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Effect of Intraabdominal Hypopressive Exercises on Postnatal Backache and Functional Disability

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Abstract

Background and Objectives: Hypopressive exercises are safe and beneficial for postpartum women. This study aimed to evaluate the effectiveness of hypopressive exercises on back pain, lordosis, and functional limitation in postpartum women. *Materials and Methods:* A total of 40 postpartum women with abnormal hyperlordosis were randomly assigned into two equal groups. For eight weeks, the study group underwent hypopressive abdominal exercises three times a week in addition to receiving traditional treatment for lower back pain (LBP), whereas the control group only received the traditional treatment. Outcomes were measured using the Revised Short McGill Pain Questionnaire Version-2 (SF-MPQ-2), lumbar lordotic angle (LLA), and the Patient-Specific Functional Scale (PSFS). *Results:* Both groups showed significant post-treatment improvements ($P < 0.05$) in pain (SF-MPQ-2), lumbar lordosis (LLA), and functional status (PSFS). However, the study group achieved greater improvements in pain (53.82% vs. 32.58%), LLA (26.71% vs. 21.49%), and PSFS (88.35% vs. 79.13%). Between-group comparisons showed a significant post-treatment difference in pain reduction favoring the study group ($P = 0.001$), though differences in LLA ($P = 0.070$) and PSFS ($P = 0.386$) were not significant. *Conclusion:* Hypopressive exercises, when combined with traditional treatment, effectively reduce postpartum back pain and improve lumbar alignment and functional outcomes. These findings highlight the importance of incorporating hypopressive training into postpartum rehabilitation programs for women with abnormal hyperlordosis and back pain.

Keywords: Back Pain; Functional Disability; Hypopressive Exercise; Lordosis; Postpartum

1. Introduction

Lower back pain (LBP) affects more than half of postpartum women, with approximately one-third experiencing symptoms within three months after delivery **[1]**. Furthermore, 40% of these women report having moderate to severe disability associated with LBP **[2]**. Persistent LBP not only causes physical discomfort but also contributes to a lower quality of life, reduced physical fitness, and exercise avoidance **[3]**. It may hinder daily activities such as housework, hobbies, and employment responsibilities **[4]**.

Physical and psychological stressors during the postpartum period activate the hypothalamic-pituitary-adrenal axis, releasing cortisol to manage inflammation. Chronic LBP, if untreated, can disrupt cortisol regulation, leading to persistent inflammation and heightened pain [5]. Excessive pain during lactation may impair milk

transfer, while pharmacological treatments, such as sedative medications, can pose risks like respiratory depression in infants [6].

Postpartum musculoskeletal changes, including alterations in lumbar lordosis, are influenced by factors such as age, pregnancy, and obesity [7,8]. These changes can result in postural pain, radiculopathy, and facet joint discomfort [9]. Alterations in spinal curvature and pelvic alignment affect the sympathetic (T10-L2) and parasympathetic (S2-S4) nerve pathways, lowering the pain threshold. The physical demands of childbirth place significant strain on the hip joints, pelvis, and abdominal muscles, contributing to LBP and dysfunction in the sacroiliac and pelvic joints [10]. The pelvic floor's strength and stiffness are particularly affected by vaginal delivery, which makes the levator hiatus less able to tolerate elevated intra-abdominal pressure and may result in further disorders [11].

Several therapeutic interventions for postpartum LBP include physical therapy, nerve stimulation, stabilization belts, acupuncture, relaxation techniques, massage, yoga, weight management, and medications [12]. However, traditional therapies like medicine or surgery often come with side effects, including nausea, muscle spasms, and insomnia [13,14].

Exercise is a non-invasive, effective strategy to manage postpartum challenges. According to the American College of Obstetricians and Gynecologists [15], exercise can avoid postpartum depression, decrease stress , prevent postpartum depression, improve energy, strengthen abdominal muscles, and promote better sleep [15]. Among these exercises, the pelvic floor and diaphragm synergistically work with the transversus abdominis to regulate intra-abdominal pressure and maintain posture [16].

