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EFFECTIVENESS OF POSTPARTUM EXERCISES ON REDUCING INTER-RECTI DISTANCE: A QUASI EXPERIMENTAL STUDY AMONG POSTPARTUM MOTHERS

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ABSTRACT

Diastasis rectus abdominis (DRA) is a common postpartum condition characterized by a widening of the inter-recti distance (IRD), which may lead to postural changes, lower back pain, and decreased quality of life. Postpartum exercise is a non-pharmacological intervention designed to strengthen abdominal muscles, improve core stability, and support the reduction of IRD. This study aims to analyze the effectiveness of postpartum exercises in reducing inter-recti distance and improving abdominal muscle recovery among postpartum women. A quasi-experimental pretest-posttest control group design was conducted involving 90 postpartum women who met the inclusion and exclusion criteria. Participants were assigned to treatment and control groups, with the intervention group receiving validated postpartum exercise videos performed routinely for six weeks. IRD was measured using a standardized palpation technique with proven validity and reliability. Additional instruments included observation sheets, muscle strength assessments, pain scales, and a postpartum quality-of-life questionnaire using the MPQOL-I (Maternal Postpartum Quality of Life Instrument). Data were analyzed using paired t-tests and independent t-tests with statistical significance set at $p < 0.05$. A significant reduction in IRD was observed in the treatment group compared with the control group ($p = 0.001$). The treatment group demonstrated greater improvement in abdominal muscle approximation, indicating a positive effect of postpartum exercises on abdominal wall recovery. Postpartum exercise is effective in reducing inter-recti distance and promoting abdominal muscle recovery in postpartum women. It is recommended as a simple, safe, and evidence-based intervention for postpartum care.

Keywords

Diastasis Rectus Abdominis, inter recti distance, postpartum mothers, postpartum exercises.

INTRODUCTION

The postpartum period is a crucial phase experienced by mothers after childbirth, when the body undergoes a complete recovery from various physiological, psychological, and anatomical changes that occur during pregnancy (Thabet & Alshehri, 2019). During this period, pregnancy hormone levels decrease, uterine involution occurs, and the musculoskeletal system adapts to restore the body's functions to their original state (Tadi, 2022).

One of the most common musculoskeletal changes during and after pregnancy is *diastasis rectus abdominis* (DRA), which is the separation of the rectus abdominis muscles along linea alba due to stretching of the abdominal wall to accommodate fetal growth (Benjamin et al., 2014). This condition is commonly found in the late trimester of pregnancy through the postpartum period and can persist for a long time if not properly addressed (Radhakrishnan & Ramamurthy, 2022).

The study by Aiolfi et al. (2021) reported that the prevalence of DRA in postpartum mothers reached more than 50%. DRA is characterized by a distance of more than 2 cm between the two sides of the rectus abdominis muscle, which can affect abdominal muscle function, posture, balance, and physical appearance (Du et al., 2025). This condition also affects daily activities, increases the risk of lower back pain, and reduces mothers' self-confidence (Skoura et al., 2024). It can also affect psychological well-being during early maternal role adaptation (Thabet & Alshehri, 2019).

Several factors influence the occurrence of DRA, including maternal age, parity, fetal weight, increased body mass index, and low levels of physical activity (Mota et al., 2015). Increased intra-abdominal pressure during pregnancy further stretches and weakens the linea alba, which frequently does not return to normal without structured exercise (Aiolfi et al., 2021).

A study by Rochmaedah (2021) stated postpartum exercise is widely recognized as an effective intervention to support maternal recovery. It promotes muscle and joint function, strengthens pelvic floor and abdominal muscles, enhances posture, and facilitates uterine involution (Shohaimi et al., 2023). Evidence further shows that core-stability and video-based postpartum exercise programs effectively reduce DRA and improve physical function (Laframboise et al.,2021).

However, the implementation of postpartum exercise programs in Indonesia remains suboptimal due to limited maternal knowledge, lack of guidance, and minimal emphasis on postpartum physical rehabilitation (Julianti & Astuti, 2022). Existing studies rarely use standardized and validated instructional videos, and most research evaluates outcomes separately, without assessing multiple domains such as IRD, muscle strength, mobility, pain, and quality of life within a single study. This creates a clear gap in comprehensive, evidence-based postpartum rehabilitation research in Indonesia.

