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Effectiveness of Pilates-Based Exercise Versus Conventional Physiotherapy in Patients with Mechanical Low Back Pain: A Comparative Pre–Post Study

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Abstract

Background: Mechanical low back pain (MLBP) is a leading cause of activity limitation, and exercise-based rehabilitation is its mainstay of management. Direct comparisons of Pilates-based exercise with conventional physiotherapy in MLBP remain limited.

Objective: To compare the effect of Pilates-based exercise and conventional physiotherapy on pain and functional disability in adults with MLBP.

Methods: In this comparative pre-test/post-test study at Sparsh Physiotherapy Hospital, Yavatmal, India, 60 adults aged 20–50 years with MLBP of more than four weeks' duration were randomly allocated to Pilates-based exercise (Group A, n = 30) or conventional physiotherapy (Group B, n = 30). Both programmes lasted 40–45 minutes per session, five days per week for two weeks. Pain (visual analogue scale, VAS, 0–10) and disability (Oswestry Disability Index, ODI, %) were assessed before and after intervention using paired and independent t-tests (significance $p < 0.05$).

Results: Baseline characteristics were comparable. Both groups improved significantly (all $p < 0.001$). Mean VAS fell from 6.93 to 2.41 in Group A (−4.52; 65% reduction) and from 6.87 to 3.68 in Group B (−3.19; 46%). Mean ODI fell from 48.2% to 18.6% (−29.6 points) and from 47.6% to 26.9% (−20.7 points), respectively. Post-intervention scores were lower with Pilates: VAS difference −1.27 (95% CI −1.67 to −0.87) and ODI difference −8.3 points (95% CI −11.0 to −5.6), $p < 0.001$.

Conclusion: Over two weeks, both approaches reduced pain and disability, with greater short-term improvement after Pilates-based exercise. Because follow-up was short and blinding was not documented, longer, assessor-blinded trials are needed to confirm durability.

Keywords: Conventional Physiotherapy, Mechanical Low Back Pain, Oswestry Disability Index, Pilates

Key points

- Both Pilates-based exercise and conventional physiotherapy produced significant, clinically important reductions in pain and disability over two weeks (all $p < 0.001$).
- Post-intervention pain was 1.27 VAS points lower (95% CI −1.67 to −0.87) and disability 8.3 ODI points lower (95% CI −11.0 to −5.6) with Pilates.
- Findings are short-term; longer, assessor-blinded trials are needed to confirm durability.

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1. Introduction

Low back pain is the leading cause of years lived with disability worldwide, and its burden continues to rise with population growth and ageing [1]–[3]. In most patients no specific pathology is found, and the condition is described as non-specific or mechanical low back pain: pain arising from the lumbar musculoskeletal structures that is aggravated by movement or posture and eased by rest [4]. In India, sedentary work, prolonged sitting and poor ergonomics make this a particularly common reason for physiotherapy referral in the 20–50-year working-age group.

Spinal stability depends on the interplay of passive structures, the muscular system and neural control [5]. Delayed activation of the transversus abdominis and impaired recovery of the lumbar multifidus have been described in people with low back pain [6], [7], which motivates exercise that trains deep trunk control rather than superficial strength alone. Exercise therapy is effective for chronic low back pain [8], and recent international guidelines recommend supervised exercise as a core component of care [9]–[11], but the best programme remains uncertain.

Pilates combines controlled movement, breathing, pelvic alignment and postural awareness with trunk conditioning. Trials and systematic reviews, including a 2023 meta-analysis of 19 randomised trials, suggest that it reduces pain and disability in low back pain [12]–[16], and network meta-analyses place Pilates among the more effective exercise modes [17], [18]; its advantage over other forms of exercise, however, is less certain [14], [15]. Recent trials have compared Pilates with home-based exercise in chronic [19] and subacute [20] low back pain and have examined mind–body cueing within Pilates [21]. Conventional physiotherapy (typically moist heat, stretching, trunk strengthening and postural advice) remains the standard in many Indian clinics, yet few studies have compared the two approaches head-to-head in patients specifically diagnosed with mechanical low back pain. We therefore compared short-term changes in pain and functional disability after Pilates-based exercise and conventional physiotherapy.

