RESEARCH PAPER

Effectiveness of Core Stabilization Exercises and Physiotherapy Health Education on Pain, Functional Disability, and Quality of Life in Pregnancy-Related Low Back Pain: A Randomized Controlled Trial

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Trial Registration

Clinical Trials Registry - India (CTRI), registration number CTRI/2025/04/104450, registered on 01 May 2025.

Abstract

Background: Pregnancy-related low back pain is a common musculoskeletal condition affecting more than half of pregnant women. Symptoms typically worsen during the second and third trimesters, resulting in significant functional limitations and reduced quality of life. Because pharmacological options are limited during pregnancy, safe conservative interventions to relieve pain and support maternal wellbeing are increasingly emphasized.

Objective: To evaluate the effectiveness of core stabilization exercises combined with physiotherapy health education on pain, functional disability, and quality of life in women with pregnancy-related low back pain.

Materials and Methods: A randomized controlled trial was conducted in 36 primigravid women with low back pain, allocated to an experimental group ($n = 18$) that received core stabilization exercises with physiotherapy health education, or a control group ($n = 18$) that received routine antenatal physiotherapy care, for 4 weeks. The primary outcome was pain intensity (Visual Analogue Scale, VAS). Secondary outcomes were functional disability (Oswestry Disability Index, ODI) and quality of life (WHOQOL-BREF), assessed at baseline and after 4 weeks.

Results: Repeated-measures ANOVA showed significantly greater reduction in pain (VAS, $p < 0.001$) and disability (ODI, $p < 0.001$) in the experimental group than in the control group. Quality of life improved significantly across all domains in the experimental group - physical ($p < 0.001$), psychological ($p < 0.001$), social ($p = 0.008$), environmental ($p < 0.001$), and general ($p < 0.001$) - with significant between-group effects ($p < 0.05$) for all domains.

Conclusion: Core stabilization exercises combined with physiotherapy health education were more effective than routine antenatal care in reducing pain and disability and in improving quality of life among primigravid women with low back pain, supporting their use as a non-pharmacological adjunct to antenatal care.

Keywords: pregnancy; low back pain; core stabilization exercises; physiotherapy health education; functional disability; quality of life.

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Introduction

According to European guidelines, pregnancy-related low back pain is characterized as recurrent or continuous pain lasting more than a week during pregnancy, located between the 12th rib and the gluteal fold.[1,2] It generally begins around the 18th week of pregnancy and is most intense between the 24th and 36th weeks.[3] This musculoskeletal condition is commonly described as axial or para-sagittal discomfort in the lower lumbar region and is thought to be multifactorial, involving mechanical, hormonal, circulatory, and psychosocial factors.[4] Biomechanically, as the abdomen and breasts enlarge, the centre of gravity shifts forward, altering posture and increasing stress on the lumbar lordosis and strain on the paraspinal muscles. The enlarging gravid uterus also compresses major blood vessels, reducing spinal blood flow, which may contribute to low back pain, particularly during the latter half of pregnancy. Hormonal changes - including water retention triggered by progesterone and increased ligament laxity due to relaxin from the corpus luteum - further reduce lumbar spine and hip joint stability, predisposing these structures to strain and discomfort.[5,6]

Global prevalence estimates range from 24% to 90%, partly because no universally recognized classification system exists for the condition. Prevalence is notably high in Northern Europe (61-84%), Australia (96%), North America (69%), and East Asia (75-77%). In contrast, pregnancy-related lumbopelvic pain remains a significant but underrecognized issue in India, often dismissed as a normal aspect of pregnancy; its reported prevalence is only 15.35%, compared with an average of 45% in European studies. Unlike in Western populations, posterior low back pain is the predominant clinical pattern reported in Puducherry, India, affecting 54.84% of pregnant women.[7,8] Relapse rates are high in subsequent pregnancies, and pain can persist to 1 year postpartum; approximately 20% of women remain symptomatic 3 years after delivery, and 16% still report pregnancy-related low back pain 6 years after childbirth, underscoring the need for effective treatment programs for this condition.[3]

Recognized risk factors for pregnancy-related low back pain include a history of joint hypermobility, higher body mass index, advanced maternal age, a history of back pain in a previous pregnancy, increased parity, low back pain during menstruation, and prior trauma to the back.[3,9] Typical symptoms include pain or discomfort located in the lumbar area above the sacrum, occasionally radiating into the leg, usually dull in character and worsening with forward bending; restricted lumbar mobility; and increased pain on palpation of the erector spinae muscles - a presentation broadly similar to low back pain in non-pregnant individuals.[3] Diagnosis relies primarily on the clinical history to distinguish lumbar pain from pelvic girdle pain, as few specific diagnostic tests are available,[4] although physical examination findings based on pain location and provocation tests can help differentiate the two.[3]