This study offers novelty by combining validated postpartum exercise videos, standardized palpation measurements of IRD, and multi-domain outcome assessments within a quasi-experimental design. The study is also guided by Kolcaba's Comfort Theory, which emphasizes enhancing physical and psychological comfort to support postpartum recovery(Smith, 2019).

Therefore, this study aims to analyze the effectiveness of postpartum exercises in reducing inter-recti distance, improving abdominal muscle strength, enhancing physical mobility, reducing postpartum pain, and improving the quality of life among postpartum mothers.

METHOD

This study employed a quasi-experimental pretest–posttest control group design and was conducted in Tlogowungu District, Pati Regency, and Miri District, Sragen Regency, from July to September 2025. A total of 90 postpartum mothers were selected using purposive sampling based on the following inclusion criteria: postpartum period of 1–6 weeks, inter-recti distance (IRD) greater than 2.5 cm measured by palpation, absence of obstetric complications, good physical condition to perform exercises, and willingness to participate in the study. Participants were assigned to two groups consisting of 45 mothers in the intervention group and 45 mothers in the control group, with baseline characteristics assessed to ensure homogeneity. The independent variable

was postpartum exercise, while the dependent variables included IRD, abdominal muscle strength, physical mobility, postpartum pain, and postpartum quality of life. Potential confounders such as parity, mode of delivery, and physical activity level were controlled through inclusion criteria and baseline matching.

The intervention was delivered over six weeks, three times per week, with each session lasting 10–20 minutes. The postpartum exercise program comprised diaphragmatic breathing, pelvic tilts, glute bridges, heel slides, toe taps, abdominal drawing-in maneuver (ADIM), knee fallouts, head lift, and cat–cow movements. All exercises were provided through validated instructional videos accessible at the following link: https://youtu.be/XNoUX3wDiVg. Participant adherence was monitored through attendance checklists and weekly supervision by trained health workers.

The control group did not receive any structured postpartum exercise program and was not given access to the instructional exercise video. Instead, they continued receiving standard postpartum care routinely provided by local health centers, such as general health education and clinical monitoring. To maintain equal attention and minimize Hawthorne bias, the control group underwent evaluation visits with the same frequency as the intervention group. These evaluations included IRD measurement, abdominal muscle strength assessment using MMT, mobility assessment, postpartum pain measurement using the NRS, and completion of the MAPP-QoL questionnaire. All assessments in both groups were conducted by trained health personnel who were blinded to group allocation (single-blind) to ensure unbiased outcome measurement.

Diastasis rectus abdominis was measured using a standardized palpation technique at three anatomical points: 2 cm below the umbilicus, at the umbilicus, and 3 cm above the umbilicus. To ensure uniformity of technique across assessors, the measurement procedure was standardized using an instructional video accessible at: https://youtu.be/bPs9Uacw5QA.

The palpation technique has demonstrated high validity ($r = 0.75–0.98$) (Benjamin et al., 2014) and excellent reliability (ICC = 0.99–1.00; wK ≥ 0.7) (Mota et al., 2015) . Additional instruments included a functional mobility observation sheet, Manual Muscle Testing (MMT) for abdominal strength, the Numeric Rating Scale (NRS) for postpartum pain, and the Indonesian version of the Maternal Postpartum Quality of Life (MAPP-QoL) questionnaire, which has a Cronbach's Alpha ≥ 0.85.

Data analysis began with the Shapiro–Wilk test to determine normality. For normally distributed data, pre–post differences within each group were analyzed using the paired t-test, while comparisons between the intervention and control groups were performed using the independent t-test. For nonparametric data, the Wilcoxon Signed-Rank Test and Mann–Whitney U Test were applied as appropriate. A significance level of $p < 0.05$ was used for all statistical analyses.

Ethical approval for this study was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Muhammadiyah University of Surakarta (Approval No. 5787/B.1/KEPK-FKUMS/VIII/2025). All participants received detailed information regarding the study objectives, procedures, benefits, and potential risks, and each provided written informed consent. Participant confidentiality and anonymity were maintained throughout the research and publication process.

RESULTS

Table 1. Frequency Distribution of Respondent Characteristics Based on Age, Birth Weight, Education, Occupation, Number of Children, Type of Delivery, and Physical Activity During Pregnancy (n=90).

