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**COMPARISON OF THE EFFECTS OF DIAPHRAGMATIC BREATHING VERSUS
ABDOMINAL BRACING COMBINED WITH CORE STABILIZATION EXERCISES
ON PAIN AND FUNCTIONAL DISABILITY IN POSTPARTUM WOMEN WITH
LUMBOPELVIC PAIN**

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ABSTRACT

Background

Postpartum lumbopelvic pain is a prevalent musculoskeletal condition following pregnancy and childbirth, associated with hormonal changes, ligament laxity, weakened core musculature, and altered biomechanics. These factors contribute to reduced lumbopelvic stability and functional limitations. Core stabilization exercises are commonly used to restore spinal stability and alleviate pain. Breathing strategies, including diaphragmatic breathing and abdominal bracing, influence intra-abdominal pressure and deep core muscle activation, potentially enhancing rehabilitation outcomes.

Methodology

A randomized controlled trial was conducted on 24 postpartum women (6 weeks to 6 months) diagnosed with lumbopelvic pain. Participants were randomly allocated into two groups (n=12 each). Group A received diaphragmatic breathing combined with core stabilization exercises, while Group B performed abdominal bracing with core stabilization exercises. Interventions

were supervised, conducted 5 sessions per week for 4 weeks. Outcome measures included pain intensity assessed using the Visual Analog Scale (VAS) and functional disability using the Oswestry Disability Index (ODI). Pre- and post-intervention data were statistically analyzed.

Results

Both groups showed statistically significant improvements in VAS and ODI scores post-intervention ($p < 0.001$). However, between-group comparison indicated that Group B (abdominal bracing with core stabilization) achieved significantly greater reductions in pain and disability compared to Group A ($p < 0.05$).

Conclusion

Both interventions are effective in managing postpartum lumbopelvic pain. However, abdominal bracing combined with core stabilization demonstrates superior outcomes in reducing pain and functional disability. Integrating these strategies into postpartum rehabilitation may enhance recovery and improve quality of life.

Keywords: Breathing exercises, Lumbopelvic pain, Core stability exercises

INTRODUCTION

Lumbopelvic pain (LPP) is a common musculoskeletal condition affecting women during pregnancy and the postpartum period. It is characterized by pain localized to the lumbar spine (low back pain, LBP), the pelvic girdle, or both regions. While symptoms typically resolve within three months postpartum in most cases, evidence suggests that approximately 2% to 75% of women may continue to experience persistent back pain for up to three years after childbirth, leading to functional disability and increased economic burden [1]. Epidemiological evidence suggests that approximately 50% of pregnant women experience some degree of lumbopelvic pain.

The etiology of pelvic girdle pain (PGP) is multifactorial, encompassing impaired

mechanical stability of the pelvis, reduced core muscle function, ligamentous laxity, and hormonal influences. Following childbirth, the decline in hormones such as relaxin and estrogen, along with altered tension in the pelvic floor and abdominal musculature, may further compromise pelvic stability and intensify pain. This pain can limit physical activity, leading to deconditioning of core muscles and the development of a self-perpetuating cycle. Evidence indicates that core musculature—particularly the transversus abdominis, multifidus, and pelvic floor muscles—plays a critical role in maintaining spinal and pelvic girdle stability. In the absence of sufficient stability, the sacroiliac joints and pubic symphysis are subjected to abnormal

mechanical stresses, resulting in pain and functional limitations [2].

Core stability training facilitates coordinated activation of the lumbar core musculature. Breathing training, a widely applied clinical rehabilitation approach, enhances pulmonary ventilation and helps to correct respiratory dysfunction [3].

The diaphragm contributes to lumbar spinal stability through coordinated co-contraction with the abdominal muscles and pelvic floor muscles (PFMs). During pregnancy, respiratory demand increases as both maternal and fetal needs must be met with a single ventilatory system. This heightened demand on the diaphragm's respiratory function may compromise its postural role, reducing the ability of respiratory muscles to maintain spinal stability. Breathing exercises promote effective muscle activation, thereby strengthening the core musculature—including the diaphragm, abdominal muscles, and PFMs—and enhancing spinal stabilisation through their coordinated co-contraction [4].

