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# Stabilization Exercises Combined with Pelvic Floor Exercises for Pregnancy Related Low Back Pain: A Randomized Clinical Trial

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**Abstract:**

**Purpose:** To determine the effect of stabilization exercises combined with pelvic floor exercises on PRLBP.

**Methods:** Forty-eight pregnant women diagnosed with low back pain (LBP) were recruited from the gynecology and obstetrics outpatient clinic at EL-Kasr El-Ainy Hospital and are in the 2nd trimester and were assigned randomly into two equal groups. Group A (control group) received stabilization exercises only triweekly for 8 weeks. Group B (study group) received stabilization and pelvic floor exercises triweekly for 8 weeks. Assessment of both groups before and after the 8-week treatment program involved measuring pain intensity by the visual analogue scale (VAS), evaluating lumbar flexion range of motion (ROM) by the modified Schober's test (MST), and evaluating functional disability by the Arabic version of Oswestry Disability Index (ODI).

**Results:** Both groups, A and B, demonstrated significant within-group improvements in all outcome measures post-treatment ($p<0.05$). Between-group comparisons post-treatment showed no significant differences in VAS score or ODI disability scores ($p>0.05$). However, group B exhibited significantly greater improvement in lumbar flexion ROM compared to group A post-treatment ($p<0.05$).

**Conclusion:** Adding pelvic floor exercises to stabilization exercises has a positive effect in the treatment of LBP during pregnancy and is more effective in increasing lumbar ROM than stabilization exercises alone.

**Key words:** Pregnancy related low back pain, Pelvic floor exercise, Stabilization exercise.

## 1.Introduction:

Pregnancy-related low back pain (PRLBP) presents as localized lumbar pain extending from the 12th rib down to the crease of the buttocks. This common musculoskeletal complication of pregnancy is estimated to affect between 30% to 78% of individuals in the United States, European nations, and some African regions (1).

Low back pain (LBP) can emerge at any stage throughout pregnancy, from the first to the third trimesters, with individuals in pregnancy stages, specifically the trimesters two and three, being at a greater risk of developing LBP compared to those in the first trimester (2). The causes of LBP are complex and often attributed to a combination of biomechanical, hormonal, and vascular changes (3).

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Biomechanically, the center of gravity shifts forward as the abdomen and breasts enlarge, leading to postural alterations like decreased arch in the feet, knee hyperextension, and forward pelvic tilting. These alterations in posture place extra stress on the lumbar spine and surrounding musculature. Compression of the major blood vessels by the expanding uterus also restricts spinal blood flow, potentially inducing LBP, especially during later pregnancy (4). Increased body weight, postural alterations, and hormonal fluctuations during the antenatal period may provoke musculoskeletal system problems. Specifically, the hormone relaxin, which is produced by the placenta mainly in the later stages of pregnancy, softens the pelvic and spinal supporting ligaments, triggering LBP in pregnant women (5).

Physiotherapy has a main contribution in treating LBP, encompassing both passive approaches like manual therapy and active strategies like therapeutic exercises. Additional therapeutic options involve acupuncture, aquatic therapy, ergonomic recommendations, and using a pelvic belt. Engaging in exercise can lower pain severity, enhance functionality, and decrease disability (6).

In pregnant women with LBP, it is common to note reduced endurance of the trunk muscles and reduced strength in the hip extensor muscles (7). So, an association exists between trunk muscle dysfunction and LBP during and after pregnancy. Specific exercises for motor control and stability exercises have been recommended for LBP during antenatal and postnatal periods (8).

Stabilization exercises enhance paraspinal and abdominal muscle strength, improving lumbopelvic stability. Specifically, transverse abdominis muscle contraction stabilizes the lumbar spine, overcoming sacroiliac joint laxity and facilitating LBP rehabilitation. Research indicates that exercising during pregnancy can alleviate pelvic and back pain (9). Stabilization exercises primarily target the trunk muscles, with the goal of restoring the function of deep intrinsic muscles in the lumbar and pelvic regions. This facilitates the coordination of actions of both deep and superficial trunk muscles during everyday tasks in those suffering from LBP. Therefore, stabilization exercises become a key strategy in LBP management to promote spinal muscle contraction and coordination (10).