Hypopressive exercises (HE) are designed to reduce intra-abdominal pressure with increasing the basal tone of deep abdominal muscles and pelvic floor muscles without conscious activation [17]. These exercises trigger type I reflex activation in the pelvic floor and abdominal muscles, progressively activating the transversus abdominis. This activation stabilizes the spine, strengthens the abdominal girdle, and contracts bilaterally, generating fascial bands that contract like braces so enhances lumbar stiffness via fascial contractions [18,19]. This deep muscle helps to stability by modulating intra-abdominal pressure, transmitting force to the lumbar spine via the thoracolumbar fascia, and increasing lumbar spine stiffness [20].

Considering the challenges faced by postpartum women, this study aims to to assess the effectiveness of hypopressive exercises in combination with conventional treatments in decreasing postpartum low back pain, improve lumbar lordosis, and promoting functional outcomes in postpartum women having hyperlordosis. We hypothesize that incorporating hypopressive exercises into conventional postpartum treatments will result in substantially greater improvements in decreasing pain, lumbar lordosis correction, and functional outcomes than traditional treatments alone.

2. Materials and Methods

2.1. Study Design

This study, conducted from March to September 2023, was a randomized, single-blind, pretest-posttest controlled trial. The Ethical Committee of the Faculty of Physical Therapy at Kafrelsheikh University, Egypt, approved the study under protocol number (P.T/**WH** /2/2023/38). Additionally, the trial had a registration number of NCT06259474 in the Clinical Trial Registry. Written informed consent was given by each subject after discussing the study's benefits, goals, and strategies. They agreed to adhere to the two-month treatment plan (May and June 2023) but were allowed to leave the study at any moment whatever the reason.

2.2. Participants and Randomization

The preliminary sample consisted of 47 women referred from orthopedic clinics due to back pain. Participant screening was conducted at Shabas Emir Family Medicine Center (Kafr El Sheikh, Egypt), where the assistant therapist reviewed radiographs and medical data to ensure eligibility based on the study’s criteria. Six women declined to participate for personal reasons, and three were unable to complete the exercises. Ultimately, 34

participants (17 in each group) completed all study requirements, with two participants in each group lost to follow-up during the trial, figure 1 shows the flowchart of the participants.

The following were requirements for eligibility: a history of a healthy pregnancy, a normal vaginal delivery, LBP that persisted for 24 weeks after giving birth, and functional limitations in daily activities. Participants were to be females between the ages of 20 and 35, have a BMI of less than 25 kg/m2, and have had no more than two previous pregnancies. Participants with lumbar spine tumors, heart illness, hypertension, chronic pelvic pain, chronic uterine prolapse, lumbar spondylosis, or lumbar spondylolisthesis, as well as those receiving pharmacological or psychological treatment, were excluded.

Participants in the study groups completed the intervention under the supervision of a trained physiotherapist, attending sessions three times a week for eight weeks in a clinical setting. The duration of each traditional supervised session was forty minutes. Furthermore, HE was provided for study group participants, with an extra 20 to 30 minutes added for each HE session. On the other hand, the control group did not engage in any extra HE exercises and instead adhered solely to the traditional treatment protocol, which included 40-minute supervised sessions. Every participant was given instructions to fill out the Patient-Specific Functional Scale (PSFS) and the Revised Short McGill Pain Questionnaire (SF-MPQ-2). Each participant received an advice brochure and program manual to ensure consistency.

Randomization was conducted using a computer-generated randomization sequence to ensure unbiased group assignment. Allocation concealment was implemented with sealed, opaque envelopes to prevent selection bias. The randomization process was performed by an independent person.

To reduce bias, outcome assessors were blind to group allocation. Participants were blinded by being assigned unique codes that were unrelated to their treatment groups. During recruiting, subjects were evaluated for consistent habitual exercise habits and psychological stability to identify any confounding factors. Participants were unaware of the study's groups.