Characteristics	Category	Group			
		Treatment		control	
		f	%	f	%
Mother's age Postpartum	< 20	5	11.1	3	6.7
	20–25	11	24.4	9	20.0
	26–30	18	40.0	19	42.2
	31–35	8	17.8	9	20.0
	> 35	3	6.7	5	11.1
Birth Weight (grams)	< 2500 (BBLR)	4	8.9	3	6.7
	2500–3999 (Normal)	41	91.1	39	86.7
	≥ 4000 (Macrosomia)	0	0.0	3	6.6
Education	Elementary school	1	2.2	3	6.7
	Junior high school	12	26.7	12	26.7
	High school	26	57.8	26	57.8
	Bachelor's degree	6	13.3	4	8.9
Occupation	Housewife	34	75.6	35	77.8
	Entrepreneur	4	8.9	3	6.7
	Private sector	7	15.6	7	15.6
Number of children	1	14	31.1	24	53.3
	2	23	51.1	17	37.8
	3–4	8	17.8	4	8.9
Type of delivery	Normal	30	66.7	33	73.3
	Caesar	15	33.3	12	26.7
Physical activity during pregnancy	Light	38	84.4	39	86.7
	Moderate-heavy	7	15.6	6	13.3

Table 1 describes the baseline characteristics of the 90 postpartum mothers. The two groups were statistically comparable ($p > 0.05$ for all comparisons), indicating successful random allocation and minimizing baseline bias.

The age distribution was similar, with the largest proportion falling within 26–30 years (40.0% in the treatment group and 42.2% in the control group). Most newborns had normal birthweight (91.1% in the treatment group and 86.7% in the control group).

High school education was the most prevalent level (57.8% in both groups). The majority were housewives (75.6% vs 77.8%). Regarding parity, 51.1% of mothers in the treatment group had two children, while 53.3% of mothers in the control group had one child. Most respondents delivered vaginally (66.7% vs 73.3%) and engaged in

light physical activity during pregnancy (84.4% vs 86.7%).

Overall, chi-square tests confirmed no significant differences between groups across all baseline variables ($p > 0.05$), ensuring both groups were homogeneous before the intervention.

Table 2. Average Abdominal Rectus Diastasis (IRD) Measurements per Point Before and After Postnatal Exercise

IRD Measurement Points	Pretest	Posttest	Difference (cm)	t	p-value
	Mean ± SD	Mean ± SD			
Treatment					
Point A (3 cm Above the Umbilicus)	3.23 ± 0.28	1.87 ± 0.13	1.36	29.30	<0.001
Point B (at Umbilicus)	2.98 ± 0.24	1.81 ± 0.14	1.17	27.89	<0.001
Point P (2 cm Below the Umbilicus)	2.73 ± 0.37	1.70 ± 0.16	1.03	17.72	<0.001
Control					
Point A (3 cm Above the Umbilicus)	3.31 ± 0.28	2.76 ± 0.19	0.54	12.44	<0.001
Point B (at Umbilicus)	3.04 ± 0.24	2.57 ± 0.17	0.48	10.85	<0.001
Point P (2 cm Below the Umbilicus)	2.68 ± 0.36	2.48 ± 0.20	0.20	3.48	0.001

Based on Table 2, there was a significant reduction in inter-recti distance (IRD) at all measurement points among mothers in the intervention group after six weeks of postpartum exercise. IRD decreased by 1.36 cm above the umbilicus, 1.17 cm at the umbilicus, and 1.03 cm below the umbilicus (paired t-test, $p < 0.001$). These reductions represent strong clinical improvements with a large effect size. Meanwhile, the control group showed only minimal natural reductions (0.54 cm, 0.48 cm, and 0.20 cm). Independent t-tests confirmed that the magnitude of IRD reduction in the intervention group was significantly greater than in the control group ($p < 0.001$). These findings indicate that postpartum exercise accelerates recovery of abdominal muscle separation more effectively than spontaneous healing.

Table 3. Posttest Continuous Outcomes (Total IRD, Pain, and Quality of Life) with t-Test and Effect Size (Cohen's d)

Variables	Treatment	control	t/Z/-	p-value	Cohen's *d*
	Mean ± SD	Mean ± SD			
Total IRD	4.25 ± 0.20	6.16 ± 0.26	-39.49	<0.001	8.33

Variables	Treatment	control	t/Z/	p-value	Cohen's *d*
	Mean ± SD	Mean ± SD			
Size (cm)					
Postpartum Pain	3.13 ± 0.92	6.21 ± 1.07	-7.23	<0.001	3.08
Quality of Life	71.87 ± 2.22	66.80 ± 2.31	10.60	<0.001	2.24

Based on Table 3, the post-test analysis of continuous outcomes shows significant differences between the intervention and control groups across all variables. The mean total IRD in the intervention group was substantially lower than in the control group (4.25 ± 0.20 cm vs 6.16 ± 0.26 cm), with t = –39.49 and p < 0.001. The Cohen's d value of 8.33 indicates an extremely large effect size, demonstrating that postpartum exercise produced a highly meaningful reduction in IRD.