Several studies indicate that engaging in physical fitness activity before pregnancy can lower the likelihood of back pain in subsequent pregnancies, an effect comparable to that seen in the general population. In a study of 208 first-time mothers, early back-care advice during pregnancy was found to reduce the intensity of back pain experienced throughout gestation.[9] The pelvic floor muscles, diaphragm, transversus abdominis, and multifidus are key structures contributing to the mechanical stability of the spine.[10,12,13,14] Core stabilization exercises use a motor-learning approach that emphasizes simultaneous activation of the transversus abdominis and lumbar multifidus. These deep stabilizing muscles attach to the thoracolumbar fascia and increase intra-abdominal pressure, thereby stiffening the lumbar spine and providing segmental stability.[11] Health education and training programs have also been shown to reduce workplace absenteeism among women with back pain; back-care classes typically cover relevant anatomy, ergonomics, posture, pain-management techniques, and relaxation methods.[9,15,16]

Evidence suggests that combining exercise therapy with physiotherapy-based health education is more effective for treating low back and pelvic pain during pregnancy than either intervention alone.[17,18] Moderate- to low-quality evidence suggests that exercise, in general, improves functional disability and reduces sick leave more than usual prenatal care, but few studies have directly compared exercise combined with health education against exercise alone. Core stabilization exercises targeting the deep abdominal and pelvic floor muscles appear to be more effective in improving pain and disability than usual antenatal exercise programs. Given this evidence, it is important to examine the effects of core stabilization exercises combined with physiotherapy health education, relative to routine antenatal physiotherapy care, through a methodologically rigorous randomized controlled trial.

Materials and Methods

Study design and setting

This was a two-arm, parallel-group randomized controlled trial conducted in a hospital-based setting at the antenatal outpatient department (OPD) of the

Department of Obstetrics and Gynaecology, Indira Gandhi Medical College & Research Institute (IGMC & RI), Puducherry, India, over a period of one year.

Participants

The target population comprised primigravid women with low back pain. Participants were recruited from the antenatal OPD and were referred by an obstetrician/gynaecologist. Women willing to participate were screened for eligibility against the inclusion and exclusion criteria and were enrolled only after providing written informed consent.

Inclusion criteria

Pregnant women referred with a complaint of lumbar pain; age 20-40 years; lumbar pain persisting for more than 1 week; first pregnancy; low back pain score ≥ 3/10 on the VAS; access to a smartphone; gestational age 20-32 weeks; and willingness to participate.[8,10,16,19,20]

Exclusion criteria

History of miscarriage; high-risk pregnancy; neurological pathology; history of pelvic or spinal surgery; urinary tract infection; twin pregnancy; concurrent pharmacological treatment during pregnancy; low back pain predating pregnancy; antepartum haemorrhage; previous trauma to the lumbopelvic region; and contraindications to exercise during pregnancy.[8,10,19,21]

Sample size

Sample size was calculated using OpenEpi version 3, an open-source calculator (SS Mean). Based on a reference study,[10] a sample of 32 pregnant women with lumbar pain was estimated to provide 80% power to detect a between-group difference of 2.14 in VAS score at a significance level of 0.05. Allowing for an anticipated 10% dropout rate, a minimum of 36 pregnant women (18 per group) was required.

Randomization and allocation concealment

Eligible participants were allocated to the experimental or control group using computer-generated permuted block randomization (block size of 4), performed by an independent physiotherapist not otherwise involved in the trial. Allocation concealment was maintained using sequentially numbered, sealed, opaque envelopes.

Procedure

Thirty-six primigravid women with low back pain were enrolled from the antenatal OPD of the Department of Obstetrics and Gynaecology, IGMC & RI. The purpose and procedures of the study were explained to all participants using a participant information sheet, and written informed consent was obtained. Baseline assessment was performed by the principal investigator, after which participants were allocated to the control (Group A) or experimental (Group B) group by an independent physiotherapist using sequential sealed-envelope block randomization. Group A received conventional (routine antenatal physiotherapy) treatment, and Group B received the interventional treatment (core stabilization exercises plus physiotherapy health education), each on 3 alternate days per week for 4 weeks. Post-intervention assessment was performed at the end of the 4th week, and outcomes were compared between groups.