Pelvic floor exercises are essential for stabilizing the lumbar region by ensuring correct muscle activation (11). The pelvic floor muscles (PFMs) form the base of the abdomen-pelvic cavity and regulate intra-abdominal pressure during daily activities. Pelvic floor contraction prompts reactionary abdominal muscle contraction . This synergistic activation allows the abdominal musculature and pelvic floor to activate each other during both “hollowing” and “bracing” maneuvers. Thus, pelvic floor exercises contribute significantly to lumbar stabilization (10).

The integration of stabilization exercises and PFM training may confer unique advantages for managing PRLBP. Stabilization exercises target local stabilizing muscles, enhancing motor control and lumbopelvic stability (11). Simultaneously, PFM exercises facilitate abdominal muscle activation through synergistic co-contraction mechanisms, providing additional spinal and pelvic stabilization (10). This combination is likely to lead to enhanced overall lumbopelvic stability and may also maximize self-efficacy and exercise adherence through varied training. Hence, this study aimed to determine the effect of stabilization exercises combined with pelvic floor exercises on PRLBP, addressing the lack of prior research on this topic during pregnancy and potentially introducing a new method for managing PRLBP.

## *2.Patients and Methods:*

*2.1. Study participants and recruitment criteria:*

Forty-eight pregnant women, diagnosed by their physician as having LBP, were recruited from the gynecology and obstetrics outpatient clinic at EL-Kasr El-Ainy Hospital, Giza, Egypt. The participants’ ages ranged from 25 to 35 years and were in the 2$^{nd}$ trimester (20-23 weeks gestation). The pain started during pregnancy (pain level on VAS $\geq$ 3), their body mass index (BMI) was below 30 kg/m$^2$, with a history of 2 to 3 deliveries, and did not receive any treatment for her PRLBP. The criteria for exclusion included individuals with prior lumbar disc prolapse, spondylosis, pelvic spine surgery history, structural anomalies, urinary tract infections, twin pregnancies, pre-existing health issues before pregnancy (like cardiovascular diseases, diabetes, hypertension, asthma, bronchitis, human immunodeficiency virus), current pregnancy-related health issues (gestational diabetes or hypertension, and preeclampsia), exercise contraindications (persistent bleeding, premature labor, cervical insufficiency, acute fever, and restricted fetal growth), or a planned elective C-section due to conditions like placenta previa or cephalopelvic disproportion.

*2.2. Study Design:*

A pre–post-test randomized control design. The study was conducted between January 2023 and May 2023. The study received ethical approval from the Ethical committee at the Faculty of Physical Therapy in December 2022, Cairo University prior to starting [NO: P.T.REC/012/004252]. It was registered at ClinicalTrials.gov [NCT06120959]. The study followed the principles outlined in the Declaration of Helsinki for conducting human research. Each participant provided informed consent after receiving a thorough explanation of the study's nature, objectives, and potential benefits. They were also informed that they could decline participation or withdraw at any point, with an assurance of the utmost confidentiality regarding their provided information.

2.3. Methods:

*Stabilization exercises*

Each woman in both groups (A & B) performed stabilization exercises, 30 minutes/session, 3 sessions/week/ 8 weeks. They included pelvic bridging, curl up, modified side plank, bird dog, seated marching twist, and quadruped pelvic tilts. Pelvic bridging was performed from supine with knees bent by raising the pelvis and holding for 5 seconds, 5 repetitions initially, progressing to 10-second holds and 10 repetitions. Curl-ups were done seated with knees bent, hands clasped behind the head, and torso curled toward knees for 5 repetitions initially, building up to 10 repetitions (12).