Regarding postpartum pain, the intervention group reported noticeably lower pain scores (3.13 ± 0.92) than the control group (6.21 ± 1.07). The difference was statistically significant (t = –7.23, p < 0.001), with Cohen's d = 3.08, showing that the intervention had a strong effect in reducing pain intensity.

In terms of quality of life (QoL), the intervention group achieved higher mean scores (71.87 ± 2.22) compared to the control group (66.80 ± 2.31). This difference was also significant (t = 10.60, p < 0.001), and the effect size was large (Cohen's d = 2.24), indicating that postpartum exercise contributed meaningfully to improving the overall quality of life among postpartum mothers.

Table 4. Post-test Comparison of Abdominal Muscle Strength and Physical Mobility Between Groups

Variables	Category	Treatment	control	χ^2	p-value
		n (%)	n (%)		
Abdominal Muscle Strength	Weak	1	14	35.27	<0.001
	Normal	14	27		
	Strong	30	4		
Physical Mobility	Difficult	0	0	4.46	<0.001
	Normal	16	26		
	Free movement	29	19		

Based on Table 4, there was a significant difference in abdominal muscle strength between the intervention and control groups. Most participants in the intervention group were categorized as strong (66.7%), whereas the control group was predominantly classified as normal or weak. The Chi-square test confirmed that the difference in distribution was highly significant ($\chi^2 = 35.27$, $p < 0.001$). These findings indicate that postpartum exercise effectively improved abdominal muscle strength.

For the variable of physical mobility, the distribution of categories did not differ significantly between the two groups. Although the intervention group showed a higher proportion of participants in the free movement category, the Chi-square test indicated no statistically significant difference ($\chi^2 = 4.46$, $p = 0.35$). This suggests that the postpartum exercise program in this study did not have a significant impact on physical mobility outcomes.

DISCUSSION

A. DRA Changes After Intervention

Based on the findings of this study, most postpartum mothers in both Tlogowungu (Pati) and Miri (Sragen) exhibited a widened diastasis recti abdominis (DRA) during the early postpartum period. At the pre-

intervention assessment, the majority of respondents demonstrated an inter-recti separation greater than 2,5 cm at all three measurement points, with the largest gap typically observed supra-umbilically (above the umbilicus). This pattern is consistent with the findings of Benjamin et al. (2014) who reported that the supra-umbilical region is the most vulnerable to widening due to increased intra-abdominal pressure during pregnancy.

After completing a six-week exercise program, the intervention group showed a significant reduction in DRA across all three measurement points, whereas the control group experienced only a slight decrease, likely attributable to natural postpartum healing. This outcome aligns with evidence from Aiolfi et al. (2021) and Thabet & Alshehri (2019), which indicates that active exercises involving tranversus abdominis and rectus abdominis activation accelerate linea alba closure through improved core stability and increased fascial tension.

B. Theoretical Framework (Kolcaba's Comfort Theory)

Kolcaba's Comfort Theory supports the findings of this study because the postpartum exercise program enhanced physical comfort through pain reduction, psychospiritual comfort by reducing anxiety and improving confidence, and functional comfort through improved mobility and strength. By fulfilling these dimensions, the intervention aligns with Comfort Theory and demonstrates that structured postpartum exercise can serve as an effective, holistic nursing intervention (Smith, 2019).

C. Abdominal Muscle Strength

Abdominal muscle strength improved significantly in the intervention group after six weeks, whereas the control group exhibited only minimal improvement. This enhancement resulted from targeted exercises such as the Abdominal Drawing-in Maneuver (ADIM), bridging, heel slides, and pelvic tilts that specifically activate the transversus abdominis and rectus abdominis. Yulianti et al. (2022) stated that repeated core activation over 4–6 weeks induces neuromuscular adaptation, leading to increased muscle strength.

Structural mechanisms also support this improvement. Skoura et al. (2024) reported that core-focused exercise enhances fascial tension and connective tissue remodelling, contributing directly to stronger abdominal wall support. Lee et al. (2023) further found that transversus abdominis activation increases abdominal muscle thickness and overall trunk stability, aligning with the strength improvements observed in this study.