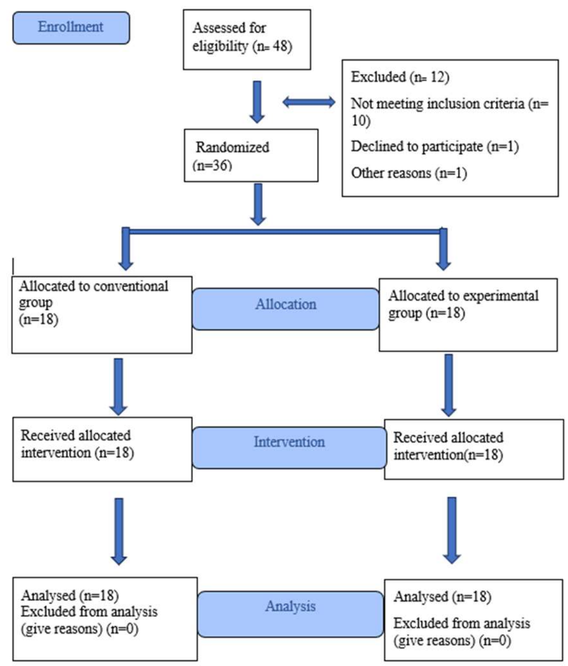

Figure 1. CONSORT flow diagram of participant recruitment, allocation, and follow-up.

Outcome measures

The primary outcome was the change in pain intensity, measured using the Visual Analogue Scale (VAS), from baseline to 4 weeks. Secondary outcomes were functional disability, measured using the 10-item Oswestry Disability Index (ODI), a validated patient-reported outcome measure, and quality of life, measured using the 26-item WHOQOL-BREF questionnaire. Additional materials used for assessment and treatment included a treatment couch, a drape sheet to ensure privacy, a stopwatch to time exercises, and a printed exercise diary for treatment follow-up.

Study treatment protocol

Table 1. Study protocol for the control group (Group A)

Intervention	Components	Duration
Routine antenatal physiotherapy care	Abdominal drawing-in manoeuvre; diaphragmatic breathing exercise;	10 minutes

	ankle dorsiflexion and plantarflexion; foot circling	

Table 2. Study protocol for the experimental group (Group B)

Component	Details	Duration
Core stabilization exercises - warm-up	General warm-up: walking; iliopsoas and paravertebral muscle stretches	5 minutes
Core stabilization exercises - main set	Diaphragmatic breathing exercise; co-contraction of transversus abdominis and lumbar multifidus; pelvic floor muscle activation; pelvic bridge with deep abdominal contraction; pelvic tilt; bird-dog exercise	30 minutes
Core stabilization exercises - cool-down	Breathing exercise; iliopsoas and paravertebral muscle stretches	5 minutes
Physiotherapy health education - back care	Standing posture; sitting posture; bending and lifting technique	10 minutes
Physiotherapy health education - relaxation positions	Side-lying with pillow support; sitting with forward lean; prone kneeling (child's pose) position	included above
Routine antenatal physiotherapy care	Abdominal drawing-in manoeuvre; breathing exercise; ankle dorsi- and plantarflexion; foot circling	10 minutes

Data collection procedure

All 36 primigravid women who met the eligibility criteria underwent a baseline antenatal low back pain physiotherapy assessment (VAS, ODI, WHOQOL-BREF) prior to randomization. The post-test assessment using the same measures was repeated after 4 weeks of physiotherapy management.

Table 3. Phases of treatment and assessment

Phase	Group A	Group B
Before intervention	Antenatal low back pain physiotherapy assessment, VAS, ODI, WHOQOL-BREF	Antenatal low back pain physiotherapy assessment, VAS, ODI, WHOQOL-BREF
After intervention (4 weeks)	VAS, ODI, WHOQOL-BREF	VAS, ODI, WHOQOL-BREF

Statistical analysis

Data were analysed using SPSS version 20 (IBM Corp.). Descriptive statistics (mean ± standard deviation) were used to summarize normally distributed data, with normality assessed using the Shapiro-Wilk test. Repeated-measures analysis of variance (ANOVA) was used to test for significant within-group (time), between-group, and time × group interaction effects, at a 95% confidence level with 80% study power.

Results

Results are presented in two sections. Section A describes the baseline demographic characteristics of the experimental and control groups. Section B presents the effect of core stabilization exercises and physiotherapy health education on pain, functional disability, and quality of life.

Section A: Baseline demographic characteristics

Table 4. Demographic characteristics of participants in the experimental and control groups

Variable	Experimental (n = 18)	Control (n = 18)	p value
Age (years), mean ± SD	26.5 ± 3.761	25.83 ± 3.240	0.573
BMI (kg/m²), mean ± SD	25.68 ± 3.83	26.79 ± 4.01	0.401
Gestational age (weeks), mean ± SD	27.44 ± 3.59	28.39 ± 3.01	0.398
Occupation - Employed, n (%)	4 (22.2)	5 (27.8)	1.000
Occupation - Unemployed, n (%)	14 (77.8)	13 (72.2)	
Education - Higher secondary, n (%)	5 (27.8)	3 (16.7)	0.691
Education - Graduate, n (%)	13 (72.2)	15 (83.3)	
Residence - Rural, n (%)	3 (16.7)	8 (44.4)	0.070
Residence - Urban, n (%)	15 (83.3)	10 (55.6)	