The intrinsic core musculature of the abdomen comprises the diaphragm superiorly, pelvic floor muscles inferiorly, multifidus posteriorly, and the transversus abdominis anteriorly. These structures function synergistically to regulate intra-abdominal pressure and ensure trunk stability. The diaphragm serves as the primary muscle of respiration; however,

during pregnancy, fetal expansion limits its excursion, leading to increased reliance on accessory respiratory muscles. This compensatory mechanism may reduce diaphragmatic efficiency and compromise overall core stability. Consequently, restoring core stability necessitates targeted strengthening of the diaphragm [5].

Abdominal bracing is a commonly used core stabilization technique that involves the co-contraction of trunk musculature to enhance spinal stability and improve load transfer across the lumbopelvic region. It is frequently incorporated into stabilization exercise programmes for individuals with lumbopelvic pain, as it promotes activation of both local and global stabilizing muscles. This coordinated muscle activity contributes to increased stiffness and support of the lumbar spine and sacroiliac joints, thereby reducing excessive movement and mechanical stress. In postpartum women, where pelvic instability and insufficient compression of the sacroiliac joints are prevalent, abdominal bracing plays a vital role in restoring functional stability and reducing pain [6].

Although both approaches aim to improve lumbopelvic stability, their mechanisms differ, and limited evidence exists comparing their relative effectiveness in postpartum LPP. Therefore, this study aims to compare the effects of diaphragmatic breathing versus abdominal bracing

combined with core stabilization exercises on pain and functional disability in postpartum women with lumbopelvic pain.

OBJECTIVES

- 1) To evaluate the effects of Diaphragmatic breathing combined with core stabilization exercises on pain using VAS (Visual analogue scale) in postpartum women with lumbopelvic pain.
- 2) To evaluate the effects of Diaphragmatic breathing combined with core stabilization exercises on functional disability using Oswestry disability index in postpartum women with lumbopelvic pain.
- 3) To evaluate the effects of Abdominal bracing combined with core stabilization exercises on pain using VAS (Visual analogue scale) in postpartum women with lumbopelvic pain.
- 4) To evaluate the effects of Abdominal bracing combined with core stabilization exercises on functional disability using Oswestry disability index in postpartum women with lumbopelvic pain.

METHODOLOGY

Study design: A randomized, comparative, open label clinical trial

Study type: Experimental study

Study setting: Hospitals, physiotherapy clinic

Sample size: 24 postpartum women

Study population: Females from age 20-40 years

Inclusion criteria:

- Age between 20-40 years
- Postpartum period: 6 weeks to 6 months
- Presence of lumbopelvic pain (VAS ≥ 3)
- Willingness to participate

Exclusion criteria:

- History of spinal surgery
- History of neurological, cardiovascular, respiratory, renal disease or rheumatoid arthritis
- Postpartum urinary dysfunctions
- Refusal to participate in the study

Each participant was informed about the study methodology and written consent form

was filled by all the participants and then detail assessment was taken using VAS for pain and Oswestry disability index for functional disability as outcome measures to assess

pain and functional disability before and after the intervention. 24 postpartum women were selected using random sampling method.

Intervention

Core stabilization exercise: The session included 5 minutes of stationary cycling warm up, 20 minutes of CSE involving 10-second holds, 10 repetitions, 3 to 4 seconds

of rest between each contraction, and doing 3 sets. The session was wound up with 5 minutes of cool-down by stationary cycling [10]. The exercise for core stabilization was incorporated into 6 stages:

- 1) In the supine position, the PBU was used to activate the transverse abdominis as the patient drew their navel in towards the spine, and pressure in the PBU rise from 40mmHg to 42 mmHg. Secondly, an abdominal draw-in maneuver was performed in a 4-point kneeling position. And lastly, in this stage, the arm lift maneuver was performed in a sitting position
- 2) The co-contraction of transverse abdominis and lumbar multifidus was achieved by alternating arm leg lift in crook lying position and posterior pelvic tilt.
- 3) Patients sat on a stable surface with feet on the ground and were asked to lift their heel from the ground, hip abduction as doing clamshell while sitting, and horizontal arm abduction while maintaining abdominal tuck-in throughout the exercise.
- 4) Patients were asked to do heel slide and clamshell in the supine position, hip abduction, and hip and knee flexion in the side-lying position while maintaining abdominal tuck-in throughout the exercise.

- 5) Patients sat on an unstable surface and maintained balance while moving the trunk from the hip joint forward and backward. They then rotated the lumbar spine to both sides and maintained the position to improve control over their movement while doing a diagonal pattern (chopping) on each side. Lastly, they lifted the knee while maintaining balance and abdominal tuck-in throughout the exercise.
- 6) Patients were asked to do bridging, leg cycling, and leg lift in a quadruped position.