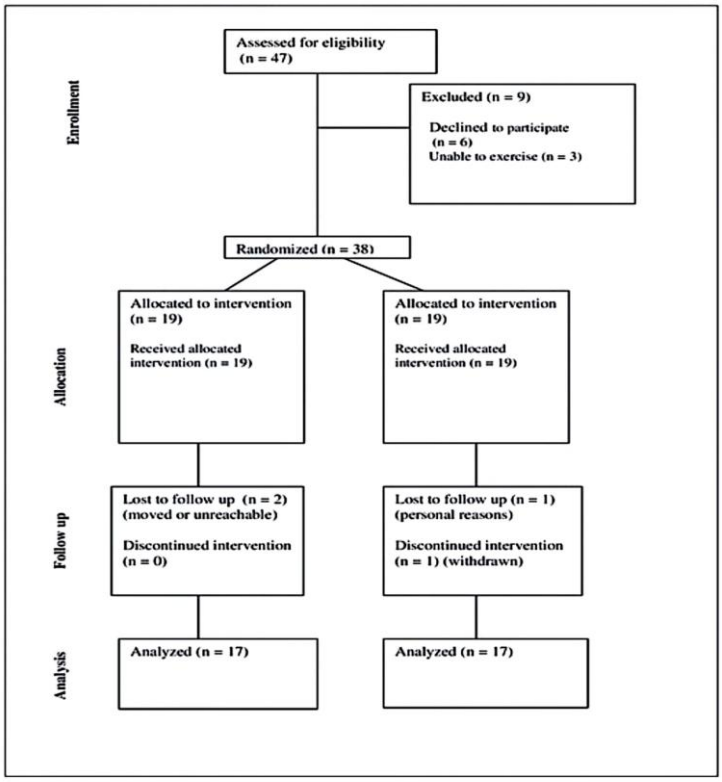

Figure 1. Flow chart of the study

2.3. Intervention Protocols

Study group received hypopressive exercises (HE) in addition to conventional treatments for low back pain, such as heat therapy, progressive strength training, and medication. HE involved three phases: a full exhale, a slow diaphragm-controlled inhale, and a diaphragm-controlled suction, which pulls the abdominal wall backward toward the lumbar spine. Participants were instructed to hold their breath with chest extension for 10 seconds before resuming normal breathing. They practiced various "hypopressive postures" (standing, kneeling, sitting, and lying down) and completed 5 to 10 HEs per session, avoiding breath-holding or pelvic floor muscle contractions during the exercises.

Traditional treatment included acetaminophen (0.5–1g three times daily) for pain relief [21], and heat therapy with a continuous heat wrap applied for 2 hours, 3 times per week at 40°C [22,23]. Progressive strength training began with dynamic exercises, starting with a warm-up of 10 light-resistance repetitions before each exercise. The intensity gradually increased every two weeks, starting from a 20 repetition-maximum (RM) and progressing to 10 RM (20 RM, 15 RM, 12 RM, and 10 RM). Elastic bands were introduced, when necessary, stretched to about 50% of their original length. Each exercise consisted of three sets, with both the eccentric and concentric phases performed at a pace of 1.5 seconds each. For isometric exercises, the base of support was progressively reduced to focus on activating the core muscles. Once the basic exercise was mastered, the number of repetitions gradually increased every two weeks to extend the time under tension. This progression went from 15 reps of 5 seconds (75 seconds total) to 30 reps of 5 seconds (150 seconds total). If pain prevented completing the set, participants returned to the basic version of the exercise. Control group received the same conventional treatment (progressive strength training, heat therapy, and medication) without the addition of hypopressive exercises.

2.4. Outcome Measures

Functional evaluations were conducted at two time points: baseline (pre-treatment) and after eight weeks (post-treatment). To prevent circadian effects, the assessments were planned during the same time of day for each participant. An independent physical therapist who was blind to the study's goals and group assignment administered the pain perception (SF-MPQ-2) and functional scale (PSFS) tests. The use of sealed codes for data labeling ensured this. To reduce the possibility of bias, the lead investigator provided the evaluator with training in standardized assessment procedures.