Modified side planks (activating quadratus lumborum and obliques) were performed in side-lying with knees bent/straight by rising horizontally on one elbow and one knee/leg, holding for 3 seconds and repeating 3 times initially, building to 6-second holds and 10 repetitions (13). The bird dog exercise (activating back extensors - longissimus, iliocostalis, multifidus) was done in quadruped with head neutral and elbows locked straight. Participants were asked to statically contract their abdominal muscles, lifted one leg/arm simultaneously, held for 5 seconds and 5 repetitions initially, advancing to 10-second holds and 10 repetitions (13). Seated marching twists involved sitting tall with hands behind the head, lifting one knee high, twisting the torso, and touching the opposite elbow to the lifted knee, holding for 3 seconds before switching sides (14). Quadruped pelvic tilts were performed in a quadruped position with a flat back. Participants then posteriorly tilted the pelvis by contracting the abdominals and rounding the low back (14).

*Pelvic floor exercises*

Women in group B (study group) received pelvic floor exercises daily, 3 days/week, for 8 weeks. Before commencing the exercises, each woman was directed to empty her bladder and then assume a crock lying position with the hips slightly apart. Participants performed a maximum of 10-second pelvic floor muscle contractions, repeating 15 times with 10-second rest, for 3 sets totalling 15 minutes. This was performed once per session with supervision and twice daily at home for 45 minutes total daily training. Abdominal, thigh, and gluteal muscles remained relaxed to isolate the pelvic floor (15).

2.4.Outcome measures:

The primary outcome for all patients was the Arabic version of the visual analogue scale (VAS) for determining the degree of pain. The secondary outcomes of the study were the Modified Schober Test (MST) for assessing the ROM of lumbar flexion and the Arabic version of the ODI for assessing the disability level after 8 weeks of the treatment program.

Primary Outcome Measure:

*Pain intensity*

The VAS was used to assess the LBP intensity level for each woman in both groups A and B before and after the treatment program (8 weeks). The VAS is recognized for its simplicity, speed of use, and its validity and reliability as a tool for pain rating. It consists of a 10 cm line with descriptors at each end, ranging from "none" to "severe". Participants indicate their pain level by marking the point on the line that best represents their experience. The score ranges between 0 and 10, where 0 is equivalent to "no pain" and 10 is equivalent to "the most severe pain possible" (16).

Secondary Outcome Measure:

*Range of motion for lumbar flexion*

To assess the lumbar flexion ROM, the MST was employed. The evaluator identified the lower edges of the posterior superior iliac spines (PSISs) using their thumbs and then drew a horizontal line intersecting the PSISs at their midpoint. Another line was then drawn superior to the central point of the initial horizontal line by 15 cm. The distance between these two lines was measured in both standing and maximum forward flexion positions, until the onset of pain, to quantify lumbar flexion ROM (17).

*Functional disability*

The Oswestry Disability Index (ODI) Arabic version was used to assess functional disability. It is a condition-specific self-reported questionnaire used to assess the functional disability level in patients with LBP. It contains 10 sections covering common everyday tasks (Pain intensity, Personal care, Lifting, Walking, Sitting, Standing, Sleeping, Sexual life, social life, and traveling). Each section has 6 statements that describe the degree of disability for that activity ranging from 0 to 5. In this scale, 0 denotes "no disability," while 5 signifies "maximum disability". Patients selected the one statement in each section that best represents their current condition. If more than one statement is selected, the statement with the highest score is recorded. For unanswered questions, the total maximum possible score is adjusted by subtracting 5 points for each unanswered section. The scores from all 10 sections were accumulated and this total was then divided by the adjusted maximum possible score and converted to a percent to represent the patient's overall disability level. The final ODI scores vary between 0% (absence of disability) and 100% (completely disabled because of LBP) (18).

## 3.DATA ANALYSIS:

***Calculation of sample size:***

The calculation of the sample size was based on the pain measurements using the VAS, as documented in the study by Mirmolaei et al. (19). This calculation aimed for a 90% statistical power at an alpha level of 0.05, with two measurements for two groups and an effect size of 0.51, employing the F-test for MANOVA to examine both within and between group interaction effects. The calculation indicated a minimum requirement of 43 participants. To account for a potential dropout rate of 10%, an additional 5 subjects were included, bringing the total required sample size to 48 participants, approximately 24 per group. This sample size estimation was performed using the G*Power software (version 3.0.10).