The mean age of participants was 26.5 ± 3.76 years in the experimental group and 25.83 ± 3.24 years in the control group. Mean BMI was 25.68 ± 3.83 kg/m² and 26.79 ± 4.01 kg/m², and mean gestational age was 27.44 ± 3.59 and 28.39 ± 3.01 weeks, respectively. No statistically significant between-group differences were observed for age, BMI, or gestational age ($p > 0.05$). Most participants in both groups were unemployed (77.8% vs. 72.2%, $p = 1.000$) and had graduate-level education (72.2% vs. 83.3%, $p = 0.691$). A higher proportion of the experimental group resided in urban areas compared with the control group (83.3% vs. 55.6%), although this difference did not reach statistical significance ($p = 0.070$). Overall, the two groups were comparable in sociodemographic characteristics at baseline, supporting adequate randomization.

<u>Section B: Effect of the intervention on pain, functional disability, and quality of life</u>

Comparison of Visual Analogue Scale (VAS) score between the intervention and control groups at baseline and at the end of the 4th week

Table 5. Descriptive statistics of the Visual Analogue Scale (VAS) score in the experimental and control groups

Visual Analogue Scale (VAS) score	**Group**	**N**	**Mean**	**SD**
Baseline	Experimental	18	5.28	1.127
	Control	18	5.17	1.383
End of 4th week	Experimental	18	2.56	1.199
	Control	18	5.06	2.127

Table 6. Test of within-subject effects for the Visual Analogue Scale (VAS) score

Source	**Type III SS**	**df**	**Mean Square**	**F**	**Sig.**
Time	36.125	1.000	36.125	83.586	<0.001
Time × Group	30.681	1.000	30.681	70.989	<0.001
Error	14.694	34.000	0.432		

The main effect of time was significant ($F = 83.586$, $p < 0.001$), indicating a significant reduction in VAS scores from baseline to the end of the 4th week. The time × group interaction was also significant ($F = 70.989$, $p < 0.001$), indicating that the pattern of change in VAS scores over time differed significantly between the intervention and control groups.

Table 7. Test of between-subject effects for the Visual Analogue Scale (VAS) score

Source	**Type III SS**	**df**	**Mean Square**	**F**	**Sig.**
Intercept	1467.014	1	1467.014	354.237	<0.001
Group	25.681	1	25.681	6.201	0.018
Error	140.806	34	4.141		

The main effect of group was significant ($F = 6.201$, $p = 0.018$), indicating that the intervention group had significantly lower average VAS scores than the control group across time points.

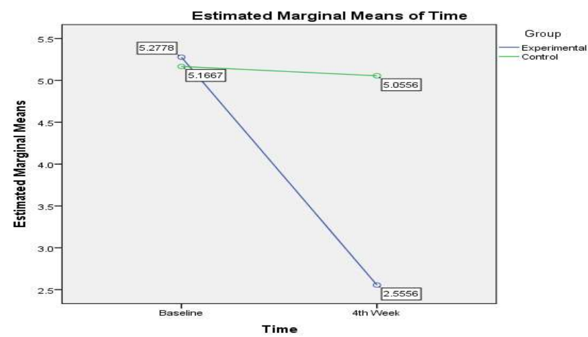

Figure 2. Estimated marginal means of VAS scores at baseline and at the end of the 4th week for the experimental and control groups.

Comparison of Oswestry Disability Index (ODI) score between the intervention and control groups at baseline and at the end of the 4th week

Table 8. Descriptive statistics of the Oswestry Disability Index (ODI) score in the experimental and control groups

Oswestry Disability Index (ODI) score	**Group**	**N**	**Mean**	**SD**
Baseline	Experimental	18	31.44	5.772
	Control	18	31.56	7.245
End of 4th week	Experimental	18	20.44	4.369
	Control	18	31.33	7.420

Table 9. Test of within-subject effects for the Oswestry Disability Index (ODI) score

Source	**Type III SS**	**df**	**Mean Square**	**F**	**Sig.**
Time	566.722	1.000	566.722	145.362	<0.001
Time × Group	522.722	1.000	522.722	134.076	<0.001

Error	132.556	34.000	3.899		

The main effect of time was significant (F = 145.362, p < 0.001), indicating a significant reduction in ODI scores from baseline to the 4th week. The time × group interaction was also significant (F = 134.076, p < 0.001), indicating that the pattern of change in ODI scores over time differed significantly between groups.

Table 10. Test of between-subject effects for the Oswestry Disability Index (ODI) score

Source	Type III SS	df	Mean Square	F	Sig.
Intercept	59282.722	1	59282.722	779.198	<0.001
Group	544.500	1	544.500	7.157	0.011
Error	2586.778	34	76.082		

The main effect of group was significant (F = 7.157, p = 0.011), indicating that the intervention group had significantly lower ODI scores than the control group when averaged across time points.

