy settings. In addition, the study addressed a focused clinical question involving a specific dysfunction-based subgroup of chronic mechanical low back pain, which may help guide more individualized rehabilitation planning.

Several limitations should be considered when interpreting the findings. First, the study assessed outcomes only from baseline to post-intervention, so the durability of treatment effects beyond the immediate intervention period remains uncertain. Longer follow-up is needed to determine whether improvements in pain, disability, and ROM are maintained over time. Second, although the findings support a plausible fascial mechanism, objective imaging or biomechanical assessment of thoracolumbar fascia mobility was not included; therefore, the mechanism of improvement cannot be confirmed directly. Third, participant and therapist blinding may have been difficult because the active interventions involved recognizable exercise procedures, although assessor blinding and standardized assessment methods can reduce measurement bias. Fourth, the findings may be most generalizable to adults with chronic mechanical low back pain and clinically identified thoracolumbar dysfunction, and may not apply to patients with radiculopathy, inflammatory disease, postsurgical pain, or serious spinal pathology. Finally, future studies should include longer follow-up, objective fascial or movement assessment, adherence-response analysis, adverse-event reporting, and multicenter replication to strengthen causal and clinical interpretation.

Overall, this trial suggests that targeted thoracolumbar rehabilitation can improve pain, disability, and lumbar mobility in adults with chronic mechanical low back pain associated with thoracolumbar dysfunction. Latissimus dorsi–thoracolumbar fascia stretching produced the greatest overall benefit, indicating that direct treatment of the posterior fascial chain may be especially relevant when fascial restriction and mobility limitation are present. Lower trapezius strengthening also produced meaningful improvement, supporting the role of postural control and scapulothoracic function in the broader kinetic-chain management of low back pain. These findings support the integration of dysfunction-specific assessment and targeted intervention selection into physiotherapy practice for chronic mechanical low back pain.

CONCLUSION

Latissimus dorsi–thoracolumbar fascia stretching and lower trapezius strengthening both produced meaningful improvements in pain intensity, functional disability, and lumbar range of motion in adults with chronic mechanical low back pain associated with thoracolumbar dysfunction; however, the greatest overall benefit was observed with latissimus dorsi–thoracolumbar fascia stretching. The LD-Fascia group showed the largest reduction in pain, greatest improvement in Oswestry Disability Index score, and highest gain in lumbar mobility compared with both lower trapezius strengthening and sham control, indicating that direct targeting of the posterior fascial chain may be particularly effective when thoracolumbar soft-tissue restriction contributes to symptoms. Lower trapezius strengthening also produced clinically relevant improvement, supporting the role of postural control and scapulothoracic muscle function in chronic mechanical low back pain rehabilitation. These findings support the use of assessment-driven, targeted physiotherapy interventions rather than nonspecific management alone, with latissimus dorsi–thoracolumbar fascia stretching emerging as the preferred intervention for improving pain-related function and mobility in this population.

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