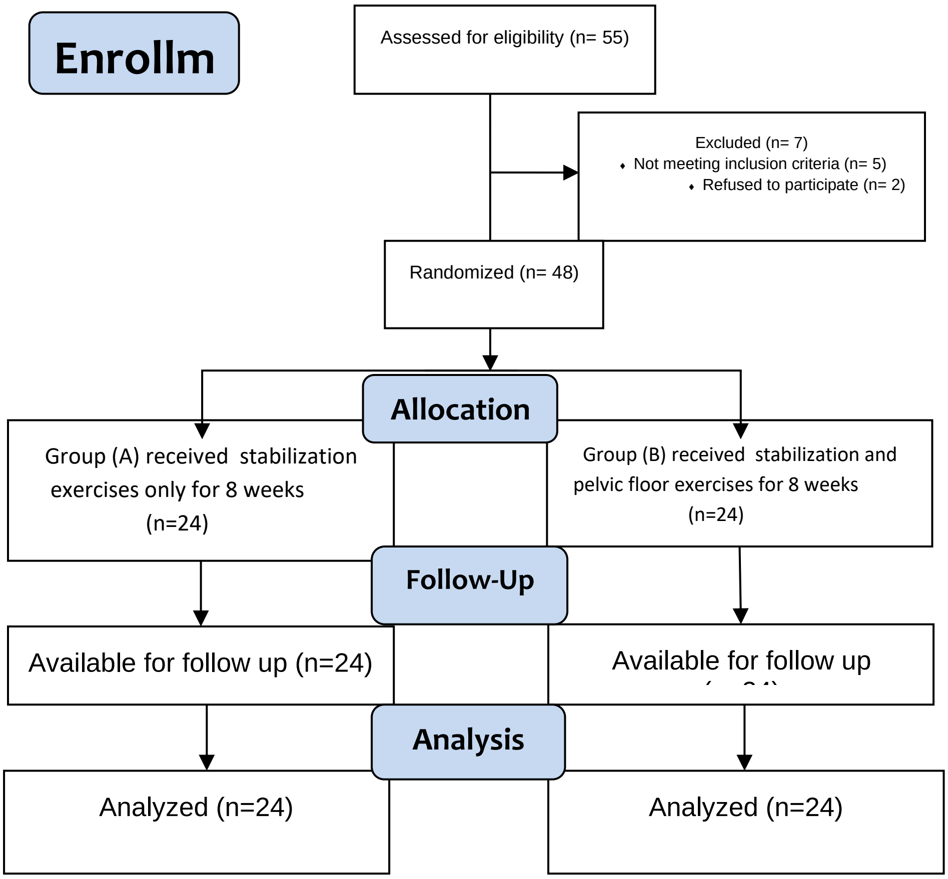


**Figure (1): Study flow chart.**

**Statistical Analysis**:

The study incorporated two independent variables. The first independent variable was the tested group (a between-subjects factor), comprising two groups; group (A): received stabilization exercises only, and group (B): received stabilization exercises plus pelvic floor exercises. The other independent variable related to the timing of assessments (a within-subjects factor), featuring two phases; pre-test and post-test. There were three measured dependent variables; pain intensity measured by VAS, lumbar spine flexion ROM measured by modified Schober test, and physical disability assessed by ODI. Therefore, two way (2×2) mixed design Multivariate Analysis of Variance (MANOVA) was conducted to test the effect of adding pelvic floor exercises to the stabilization exercises on the three measured dependent variables. The results were compared before and after treatment programs at each tested group and between the two tested groups in each testing time. The alpha level of significance was set at 0.05. All statistical tests were carried out using Statistical package for social sciences (SPSS), version 20.