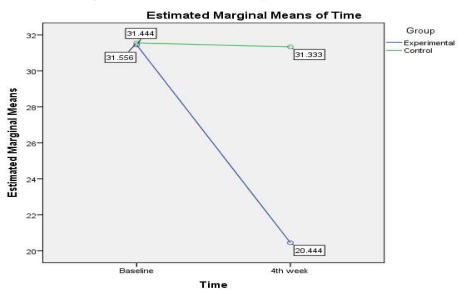

Figure 3. Estimated marginal means of ODI scores at baseline and at the end of the 4th week for the experimental and control groups.

Comparison of WHOQOL-BREF physical domain score between the intervention and control groups at baseline and at the end of the 4th week

Table 11. Descriptive statistics of the WHOQOL-BREF physical domain score in the experimental and control groups

WHOQOL-BREF physical domain score	Group	N	Mean	SD
Baseline	Experimental	18	49.89	11.034
	Control	18	48.39	12.486
End of 4th week	Experimental	18	65.11	7.775
	Control	18	48.72	15.316

Table 12. Test of within-subject effects for the WHOQOL-BREF physical domain score

Source	Type III SS	df	Mean Square	F	Sig.
Time	1088.889	1.000	1088.889	76.880	<0.001
Time × Group	997.556	1.000	997.556	70.432	<0.001
Error	481.556	34.000	14.163		

The main effect of time was significant (F = 76.880, p < 0.001), indicating a significant increase in physical domain scores from baseline to the 4th week. The time × group interaction was also significant (F = 70.432, p < 0.001), indicating that the change in physical domain scores over time differed significantly between groups.

Table 13. Test of between-subject effects for the WHOQOL-BREF physical domain score

Source	Type III SS	df	Mean Square	F	Sig.
Intercept	202460.056	1	202460.056	743.865	<0.001
Group	1440.056	1	1440.056	5.291	0.028
Error	9253.889	34	272.173		

The main effect of group was significant (F = 5.291, p = 0.028), indicating that the intervention group had significantly higher physical domain scores than the control group across time points.

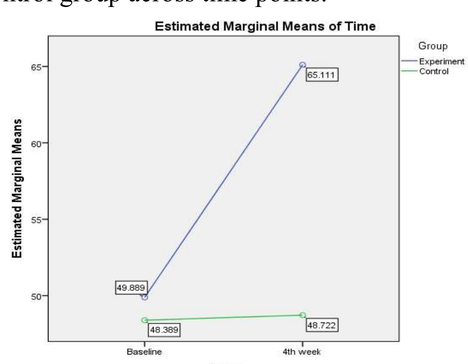

Figure 4. Estimated marginal means of WHOQOL-BREF physical domain scores at baseline and at the end of the 4th week for the experimental and control groups.

Comparison of WHOQOL-BREF psychological domain score between the intervention and control groups at baseline and at the end of the 4th week

Table 14. Descriptive statistics of the WHOQOL-BREF psychological domain score in the experimental and control groups

WHOQOL-BREF psychological domain score	Group	N	Mean	SD
Baseline	Experimental	18	59.44	6.336
	Control	18	57.11	11.077
End of 4th week	Experimental	18	68.28	5.529
	Control	18	57.06	14.367

Table 15. Test of within-subject effects for the WHOQOL-BREF psychological domain score

Source	Type III SS	df	Mean Square	F	Sig.
Time	346.722	1.000	346.722	27.953	<0.001
Time × Group	355.556	1.000	355.556	28.666	<0.001
Error	421.722	34.000	12.404		

The main effect of time was significant ($F = 27.953$, $p < 0.001$), indicating a significant increase in psychological domain scores from baseline to the 4th week. The time × group interaction was also significant ($F = 28.666$, $p < 0.001$), indicating that the change in psychological domain scores over time differed significantly between groups.

Table 16. Test of between-subject effects for the WHOQOL-BREF psychological domain score

Source	Type III SS	df	Mean Square	F	Sig.
Intercept	263296.056	1	263296.056	1404.233	<0.001
Group	826.889	1	826.889	4.410	0.043
Error	6375.056	34	187.502		

The main effect of group was significant ($F = 4.410$, $p = 0.043$), indicating that the intervention group had significantly higher psychological domain scores than the control group across time points.

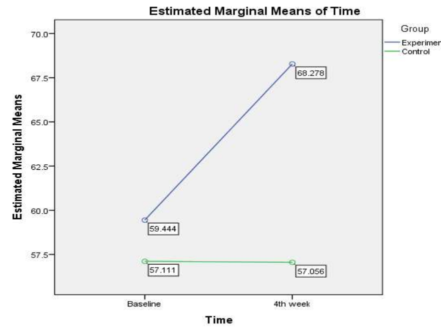

Figure 5. Estimated marginal means of WHOQOL-BREF psychological domain scores at baseline and at the end of the 4th week for the experimental and control groups.