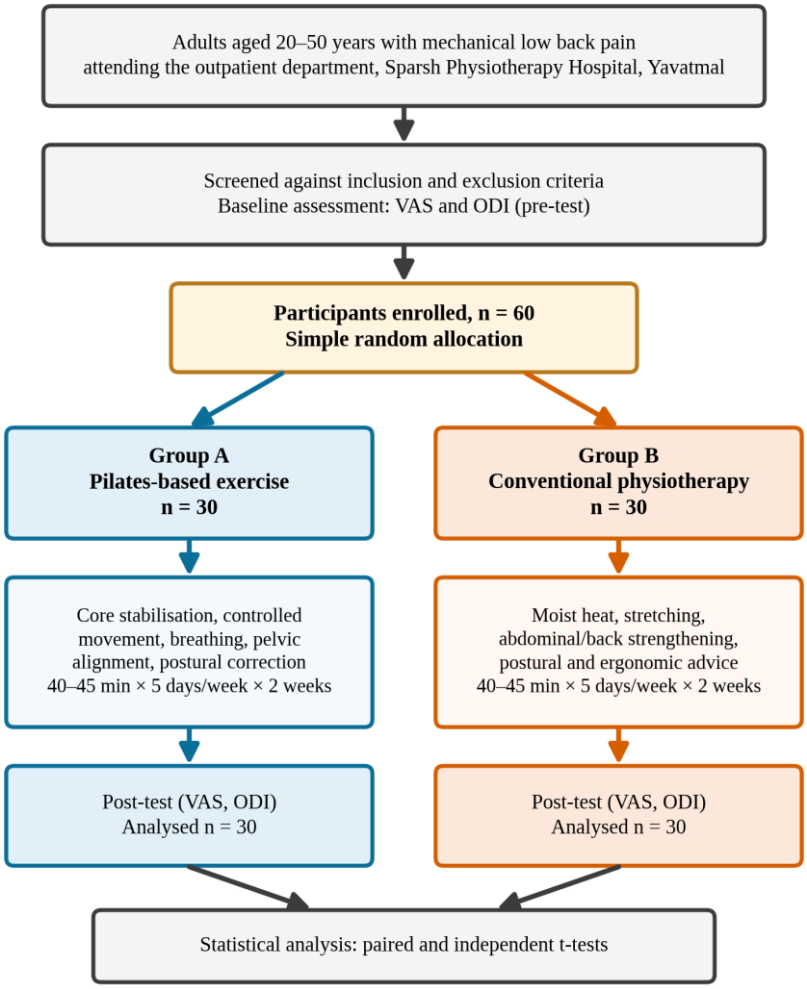
2. Materials and Methods

2.1 Study Design and Setting

This was an experimental, two-group, pre-test/post-test comparative study conducted in the outpatient department of Sparsh Physiotherapy Hospital, Yavatmal, Maharashtra, India. The report follows the CONSORT 2010 guidance as far as applicable [22]. Participant flow is shown in Figure 1 and the assessment schedule in Figure 2.

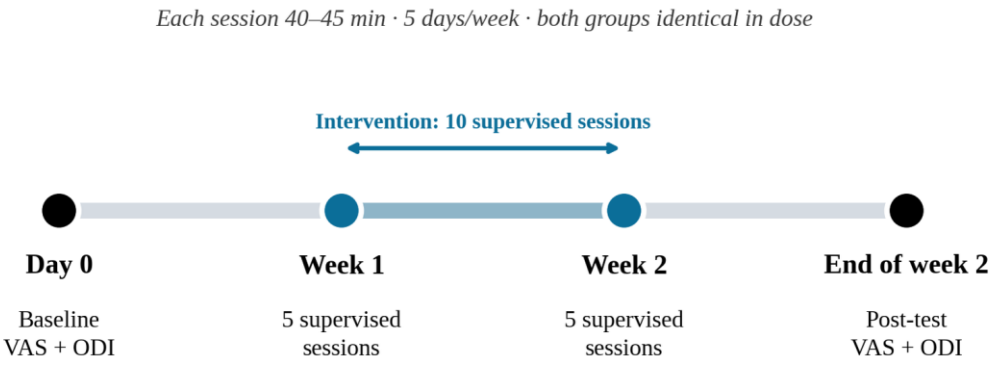
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Figure 1: Study Flow Diagram



VAS, visual analogue scale; ODI, Oswestry Disability Index; OPD, outpatient department.

Figure 2: Assessment and Intervention Schedule (Identical for Both Groups)



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2.2 Participants

Patients diagnosed with mechanical low back pain and meeting the criteria in Table 1 were invited to participate. Written informed consent was obtained before enrolment.