Assessment of Pain: The Revised Short McGill Pain Questionnaire (SF-MPQ-2) was used to assess pain levels in both groups before and after the study. The 22 descriptions on this questionnaire are assessed on a scale of 0 to 10, where 0 denotes no pain and 10 denotes the participant's most severe discomfort. Four subscales are included in the questionnaire: neuropathic pain, emotional pain, intermittent pain, and continuous pain. The seven-day recall interval on the SF-MPQ-2 gives individuals time to consider symptoms from the previous week. An overall score was created by adding the subscale results; higher scores denoted more severe pain [24,25].

Evaluation of Functional Disability: Self-reported data using the Patient-Specific Functional Scale (PSFS) in patients with musculoskeletal disorders were utilized to evaluate functional alterations. Using an 11-point rating scale, participants assessed the difficulty of five different activities. Additionally, after the intervention, they were permitted to recommend additional activities that established troublesome [26].

Evaluation of Lumbar Lordotic Angle: Using a flexible ruler, the lumbar lordotic angle was measured both before and after the study. The measurements were performed by the principal examiner, who made sure they were accurate by repeating each one three times. The examiner placed the participants in their natural anatomical stance and used the posterior superior iliac spine, which corresponds to the S2 vertebra, as a point of reference. The examiner positioned the flexible ruler between L1 and S2, found the spinous process of S2, and then applied pressure to the lower back to find the spinous process of L1 (figure 2). The skin-contacting side of

the ruler was used to delineate the lumbar curvature, and any gaps were manually rectified. Using the formula θ = 4 × arctan (2h / L), where "h" and "L" represent the vertical and horizontal distances, respectively **[27]**.

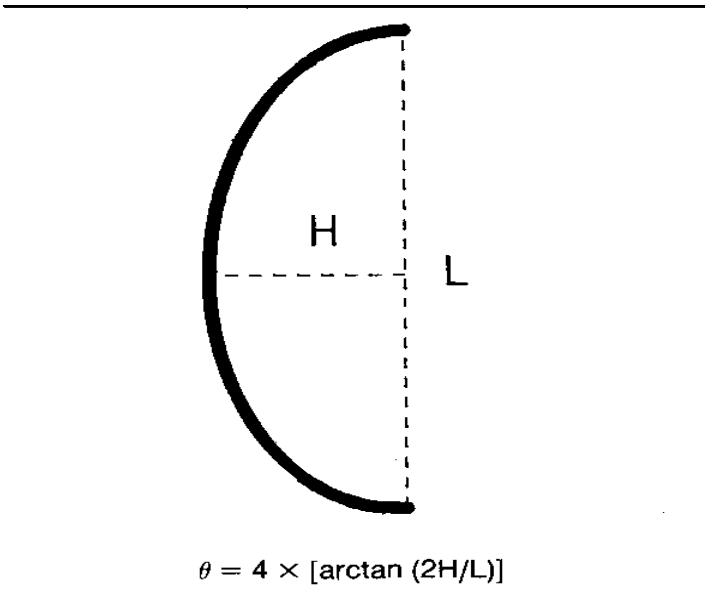

Figure 2: Curve that shows the tracing that was made with the flexible ruler. The formula below yields the index of lordosis (0), where L is the curve's length and H is its height [28].

2.5. Statistical Analysis

Statistical analyses were performed with SPSS version 25 (SPSS, Inc., Chica-go, IL) and significance set at $p < 0.05$. A mixed-design 2 × 2 MANOVA was used to investigate the effects of group (study vs. control) and time (pre-treatment vs. post-treatment) on SF-MPQ-2, LLA, and PSFS scores. The Shapiro-Wilk test proved data normality, while Levene's test confirmed variance homogeneity. Independent t-tests were used to compare demographic characteristics between groups. Post-hoc pairwise comparisons were adjusted using Bonferroni correction.

3. RESULTS

In the current study, a total of 34 patients were participated and distributed randomly into two groups (17 patients/group). The results of patient's clinical general demographic data (Table 1) showed that no significant differences (P>0.05) in mean values of patients age (P=0.742) and BMI (P=0.944) between group A and groupB.