Comparison of WHOQOL-BREF social domain score between the intervention and control groups at baseline and at the end of the 4th week

Table 17. Descriptive statistics of the WHOQOL-BREF social domain score in the experimental and control groups

WHOQOL-BREF social domain score	Group	N	Mean	SD
Baseline	Experimental	18	69.44	8.060
	Control	18	67.00	9.375
End of 4th week	Experimental	18	75.67	5.402
	Control	18	66.94	10.502

Table 18. Test of within-subject effects for the WHOQOL-BREF social domain score

Source	Type III SS	df	Mean Square	F	Sig.
Time	171.125	1.000	171.125	7.905	0.008
Time × Group	177.347	1.000	177.347	8.192	0.007
Error	736.028	34.000	21.648		

The main effect of time was significant ($F = 7.905$, $p = 0.008$), indicating a significant increase in social domain scores from baseline to the 4th week. The time × group interaction was also significant ($F = 8.192$, $p = 0.007$), indicating that the change in social domain scores over time differed significantly between groups.

Table 19. Test of between-subject effects for the WHOQOL-BREF social domain score

Source	Type III SS	df	Mean Square	F	Sig.
Intercept	350424.014	1	350424.014	2814.411	<0.001
Group	561.125	1	561.125	4.507	0.041
Error	4233.361	34	124.511		

The main effect of group was significant (F = 4.507, p = 0.041), indicating that the intervention group had significantly higher social domain scores than the control group across time points.

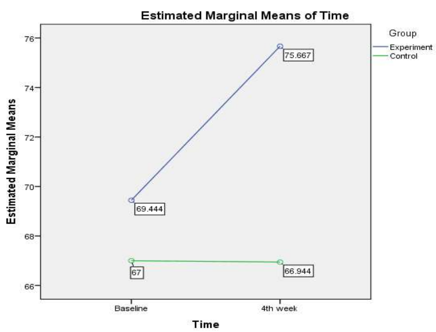

Figure 6. Estimated marginal means of WHOQOL-BREF social domain scores at baseline and at the end of the 4th week for the experimental and control groups.

Comparison of WHOQOL-BREF environment domain score between the intervention and control groups at baseline and at the end of the 4th week

Table 20. Descriptive statistics of the WHOQOL-BREF environment domain score in the experimental and control groups

WHOQOL-BREF environment domain score	Group	N	Mean	SD
Baseline	Experimental	18	69.28	6.772
	Control	18	66.44	6.905
End of 4th week	Experimental	18	75.06	6.292
	Control	18	66.72	8.137

Table 21. Test of within-subject effects for the WHOQOL-BREF environment domain score

Source	Type III SS	df	Mean Square	F	Sig.
Time	165.014	1.000	165.014	29.016	<0.001
Time × Group	136.125	1.000	136.125	23.936	<0.001
Error	193.361	34.000	5.687		

The main effect of time was significant (F = 29.016, p < 0.001), indicating a significant increase in environment domain scores from baseline to the 4th week. The time × group interaction was also significant (F = 23.936, p < 0.001), indicating that the change in environment domain scores over time differed significantly between groups.

Table 22. Test of between-subject effects for the WHOQOL-BREF environment domain score

Source	Type III SS	df	Mean Square	F	Sig.
Intercept	346528.125	1	346528.125	3687.335	<0.001
Group	561.125	1	561.125	5.971	0.020
Error	3195.250	34	93.978		

The main effect of group was significant (F = 5.971, p = 0.020), indicating that the intervention group had significantly higher environment domain scores than the control group across time points.

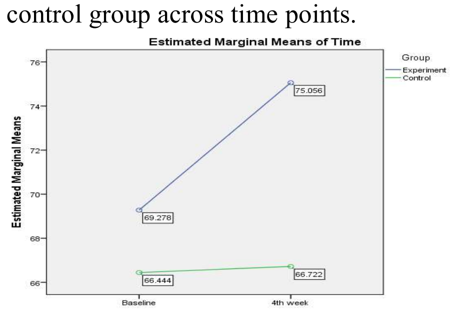

Figure 7. Estimated marginal means of WHOQOL-BREF environment domain scores at baseline and at the end of the 4th week for the experimental and control groups.