## 4. Results:

*Subjects' characteristics*

At pre-treatment assessment, there were no statistically significant differences in age, weight, height, BMI, gestational age, parity, and all outcome measures between the two tested groups, indicating homogeneity between groups ($p>0.05$) (**Tables 1-2**) Within group comparisons revealed statistically significant reductions in VAS and ODI measures, as well as a statistically significant increase in modified Schober test (MST) following treatment compared to pre-treatment value ($p<0.05$) (**Table 2**). Post-treatment, VAS and ODI changes did not differ significantly between groups ($p>0.05$). However, group A exhibited significantly greater improvement in lumbar flexion ROM compared to group B ($p<0.05$) (**Table 2**).

## 5. Discussion:

Pregnancy can impair local stabilizing and pelvic floor muscles, disrupting lumbopelvic stability (11). LBP is common during pregnancy and tends to worsen over time, which severely impacts daily activities (11, 20). Thus, there is a need for effective interventions to treat LBP during pregnancy. This study therefore aimed to determine the effect of combining stabilization exercises with pelvic floor exercises on PRLBP.

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The study's outcomes revealed statistically significant reductions in pain and disability scores within both Group A and Group B. Nevertheless, post-treatment comparisons between the two groups showed no significant differences in pain or disability scores. These results emphasize the beneficial impact of stabilization exercises, whether performed alone or combined with pelvic floor exercises, in lowering pain and disability among pregnant women diagnosed with LBP.

These findings align with Ge et al. (21), who revealed that 4-week core stability training reduced pain and disability in older women suffering from LBP. Additionally, our findings run in the same line with Frizziero et al. (22), who concluded that core stability exercises could offer therapeutic benefits to individuals with non-specific chronic LBP by minimizing pain intensity and disability, as well as enhancing life quality. The proposed mechanism is that stabilization exercises are effective in restoring normal muscle function, which in turn increases spinal stability, enhances neuromuscular coordination in the lumbopelvic area, promotes intersegmental stiffness, and prevents the risk of shear forces that could potentially harm the lumbar spine (22, 23).

The non-significant impact of integrating pelvic floor exercises with stabilization exercises on pain and disability can be supported by Mohseni-Bandpei et al. (24), who found that integrating standard physical therapy with PFM exercises did not outperform standard therapy by itself in treating chronic nonspecific LBP. Conversely, Abdel-Aziem et al. (10) reported that adding stabilization exercises and physical therapy approaches with PFM exercises led to a more pronounced decrease in pain severity and an improvement in functional impairment. The discrepancy between studies may be attributed to the difference in the sample population, as well as exercise intensity and repetition.

In terms of lumbar flexion ROM, the study demonstrated significant within-group improvement in both groups. However, post-treatment comparison revealed a significantly greater increase in lumbar flexion ROM in the group receiving both stabilization and pelvic floor exercises (Group B) compared to the group solely undergoing stabilization exercises (Group A). This underlines the positive influence of adding pelvic floor exercises in augmenting the advantages of stabilization exercises, particularly in improving lumbar flexibility.

The beneficial impact of stabilization exercises in improving lumbar ROM can be reinforced by Cho et al. (25), who reported an increase in lumbar active ROM after a 4-week core exercise program. The core exercise program centers around transverse abdominis muscle contraction, which is believed to reinforce spinal musculature and boost lumbar stability through the maintenance of spinal balance. It is hypothesized that these core exercises can restore impaired muscle function in chronic LBP patients and enhance the capability to provide stability and regulation for the spinal and pelvic regions. This, in turn, is expected to alleviate mechanical irritation and pain, leading to a decrease in spasms within the lower back area. Similarly, Hicks et al. (26) found an increase in active ROM following a 4-week implementation of stabilization exercises in chronic LBP patients. The core program comprises hamstring stretching to enhance hamstring flexibility, the double knee-to-chest exercise, lying spinal twist to stretch muscles and soft tissues in the lumbar region, and the cobra pose to alleviate back tension and disk pressure.