Table 1: Eligibility Criteria

Domain	Inclusion Criteria	Exclusion Criteria
Population	Men and women aged 20–50 years	Pregnancy
Diagnosis	Mechanical low back pain; pain aggravated by movement or posture	Disc herniation with neurological deficit; inflammatory or infective spinal conditions; spinal fracture or malignancy
Duration	Pain lasting more than 4 weeks	History of spinal surgery; any previous surgery affecting functional ability
Other	Not applicable	Knee joint effusion

2.3 Sample Size and Allocation

The sample size was calculated for a between-group difference in VAS using (1), where $Z_\alpha = 1.96$ (5% significance), $Z_\beta = 0.84$ (80% power), the expected difference $d = 1.3$ and the pooled standard deviation $\sigma = 1.8$. This gave approximately 30 participants per group. Sixty participants were allocated equally to Group A (Pilates-based exercise) or Group B (conventional physiotherapy) by simple random allocation.

$$n = 2(Z_\alpha + Z_\beta)^2 \, \sigma^2 / d^2 \quad (1)$$

2.4 Interventions

Both programmes were supervised, lasted 40–45 minutes per session and were delivered five days per week for two weeks (ten sessions). Content is summarised in Table 2; Pilates exercises were progressed gradually according to patient tolerance.

Table 2: Content of the Two Intervention Programmes

Component	Group A: Pilates-Based Exercise	Group B: Conventional Physiotherapy
Focus	Core stabilisation and neuromuscular control	Symptom relief, flexibility and general strength
Modality	Not applicable	Moist heat application
Exercises	Controlled movement; breathing control; pelvic alignment; flexibility work; postural correction	Stretching of back and lower-limb muscles; abdominal and back strengthening
Education	Postural correction during exercise	Postural advice and ergonomic education
Equipment	Exercise mat, Swiss ball, foam roll	Treatment couch, moist heat pack, exercise mat
Dose	40–45 min × 5 days/week × 2 weeks	40–45 min × 5 days/week × 2 weeks

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2.5 Outcome Measures

Pain intensity was recorded on a 10-cm visual analogue scale anchored at 0 (no pain) and 10 (worst imaginable pain) [23]. Functional disability was assessed with the Oswestry Disability Index [24], whose ten sections are each scored 0–5 (maximum 50) and expressed as a percentage (total ÷ 50 × 100). ODI scores were interpreted as minimal (0–20%), moderate (21–40%), severe (41–60%), crippling (61–80%) or bed-bound/exaggerating (81–100%). Both outcomes were measured at baseline and at the end of week 2.

2.6 Statistical Analysis

Data are presented as mean ± standard deviation (SD). Within-group changes were tested with paired t-tests and between-group differences in post-test scores with independent t-tests; $p < 0.05$ was considered significant. Baseline comparability was assessed from the group summaries. For interpretation we calculated percentage change, standardised effect sizes (Cohen's d) and 95% confidence intervals (CI) from the summary statistics; within-group CIs were derived from the mean change and its standard error (mean change ÷ t). Change was compared against commonly used minimal important change thresholds for pain and disability [25].

2.7 Ethics

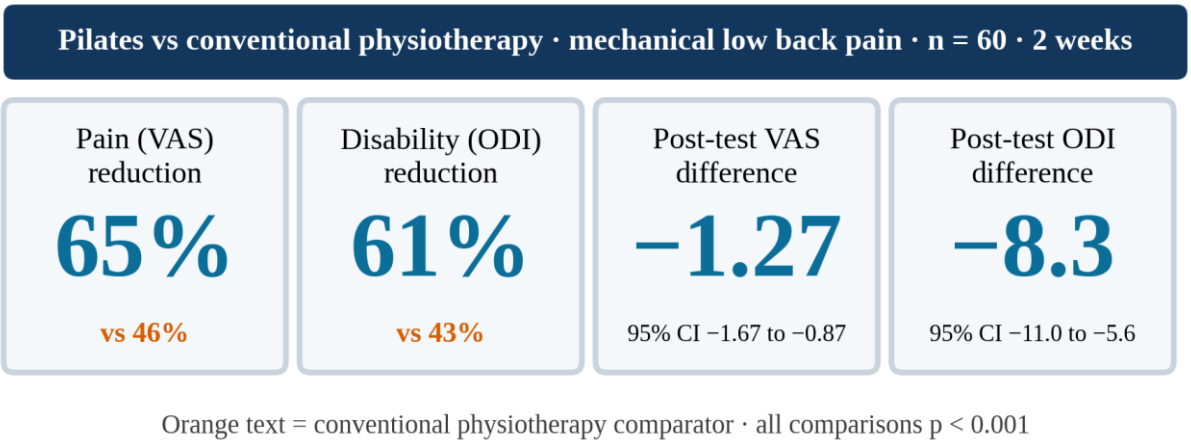
The study was approved by Institutional Ethics Committee. All participants received a patient information sheet and gave written informed consent; confidentiality was maintained and participants could withdraw at any time.