Comparison of WHOQOL-BREF general domain (overall QOL and health) score between the intervention and control groups at baseline and at the end of the 4th week

Table 23. Descriptive statistics of the WHOQOL-BREF general domain (overall QOL and health) score in the experimental and control groups

WHOQOL-BREF general domain (overall	Group	N	Mean	SD

QOL and health) score				
Baseline	Experimental	18	6.50	0.985
	Control	18	6.17	0.985
End of 4th week	Experimental	18	8.11	0.676
	Control	18	6.11	1.367

Table 24. Test of within-subject effects for the WHOQOL-BREF general domain (overall QOL and health) score

Source	Type III SS	df	Mean Square	F	Sig.
Time	10.889	1.000	10.889	29.357	<0.001
Time × Group	12.500	1.000	12.500	33.700	<0.001
Error	12.611	34.000	0.371		

The main effect of time was significant ($F = 29.357$, $p < 0.001$), indicating an overall increase in general domain scores from baseline to the 4th week. The time × group interaction was also significant ($F = 33.700$, $p < 0.001$), indicating that the pattern of change in general domain scores over time differed significantly between groups.

Table 25. Test of between-subject effects for the WHOQOL-BREF general domain (overall QOL and health) score

Source	Type III SS	df	Mean Square	F	Sig.
Intercept	3253.556	1	3253.556	1845.390	<0.001
Group	24.500	1	24.500	13.896	0.001
Error	59.944	34	1.763		

The main effect of group was significant ($F = 13.896$, $p = 0.001$), indicating that the intervention group had significantly higher general domain scores than the control group across time points.

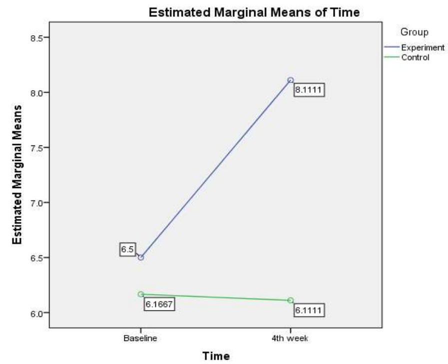

Figure 8. Estimated marginal means of WHOQOL-BREF general domain scores at baseline and at the end of the 4th week for the experimental and control groups.

Discussion

This randomized controlled trial evaluated the effect of core stabilization exercises combined with physiotherapy health education on pain, functional disability, and quality of life in primigravid women with pregnancy-related low back pain. The experimental and control groups were comparable at baseline for age, BMI, gestational age, occupation, education, and residence (all $p > 0.05$), indicating adequate randomization and supporting the internal validity of the between-group comparisons.

The intervention group showed a significantly greater reduction in pain intensity (VAS) after 4 weeks than the control group. This finding is consistent with previous work showing that core stabilization training activates deep trunk muscles - the transversus abdominis and multifidus - thereby enhancing spinal stability and reducing mechanical stress on lumbar structures.[22,23] Health education focused on posture correction, ergonomics, and activity modification has also been reported to reduce pain aggravation during daily activities in pregnant women.[24] These findings support a synergistic effect of combining therapeutic exercise with education for pain management in this population.

Functional disability, assessed using the ODI, also improved significantly more in the experimental group than in the control group, indicating better functional outcomes and reduced activity limitation with the intervention. Similar findings have been reported in earlier trials of stabilization and strengthening programs for pregnancy-related pelvic girdle and low back pain.[25,26] Because functional disability in pregnancy is often multifactorial - reflecting biomechanical, hormonal, and psychosocial influences a multimodal approach combining physical and educational components appears particularly beneficial.

Quality of life improved significantly across all WHOQOL-BREF domains - physical, psychological, social, environmental, and general - in the intervention group. Improvement in the physical domain is plausibly attributable to reduced pain and enhanced functional capacity, which in turn promote mobility and independence. Improved psychological scores may reflect the benefits of pain relief and greater self-efficacy in symptom management, consistent with prior evidence linking reduced pain to improved mood during pregnancy.[27] Improvements in the social and environmental domains suggest that better pain control and functional independence positively influenced interpersonal relationships and perceived support, consistent with evidence that untreated pregnancy-related pain can lead to social withdrawal and reduced participation in daily activities.[9] To our knowledge, relatively few trials have simultaneously examined all WHOQOL-BREF domains in this population, so this study adds further evidence of the broader benefits of physiotherapy-based intervention beyond pain and disability alone.

These findings are in line with international guidelines recommending exercise and education as first-line interventions for pregnancy-related low back pain.[28] Whereas some earlier trials evaluated exercise alone[23] or education alone,[24] the combined approach used here yielded greater and more consistent benefits across outcomes, supporting a biopsychosocial model in which addressing both physical impairment and psychosocial factors together produces superior results. These findings support incorporating structured core stabilization exercise and physiotherapy health education into routine antenatal care, with individualized exercise prescription and education on ergonomics, posture, and safe activity modification. Because low back pain in pregnancy is frequently undertreated, such non-pharmacological interventions offer a safe and effective option to improve maternal wellbeing and quality of life.