Table 1. Patients clinical general characteristics in both groups

Items	Groups (Mean ±SD)		*P*-value
	Group A (n=17)	Group B (n=17)	
Age (year)	27.59 ±4.63	28.12 ±4.67	0.742
BMI (kg/m^2)	21.70 ±1.95	21.65 ±1.94	0.944

Data are reported as mean ±standard deviation and compared by t-independent test.

P-value: probability value NS: non-significant

A comparison of the patients' clinical and general demographic data revealed no significant differences ($P > 0.05$). The research and control groups had mean ages of 27.59 ± 4.63 and 28.12 ± 4.67, respectively (Table 2). The mean BMI values for the study and control groups were 21.70 ± 1.95% and 21.65 ± 1.94%, respectively

(Table 2). There were no significant differences between the study group and the control group in terms of mean age (P = 0.742) or BMI (P = 0.944). The McGill Pain Questionnaire, Lumbar Lordosis Curve, and Patient-Specific Functional Scale (PSFS) values were analyzed with Mixed MANOVA. Table 2 shows the outcomes for both the study and the control groups.

3.1. McGill Pain Questionnaire:

For the McGill Pain Questionnaire, the results showed no significant differ-ence between the study group and the control group at pre-treatment (F = 0.010, P = 0.420), as indicated by the nonsignificant group effect. However, significant changes were observed within both groups post-treatment. The study group expe-rienced a substantial reduction in pain (from 61.65 ± 9.70 to 28.47 ± 8.86), with a mean difference of 33.18 and a 53.82% improvement (F = 108.325, P = 0.0001), while the control group showed a similar decrease (from 59.06 ± 10.13 to 39.82 ± 8.36), with a 32.58% improvement (F = 36.414, P = 0.0001). The time effect was sig-nificant for both groups (P < 0.0001), indicating that treatment reduced pain in both groups significantly. Furthermore, the interaction effect was significant (F = 9.564, P = 0.003), suggesting that the change in McGill Pain Questionnaire scores differed between the groups. At post-treatment, the study group showed signifi-cantly lower scores compared to the control group (F = 12.685, P = 0.001).

3.2. Lumbar Lordosis Curve:

Regarding the lumbar lordosis curve, the time effect was significant (F = 123.165, P = 0.0001) for both groups, indicating a substantial decrease in lumbar lordosis post-treatment. In the study group, the lumbar lordosis decreased from 70.47 ± 4.04° to 51.65 ± 8.03°, reflecting a mean change of 18.82° (26.71% im-provement, F = 75.242, P = 0.0001). Similarly, in the control group, lumbar lordosis decreased from 70.88 ± 5.07° to 55.65 ± 7.30°, with a 15.23° change (21.49% im-provement, F = 49.290, P = 0.0001). The interaction effect for lumbar lordosis was not significant (F = 1.367, P = 0.247), suggesting that the treatment effect on lumbar lordosis did not differ significantly between the two groups. Additionally, no sig-nificant group effect was observed at pre-treatment (F = 2.067, P = 0.155) or post-treatment (F = 3.398, P = 0.070), indicating no significant difference between the study and control groups in their post-treatment lumbar lordosis measure-ments.

3.3. Patient Specific Functional Scale (PSFS):

The analysis of the PSFS revealed a significant increase in functional scores within both groups. The time effect was significant for both the study group (F = 95.784, P = 0.0001) and the control group (F = 45.695, P = 0.0001). In the study group, PSFS improved from 3.95 ± 1.01 to 7.44 ± 1.39, showing a change of 3.49 points (88.35% improvement). Similarly, in the control group, PSFS increased from 3.93 ± 1.40 to 7.04 ± 1.48, with a 79.13% improvement. The interaction effect was significant (F = 4.582, P = 0.036), indicating that the pattern of change in PSFS scores differed between the two groups. However, no significant group effect was observed at pre-treatment (F = 0.892, P = 0.156) or post-treatment (F = 0.761, P = 0.386), suggesting that the overall improvement in PSFS did not differ significantly between the two groups.