3. Results

3.1 Participants and Baseline Comparability

All 60 enrolled participants (30 per group) completed the programme and were analysed. The headline findings are summarised in Figure 3. The groups were similar in age, sex distribution, symptom duration and baseline pain and disability (Table 3).

Figure 3: Summary of Headline Results



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Table 3: Baseline Characteristics of Participants

Characteristic	Pilates (n = 30)	Conventional (n = 30)	p-value
Age (Years), Mean ± SD	36.8 ± 6.4	37.2 ± 5.9	0.80
Sex (Male/Female), n	14/16	15/15	0.80
Symptom Duration (Months)	5.6 ± 1.8	5.4 ± 1.6	0.65
VAS Pain (0–10)	6.93 ± 0.83	6.87 ± 0.79	0.78
ODI (%)	48.2 ± 6.1	47.6 ± 5.8	0.70

p-values from independent t-tests (continuous variables) and χ^2 test (sex), calculated from the group summaries. SD, standard deviation.

3.2 Pain (VAS)

Pain fell significantly in both groups (Table 4, Figures 4A and 6A). The mean reduction was 4.52 points (65%) with Pilates and 3.19 points (46%) with conventional physiotherapy. Both exceeded the 2-point minimal important change commonly used for pain [25]. After intervention, VAS was 1.27 points lower in the Pilates group (95% CI −1.67 to −0.87; t = 6.42, p < 0.001; Table 5, Figure 7).

3.3 Functional Disability (ODI)

Disability fell significantly in both groups (Table 4, Figures 4B and 6B). Mean ODI decreased by 29.6 percentage points (61%) with Pilates and 20.7 points (43%) with conventional physiotherapy, each exceeding the 10-point minimal important change [25]. The post-intervention difference favoured Pilates by 8.3 points (95% CI −11.0 to −5.6; t = 6.23, p < 0.001). By group mean, the Pilates group moved from the severe to the minimal-disability band, whereas the conventional group moved from severe to moderate (Figure 5).

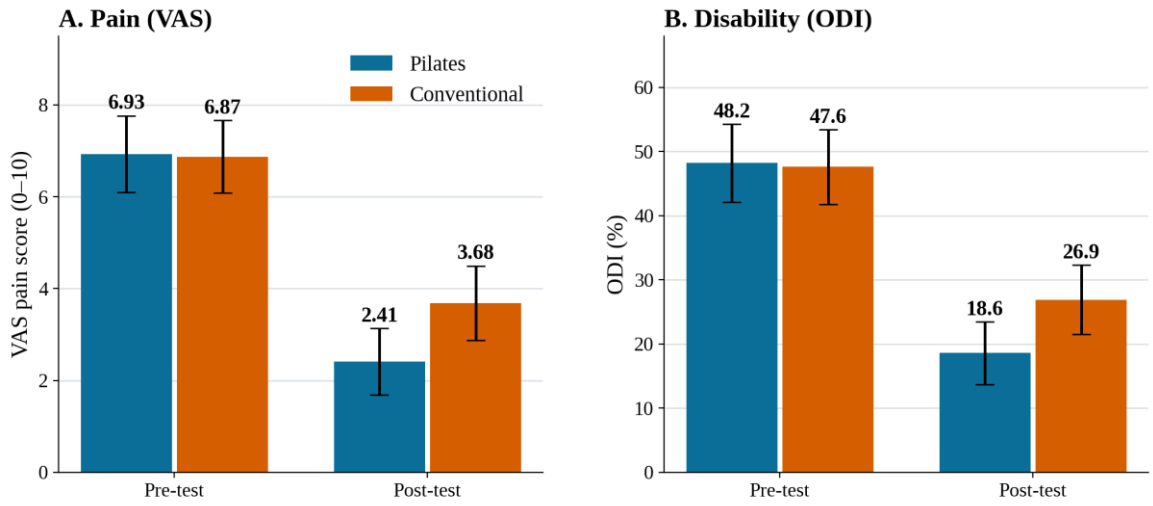
Table 4: Within-Group Changes in Pain and Disability (Paired t-Test, n = 30 per Group)