This study's strengths include its randomized controlled design and use of validated outcome measures (VAS, ODI, WHOQOL-BREF); notably, significant benefits were observed within a relatively short 4-week intervention period, suggesting that even short-term programs can be effective. Limitations include the modest sample size, short follow-up duration, and recruitment from a single centre, which may limit the generalizability of these findings.

Conclusion

Core stabilization exercises combined with physiotherapy health education reduced pain and functional disability and improved quality of life among primigravid women with pregnancy-related low back pain, relative to routine antenatal care. These findings support the use of this combined intervention as part of routine antenatal physiotherapy management of pregnancy-related low back pain.

Recommendation

Larger, multicentre randomized controlled trials with longer follow-up are recommended to confirm the long-term efficacy and sustainability of this intervention. Future studies should also examine the cost-effectiveness of physiotherapy interventions for pregnancy-related low back pain and identify barriers and facilitators to adherence among pregnant women, including cultural and psychosocial factors. Exploring partner or family involvement in health education may further enhance adherence and social support for pregnant women.

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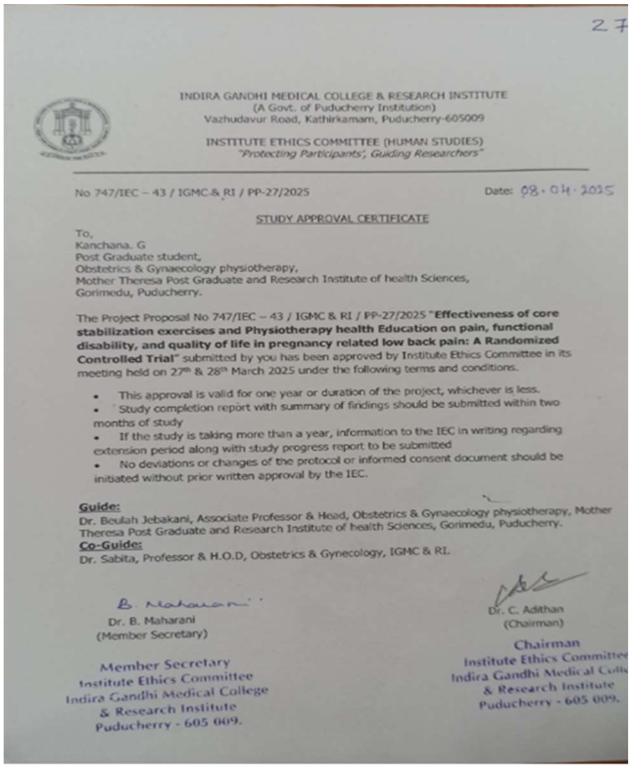
No external funding was received. The authors declare no conflicts of interest.

Ethical Approval

Ethical approval was obtained from the Institute Ethics Committee, Indira Gandhi Medical College & Research Institute, Puducherry, on 8 April 2025, prior to the commencement of the study (project proposal number 747/IEC-43/IGMC & RI/PP-22/2025). The trial was registered with the Clinical Trials Registry - India (CTRI/2025/04/104450). All participants were fully counselled about the study, and written informed consent was obtained from each participant. Participation was voluntary, and participants were informed that withdrawal at any time during the study would carry no negative consequences. Confidentiality was maintained throughout, and participants were informed of their individual results at the end of the study.



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INSTITUTE ETHICS COMMITTEE (HUMAN STUDIES)
"Protecting Participants', Guiding Researchers"

No 747/IEC – 43 / IGMC & RI / PP-27/2025 Date: 08.04.2025

STUDY APPROVAL CERTIFICATE

To,
Kanchana. G
Post Graduate student,
Obstetrics & Gynaecology physiotherapy,
Mother Theresa Post Graduate and Research Institute of health Sciences,
Gorimedu, Puducherry.

The Project Proposal No 747/IEC – 43 / IGMC & RI / PP-27/2025 "**Effectiveness of core stabilization exercises and Physiotherapy health Education on pain, functional disability, and quality of life in pregnancy related low back pain: A Randomized Controlled Trial**" submitted by you has been approved by Institute Ethics Committee in its meeting held on 27th & 28th March 2025 under the following terms and conditions.

- This approval is valid for one year or duration of the project, whichever is less.
- Study completion report with summary of findings should be submitted within two months of study
- If the study is taking more than a year, information to the IEC in writing regarding extension period along with study progress report to be submitted
- No deviations or changes of the protocol or informed consent document should be initiated without prior written approval by the IEC.

Guide:
Dr. Beulah Jebakani, Associate Professor & Head, Obstetrics & Gynaecology physiotherapy, Mother Theresa Post Graduate and Research Institute of health Sciences, Gorimedu, Puducherry.
Co-Guide:
Dr. Sabita, Professor & H.O.D, Obstetrics & Gynecology, IGMC & RI.

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Dr. C. Adithan
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Figure 9. Institute Ethics Committee approval / CTRI trial registration certificate.

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