Group A – Diaphragmatic breathing + core stabilization exercises

- Diaphragmatic Breathing Exercises:

- The DBE included 2 sets of 6 repetitions of diaphragmatic breathing in 4 unique positions. The inspiration was quiet and normal through the nose, and the abdomen rise with inspiration. Exhalations were done through the mouth, and while exhaling patients were instructed to lift the pelvic floor. The TrA, internal and external oblique, pelvic floor muscles, and diaphragm share the connection with thoraco-lumbar fascia. During exhalation, the diaphragm relaxes and returns to the normal position, and the

contraction of the abdomen favours this breathing mechanism. The lift had to be maintained by the patient in the exhalation phase. The breathing exercise sequence was as follows: (1) in the supine lying position, an upward stretch of the arm incorporated inhalation, maintaining the spine neutral and lifting the pelvis during exhalation; (2) in the long sitting position, lower limb was straightened, and arms extended in front of the chest; the spine elongated more vertically and lifted the pelvic floor during the exhalation phase of breathing; (3) in the kneeling position, exhalation was accompanied by lateral bending of the trunk while lifting the pelvic floor; and (4) in the kneeling position, one of the patient's arms was bent in front of the eyes, and the other was resting on the floor. The trunk was rotated to the right during the inhalation phase of breathing, keeping the body rotated and stretched while lifting the pelvic floor during exhalation [10].

Group B – Abdominal bracing + core stabilization [2]

1) Abdominal bracing exercise (co-contraction of trunk muscles)

Patient lies in supine crook lying (knees bent). Instruct to tighten the

abdominal muscles as if preparing for a hit, without drawing the stomach inward. Maintain normal breathing (no breath holding). Hold contraction for 5–10 seconds, relax, and repeat.

2) Side support exercise (Side plank variation):

Patient lies on one side with elbow under shoulder. Knees bent (beginner) or legs straight (advanced). Engage core using abdominal bracing. Lift hips off the ground to form a straight line from head to knees/feet. Hold position for 5–10 seconds, then lower slowly.

3) Quadruped exercise:

Patient assumes hands and knees position (neutral spine). Engage core using abdominal bracing. Extend opposite arm and leg. Hold for 5–10 seconds, then return and alternate sides.

Dosage: Women were instructed to perform the exercises once daily for 20 mins; till 4 weeks.

RESULTS

Table 1 shows that both Group A (diaphragmatic breathing + core stabilization) and Group B (abdominal bracing + core stabilization) had statistically significant improvements in pain (VAS) and functional disability (ODI) after intervention ($p < 0.001$). Group A showed a

reduction in VAS from 7.2 to 3.4 and ODI from 48.5 to 26.3, while Group B showed greater improvement with VAS reducing from 7.1 to 2.5 and ODI from 47.8 to 20.1.

Table 2 presents the comparison of post-intervention outcomes between Group A and Group B. The results show that Group B had lower mean VAS scores (2.5 ± 0.7) compared to Group A (3.4 ± 0.8), indicating better pain reduction. Similarly, Group B showed lower ODI scores (20.1 ± 4.2) compared to Group A (26.3 ± 4.8), reflecting greater improvement in functional ability.

Within-group analysis (Paired t-test):

* Both Group A and Group B showed highly significant improvement in:

* Pain (VAS)

* Functional disability (ODI)

* ($p < 0.001$)

Between-group analysis (Independent t-test):

* Group B demonstrated significantly greater improvement compared to Group A.

* ($p < 0.05$)

Table 1: Within- group comparison (VAS and ODI)

Outcome	Group	Pre (Mean $\pm$ SD)	Post (Mean $\pm$ SD)	Mean difference	p- value
VAS	Group – A	7.2 $\pm$ 1.0	3.4 $\pm$ 0.8	3.8	<0.001
VAS	Group – B	7.1 $\pm$ 1.1	2.5 $\pm$ 0.7	4.6	<0.001
ODI	Group – A	48.5 $\pm$ 5.2	26.3 $\pm$ 4.8	22.2	<0.001
ODI	Group – B	47.8 $\pm$ 5.5	20.1 $\pm$ 4.2	27.7	<0.001