Outcome	Group	Pre-Test	Post-Test	Mean Change (95% CI)	% Change	t	p
VAS (0–10)	Pilates	6.93 ± 0.83	2.41 ± 0.72	−4.52 (−4.99 to −4.05)	−65%	19.86	<0.001
VAS (0–10)	Conventional	6.87 ± 0.79	3.68 ± 0.81	−3.19 (−3.72 to −2.66)	−46%	12.42	<0.001
ODI (%)	Pilates	48.2 ± 6.1	18.6 ± 4.9	−29.6 (−32.4 to −26.8)	−61%	21.34	<0.001
ODI (%)	Conventional	47.6 ± 5.8	26.9 ± 5.4	−20.7 (−23.5 to −17.9)	−43%	14.87	<0.001

Values are mean ± SD. 95% CIs of the mean change were derived from the reported mean change and t statistic. VAS, visual analogue scale; ODI, Oswestry Disability Index.

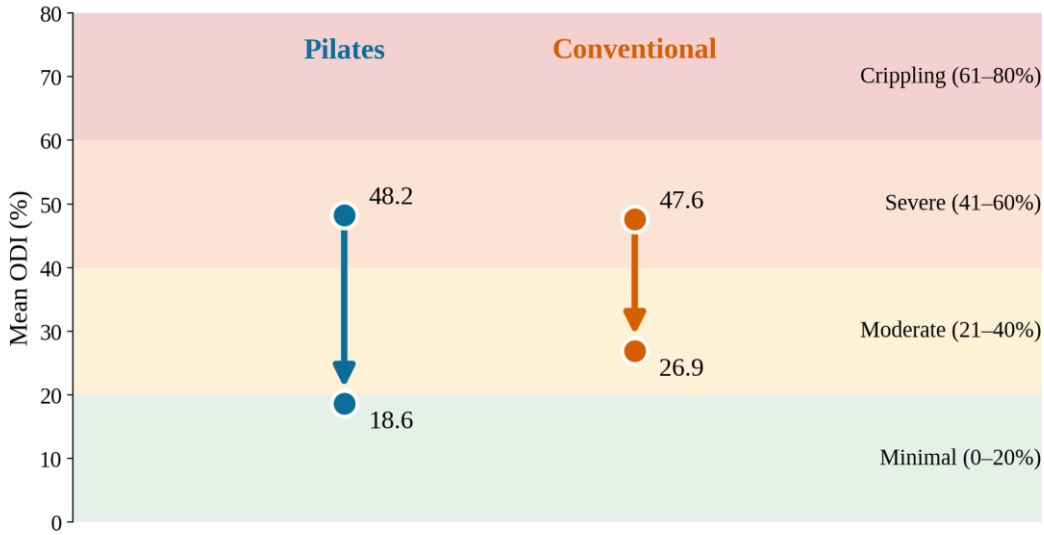
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Figure 4: Pain (A) and Disability (B) before and After Intervention



Bars show mean; whiskers show ± 1 SD. Blue, Pilates-based exercise; orange, conventional physiotherapy.