During the eight weeks of the intervention, neither the control group nor the hypopressive exercise (HE) group experienced any adverse effects or unexpected consequences. Participants were closely monitored throughout the study, and all reported good tolerance to the intervention protocols.

Table 2: Mixed MANOVA Results for McGill Pain Questionnaire, Lumbar Lordosis Curve, and Patient Specific Functional Scale

Variables	Groups (Mean ±SD)		Change	*P*-value
	Study group	Control group		
Self Specific McGill Pain Questionnaire SF-MPQ-2 (Mean ± SD)	61.65 ±9.70	59.06 ±10.13	2.59	0.420

Pre-treatment				
Post-treatment	28.47 ±8.86	39.82 ±8.36	11.35	0.001*
MD	33.18	19.24		
Improvement %	53.82%	32.58%		
P-value	0.0001*	0.0001*		
Lumbar Lordotic Angle				
LLA (Mean ± SD)	70.47 ±4.04	70.88 ±5.07	0.41	0.850
Pre-treatment				
Post-treatment	51.65 ±8.03	55.65 ±7.30	4.00	0.070
MD	18.82	15.23		
Improvement %	26.71%	21.49%		
P-value	0.0001*	0.0001*		
Patient specific Functional Scale				
PSFS (Mean ± SD)	3.95 ±1.01	3.93 ±1.40	0.02	0.156
Pre-treatment				
Post-treatment	7.44 ±1.39	7.04 ±1.48	0.40	0.386
MD	3.49	3.11		
Improvement %	88.35%	79.13%		
P-value	0.0001*	0.0001*		

LLA: Lumbar Lordosis Curve, PSFS: Patient Specific Functional Scale, SF-MPQ-2: McGill Pain Questionnaire, MD: Mean difference , P-value: probability value, * Significant (P<0.05).

4. Discussion

The impact of hypopressive exercises (HE) on low back pain (LBP), lumbar lordotic angle (LLA), and quality of life (QOL) in the postpartum period remains underexplored in the existing literature. This study represents the first to establish a causal relationship between postpartum functional impairment, HE, LLA, and LBP. The results indicate that the study group experienced significantly better outcomes compared to the control group. Specifically, improvements of 53.82%, 26.71%, and 88.35% were observed in the SF-MPQ-2, LLA, and PSFS, respectively, versus 32.58%, 21.49%, and 79.13% in the control group. The study group had better post-treatment outcomes, with lower SF-MPQ-2 and LLA scores and higher PSFS (28.47 ± 8.86, 51.65 ± 8.03, and 7.44 ± 1.39) compared to the control group (39.82 ± 8.36, 55.65 ± 7.30, and 7.04 ± 1.48).

The observed improvements in pain perception and functional outcomes are consistent with earlier studies that found hypopressive exercises lowered intra-abdominal pressure and improved core muscle function. The underlying mechanism is most likely greater stability and reduced inflammation as a result of increased deep muscle engagement and postural control [29].

These findings are consistent with earlier research that has demonstrated the benefits of an 8-week HE training strategy. Randomized controlled studies have shown that HE treatments reduce low back pain intensity and disability [30]. Furthermore, studies on female professional basketball players found that 8 weeks of HE improved posterior chain kinematics and reduced back pain [31].

It is thought that dysfunctions in external oblique, the rectus abdominis, internal oblique, and transversus abdominis muscles contribute considerably to low back pain while pregnancy and after birth. The abdominal

muscles provide a significant role in spinal stabilization [32]. The findings of this study indicate the efficacy of HE as a treatment technique for relieving low back pain, considering that lumbar spine instability is frequently the underlying cause of such dysfunctions. Exercises that improve spinal stability are thus beneficial [33,34].

One of the unique properties of HE is its capacity to lower intra-abdominal pressure (IAP) while training deep core muscle fibers, resulting in a synergistic contraction of the transversus abdominis, a muscle that regulates IAP [35]. The good results in this study regarding lumbar angle improvement may be due to the direct activation of the transverse abdominal muscle via HE, which strengthens the abdominal girdle and stabilizes the spine [36]. Caufriez and colleagues [37] also established that HE can improve body posture by strengthening the paravertebral muscle and enhancing trunk self-stretching. Furthermore, impairments in trunk flexor muscle function have been reported up to six months after childbirth [38].