The superior lumbar ROM improvements with added pelvic floor exercises can be attributed to the contribution of PFMs to spinal stability. The pelvic floor works synergistically with other muscles to stabilize the spine (27). This result can be attributed to transversus abdominis (TrA) is a basic muscle in the management of LBP, and it was noted that the rise in TrA activity during PFM activity was the highest among other abdominal muscles. In addition, activating the PFM can trigger abdominal muscle contractions, which in the end reflect on spinal stability and mobility (24). Previous research found that combining pelvic floor exercises with stabilization exercises was more effective for increasing trunk muscle endurance in women with chronic nonspecific LBP compared to stabilization exercises alone (10). Thus, the addition of pelvic floor exercises might provide further benefits by enhancing spinal stability and trunk muscle endurance.

**Table (1): Demographic data of the two groups in pregnant women with LBP**

| | Group (A) $\bar{X} \pm SD$ | Group (B) $\bar{X} \pm SD$ | p value |
|---|---|---|---|
| **Age (years)** | 28.79 ± 3.00 | 28.29 ± 3.38 | 0.591 |
| **Weight (kg)** | 67.50 ± 7.08 | 66.75 ± 4.36 | 0.661 |
| **Height (cm)** | 162.75 ± 3.86 | 161.92 ± 4.00 | 0.466 |

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| BMI (kg/m²) | 25.43 ± 1.79 | 25.44 ± 0.91 | 0.968 |
|---|---|---|---|
| Gestational age (weeks) | 21.83 ± 1.66 | 21.67 ± 1.58 | 0.723 |
| Parity | 2.08 ± 1.02 | 2.17 ± 1.17 | 0.793 |

**Table (2): Two-way mixed design MANOVA of outcome measures in both groups**

| | | Group (A) $\bar{X}$ ± SD | Group (B) $\bar{X}$ ± SD | p value |
|---|---|---|---|---|
| VAS | Pre test | 5.79 ± 1.69 | 5.54 ± 1.61 | 0.603 |
| | Post test | 2.67 ± 1.52 | 2.25 ± 1.48 | 0.342 |
| | **p value** | 0.0001* | 0.0001* | |
| MST (cm) | Pre test | 3.00 ± 1.25 | 3.43 ± 1.74 | 0.330 |
| | Post test | 4.75 ± 1.51 | 5.69 ± 1.63 | 0.043* |
| | **p value** | 0.0001* | 0.0001* | |
| ODI | Pre test | 51.50 ± 9.51 | 54.75 ± 10.40 | 0.264 |
| | Post test | 24.58 ± 7.28 | 24.92 ± 7.20 | 0.874 |
| | **p value** | 0.0001* | 0.0001* | |

**VAS = visual analogue scale; MST = modified Schober test; ODI = Oswestry Disability index; $\bar{X}$ = mean; SD = standard deviation; p = probability; * = significant with p<0.05.**

## Conclusion:

Stabilization exercises, with or without added pelvic floor exercises, significantly reduced pain intensity and disability in women with PRLBP. However, the combination of stabilization and pelvic floor exercises led to greater improvements in lumbar mobility. This indicates that coupling pelvic floor muscle training with stabilization exercises enhances treatment outcomes for PRLBP.

## Strengths and Limitations:

The present research demonstrates various valuable strengths. It represents the first controlled randomized clinical trial assessing the impacts of adding pelvic floor exercises with stabilization exercises on LBP during pregnancy. One strength is the study's insightful outcomes as reflecting the pain intensity, functional disability, and lumber ROM. Moreover, the authors carefully devised the research by predetermining the required participant sample size. This thoughtful methodology improves the reliability and validity of the study's results.

While exhibiting strengths, this study has some limitations. Participants were only followed for 8 weeks. Longer follow-up is required to ascertain if the effects are sustained over time. A more accurate understanding of adding pelvic floor exercises with stabilization exercises on PRLBP could be achieved through future clinical studies with increased sample size.

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## Conflict of interest:

No conflict of interest.

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