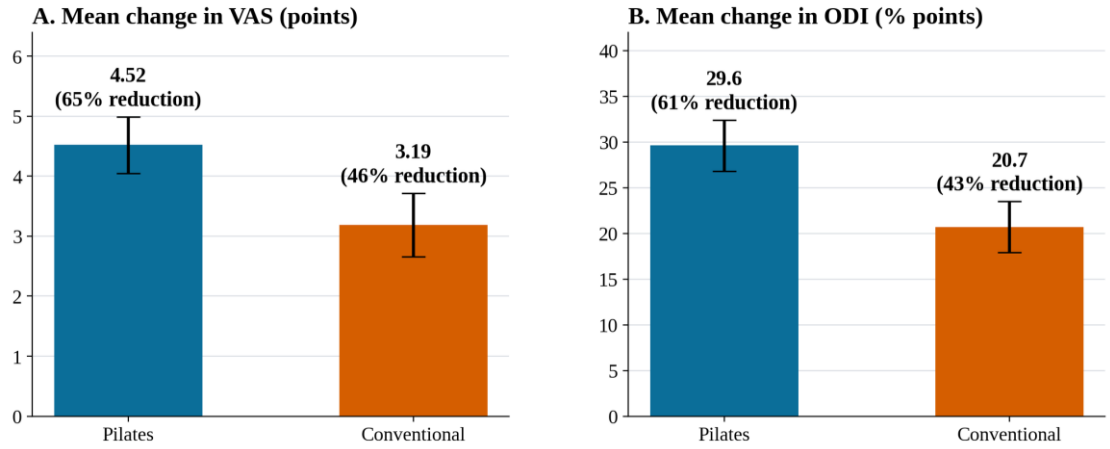
Figure 5: Shift in Mean ODI Category From Baseline to Post-Test



Shaded bands show the ODI interpretation categories used in this study; arrows connect group means.

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Figure 6: Mean Reduction in VAS (A) and ODI (B) with 95% Confidence Intervals



Percentages indicate relative reduction from baseline mean.

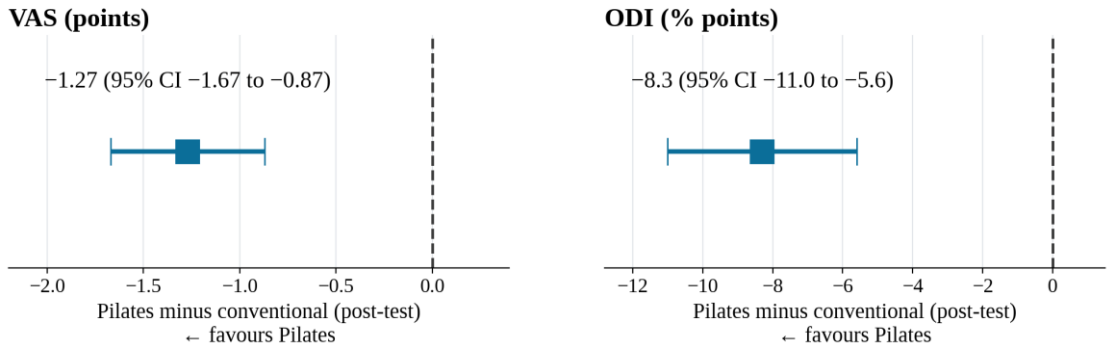
3.4 Between-Group Comparison

Table 5: Between-Group Comparison of Post-Intervention Scores (Independent t-Test, n = 30 per Group)

Outcome	Pilates	Conventional	Mean Difference (95% CI)	Cohen's d	t	p
VAS (0–10)	2.41 ± 0.72	3.68 ± 0.81	−1.27 (−1.67 to −0.87)	1.66	6.42	<0.001
ODI (%)	18.6 ± 4.9	26.9 ± 5.4	−8.3 (−11.0 to −5.6)	1.61	6.23	<0.001

Mean difference = Pilates minus conventional. CIs (Welch), Cohen's d and t were calculated from the group means and SDs (n = 30 per group).

Figure 7: Between-Group Differences in Post-Intervention Scores with 95% Confidence Intervals



Negative values favour Pilates-based exercise.

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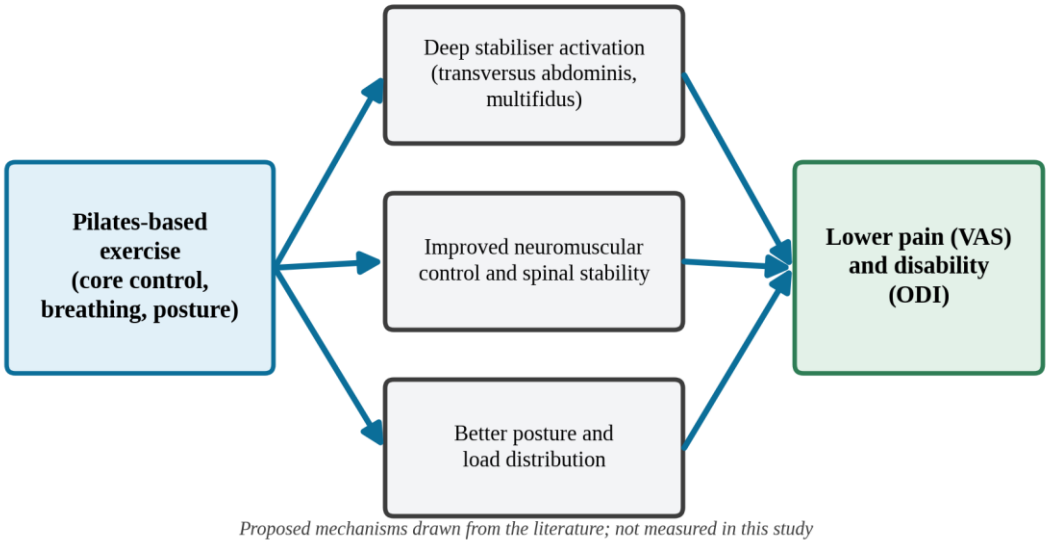
4. Discussion