Table 2: Post intervention comparison

Outcome	Group A (Mean $\pm$ SD)	Group B (Mean $\pm$ SD)
VAS	3.4 $\pm$ 0.8	2.5 $\pm$ 0.7
ODI	26.3 $\pm$ 4.8	20.1 $\pm$ 4.2

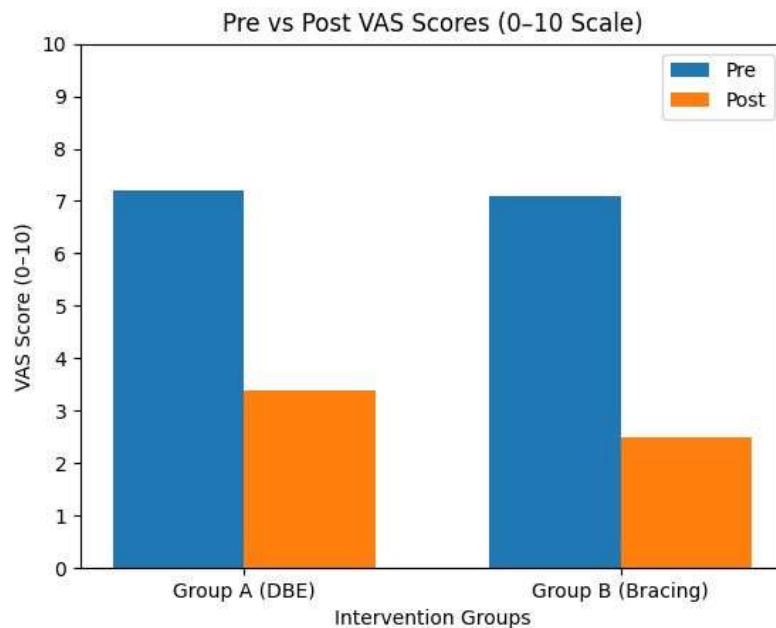


Figure 1

DISCUSSION

The present study aimed to compare the effects of diaphragmatic breathing combined with core stabilization exercises versus abdominal bracing combined with core stabilization exercises on pain and functional disability in postpartum women with lumbopelvic pain. The findings demonstrated that both intervention groups showed statistically significant improvements in pain (VAS) and functional disability (ODI), indicating that core stabilization combined with breathing strategies is effective in managing postpartum lumbopelvic pain.

The improvement observed in both groups can be attributed to enhanced activation and coordination of the deep core musculature, including the transversus abdominis, multifidus, diaphragm, and pelvic floor muscles. Core stabilization exercises are known to improve neuromuscular control, spinal stability, and load transfer across the lumbopelvic region, thereby reducing pain and improving functional capacity. Additionally, breathing techniques play a crucial role in regulating intra-abdominal pressure, which contributes to spinal stability [10].

However, the results of this study revealed that the group performing abdominal bracing combined with core stabilization exercises showed significantly greater improvements compared to the

diaphragmatic breathing group. This may be due to the mechanism of abdominal bracing, which involves co-contraction of the global and local trunk muscles, resulting in increased spinal stiffness and enhanced stability. This increased stability likely reduces excessive movement and mechanical stress on the lumbopelvic structures, thereby leading to greater pain reduction and improved function [2].

In contrast, diaphragmatic breathing primarily facilitates activation of the diaphragm and promotes coordination with the pelvic floor and abdominal muscles. While this approach enhances motor control and supports gradual stabilization, it may not provide the same level of immediate mechanical stability as abdominal bracing. This could explain the comparatively lesser improvement observed in Group A.

These findings are consistent with previous literature suggesting that abdominal bracing is more effective in increasing trunk stability and spinal stiffness, whereas diaphragmatic breathing is more beneficial for improving muscle coordination and endurance. The superiority of abdominal bracing in this study highlights its importance in early rehabilitation phases where enhanced stability is required to reduce pain and disability.

CONCLUSION

This study concludes that both diaphragmatic breathing and abdominal

bracing, when combined with core stabilization exercises, are effective interventions for reducing pain and functional disability in postpartum women with lumbopelvic pain. However, abdominal bracing combined with core stabilization exercises was found to be more effective than diaphragmatic breathing in improving outcomes.

Therefore, abdominal bracing can be considered a superior and more efficient technique for enhancing lumbopelvic stability and reducing pain in postpartum rehabilitation. Incorporating abdominal bracing into physiotherapy programs may lead to faster recovery and improved functional performance in postpartum women.

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