The study's findings on lumbar angle improvement are consistent with prior work by Caufriez et al., who suggested that hypopressive postures and breathing techniques enhance synergistic activation of postural muscles, which can benefit the lumbar region [35]. Rydeard et al. [39] roposed that HE helps to rectify neuromuscular patterns, enhancing lumbopelvic stability by incorporating deep stability into global movement patterns. Hides et al. [40] reported that HE induces tight musculofascial bands during transversus abdominis contraction, improving lumbopelvic stability and reducing aberrant hyperlordosis.

While both the study and control groups demonstrated significant improvements in reduction of pain and functional outcomes, the HE group's additional improvements may be due to its unique mechanism of engaging deep core muscles and reducing intra-abdominal pressure. Unlike conventional treatments, which focus primarily on symptomatic relief through heat therapy and medication, HE addresses the underlying causes of postpartum LBP by improving core stability and lumbar alignment. This difference in approach most likely explains the higher improvements observed in the HE group [41,42].

The work of Caufriez [37] shows that HE provides comprehensive care for postpartum women by improving posture and dramatically lowering lumbar lor-dosis. Dossou et al. [43] demonstrated that hypopressive abdominal gymnastics is a helpful way to manage functional impairment in first-time mothers. Previous randomized controlled trial has also demonstrated that HE training methods can enhance postural control [44] and increase lumbar mobility [33] after only 8 weeks. This prior study's strengths include the adoption of a thorough low back pain treatment plan for the control group, a 2-month intervention period, a mod-erate sample size, and the use of reliable assessment methods that guaranteed strong follow-up and participant involvement.

This study's findings confirm earlier studies establishing the positive effects of exercise on postpartum women's health-related quality of life [15], as long as the exercise plan follows the American College of Obstetricians and Gynecologists standards [15]. It is therefore advantageous to prescribe hypopressive exercises for postpartum females without contraindications. According to American College of Obstetricians and Gynecologists (AP131), exercise can help postpartum mothers lose weight, sleep better, have more energy, strengthen their abdominal muscles, and have a lower risk of postpartum depression. These advantages not only re-lieve back pain and correct lumbar spine alignment, but they also significantly improve the overall health of new mothers.

While the findings indicate that hypopressive exercises (HE) helped to significantly improve low back pain (LBP), functional impairment, and lumbar lordosis, it is important to highlight that the HE group had a longer total exercise time due to additional sessions. This longer length may have altered the results, and the observed benefits cannot be attributed just to HE, but rather to the combined effect of extended exercise engagement and focused intervention. Further-more, this study focused on immediate results after an eight-week intervention, with the primary purpose of assessing the short-term efficacy of HE in postpartum women. Long-term follow-up data were not obtained due to logistical restrictions and participant availability, limiting the generalizability of the findings to sustained outcomes. Future research should integrate longer follow-up periods and investigate the durability of these positive benefits. Long-term follow-up data were not collected due to logistical constraints and participant availability, limiting the generalizability of the findings to sustained outcomes. Future research should in-corporate longer follow-up periods and evaluate the durability of these benefits.

Even when attempts are made to manage confounding variables, such as regular exercise habits and mental stability, complete elimination of residual con-founding remains impossible. The small sample size and brief intervention time limit this study's generalizability, the lack of negative events demonstrates the safety of HE, aligning with earlier research indicating its low risk of complications. These results point to the necessity for careful interpretation and additional research with larger, more diverse populations and extended follow-up periods to confirm HE's long-term effectiveness as a postpartum intervention.

5. Conclusion

In conclusion, this study found that hypopressive exercises (HE) effectively reduce low back pain (LBP), lumbar lordosis, and enhance functional outcomes in postpartum women. These findings add to the expanding body of evidence that HE is a useful adjunct to physiotherapy treatments for postpartum recovery, re-ducing LBP, and improving quality of life.

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