In this two-week comparison, both Pilates-based exercise and conventional physiotherapy produced statistically significant and clinically important reductions in pain and disability, but the improvement was larger after Pilates. The additional benefit (about 1.3 VAS points and 8 ODI points at post-test) is moderate in size, and the large standardised differences ($d \approx 1.6$) should be interpreted cautiously given the small sample.

Our findings are in line with trials showing that Pilates-based programmes reduce pain and disability in low back pain compared with usual care [12], and with meta-analytic evidence that Pilates improves pain and disability in chronic low back pain [14]–[16]. A recent randomised trial in subacute low back pain similarly found that an eight-week supervised Pilates programme improved pain, disability and quality of life more than a home exercise programme [20]. However, reviews have judged the evidence for superiority over other exercise to be limited and of low quality [14], [15], and a trial of mind–body cueing within Pilates found no between-group difference in pain or disability, although fear of movement improved more with cueing [21]. The larger effect we observed relative to conventional care should therefore be regarded as hypothesis-supporting rather than conclusive.

Several mechanisms may contribute (Figure 8). Pilates trains the transversus abdominis and multifidus, whose delayed activation and incomplete recovery have been linked to low back pain [6], [7], while integrating breathing, pelvic control and posture to improve load distribution on the lumbar spine [5]. Conventional physiotherapy, with heat, stretching and general strengthening, can relieve symptoms but places less emphasis on motor-control retraining. These mechanisms were not measured here and remain proposed. Because current guidelines favour a biopsychosocial approach [9]–[11], future studies should also capture psychosocial factors such as fear of movement [21].

Figure 8: Proposed Pathway Through Which Pilates-Based Exercise May Reduce Pain and Disability



Mechanisms are drawn from the literature and were not measured in this study.

4.1 Clinical Implications

- Pilates-based core stabilisation can be offered as a structured, supervised option for adults with mechanical low back pain.

- Physiotherapists may consider training in Pilates-based rehabilitation as an addition to routine low back pain care.
- Because session time and frequency were equal in both arms, the added benefit is more likely related to programme content than to dose.

4.2 Strengths and Limitations

Strengths include a clearly defined diagnosis, equal group sizes, matched treatment dose and the use of two standard, validated outcome measures. Limitations should be noted. The study was single-centre with a modest sample and a two-week intervention with no follow-up, so durability and recurrence could not be assessed. Allocation concealment, assessor blinding, adherence monitoring and adverse events were not documented, raising the possibility of performance and detection bias, and both outcomes are self-reported. The comparison was made on post-intervention scores rather than with baseline-adjusted models, no objective measures (such as electromyography) were collected, and the study has no no-treatment control group. Future trials should be pre-registered, use concealed allocation and blinded assessors, adjust for baseline values and include follow-up of at least three to six months.

5. Conclusion

In adults with mechanical low back pain, two weeks of Pilates-based exercise and of conventional physiotherapy both reduced pain and disability, with greater short-term improvement in the Pilates group. Pilates-based exercise is a promising addition to physiotherapy practice; larger, assessor-blinded randomised trials with longer follow-up are needed to confirm these findings.

Declarations

Ethics Approval: Approved by Institutional Ethics Committee.

Informed Consent: Written informed consent was obtained from all participants.

Funding: Self-funded; no external funding.

Conflicts of Interest: None declared.

Author Contributions: Both authors contributed to the conception and design, conduct of the study, data analysis and interpretation, and drafting and revision of the manuscript, and approved the final version.

Data Availability: Data will be made available from the corresponding author on reasonable request.

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