D. Improvement in Physical Mobility

Physical mobility also improved markedly in the intervention group. Core and rhythmic movements enhance neuromuscular coordination, flexibility, and blood flow, resulting in reduced stiffness and better movement tolerance (Ma et al., 2023). These results are consistent with Prasetyaningati et al. (2024), , who reported improved functional mobility following structured postpartum exercise.

Physiologically, improved mobility may be attributed to increased blood circulation and oxygen delivery to the musculature, accelerating tissue repair and reducing stiffness (Purnami et al., 2021).

E. Postpartum Pain

The intervention group showed a more pronounced reduction in postpartum pain compared with the control group. Widyaningsih (2025) explained that postpartum exercises reduce muscle tension, improve circulation, and lower pain perception. Deep-breathing movements and controlled exercises stimulate the release of endorphins, natural analgesics that enhance comfort and mood.

Aisyah et al. (2025) also found that gentle postpartum exercise reduces perineal discomfort and improves sleep quality. Meanwhile, minimal activity in the control group contributed to slower pain reduction.

F. Quality of Life

After six weeks, the intervention group demonstrated significant improvements in quality of life, particularly in physical function, emotional well-being, and daily activity performance. These findings align with Rahayuningsih (2023), who highlighted that postpartum exercise enhances mood, reduces stress, and promotes physical fitness through increased endorphin and serotonin production. Wahdakirana (2021) also reported that postpartum exercise improves social functioning and maternal confidence.

In this study, the instructional videos and adherence monitoring encouraged consistent exercise among the intervention group, leading to greater improvements. Meanwhile, the control group experienced only limited gains attributable to natural recovery. Geographical access further influenced outcomes, with mothers in Miri benefiting more due to easier access to health services.

G. Influence of Cultural and Geographical Factors

Postpartum cultural practices strongly influenced DRA reduction, muscle strength, mobility, and participation in this study. Many mothers in Tlogowungu and Miri avoided physical activity due to persistent pain and cultural beliefs that "mothers must rest and avoid excessive movement" during the postpartum period. This decreased early motivation to exercise, especially in the control group, which did not receive education or instructional videos. This aligns with Belema et al. (2025), who showed that cultural fear of postpartum activity slows abdominal muscle recovery.

Geographical factors also shaped the outcomes. Miri District has easier access to health facilities compared with Tlogowungu, allowing more frequent contact with health workers and better understanding of the safety and benefits of postpartum exercise. This explains higher adherence in Miri's intervention participants.

H. Mechanisms Underlying the Improvements

Improvements across all outcome variables stem from interconnected physiological, neuromuscular, and psychosocial mechanisms. Core muscle activation increases linea alba tension and enhances abdominal wall support (Aiolfi et al., 2021). Rhythmic movements improve blood circulation, facilitating tissue regeneration and reducing stiffness. Exercise also modulates the autonomic nervous system by increasing parasympathetic activity, reducing muscle tension and pain.

Psychologically, endorphin release improves emotional stability and reduces anxiety. Cultural factors modulate these mechanisms: mothers with initial fear of movement gained confidence through video demonstrations, improving adherence and accelerating recovery. These combined pathways highlight postpartum exercise as a holistic intervention beneficial for both physical and psychological recovery.

I. Comparison With Existing Literature

These findings are consistent with earlier studies demonstrating that postpartum exercise reduces IRD (Rochmaedah et al., 2021), increases abdominal strength (Yulianti et al., 2022), reduces pain (Widyaningsih, 2025), and improves quality of life (Rahayuningsih, 2021). Minor improvements in the control group align with Anggraini (2021), who noted that natural physiological recovery continues during the postpartum period.

J. Clinical Implications

The results highlight the importance of integrating video-guided postpartum exercise programs into routine postpartum care. Such interventions are practical, low-cost, and can be delivered in both urban and rural settings. Nurses can incorporate these exercises into evidence-based postpartum care and provide follow-up support through community visits or digital platforms (Mhsc et al., 2023).

K. Limitations and Potential Measurement Bias

Despite positive outcomes, several limitations exist. Palpation, although validated, may introduce measurement bias compared with ultrasound (Mota et al., 2015). The absence of long-term follow-up limits conclusions regarding sustained benefits. Self-reported adherence may introduce reporting bias. Geographical differences in access to health services may influence motivation and baseline knowledge. Cultural beliefs discouraging movement may also influence participation, particularly in early postpartum weeks. Future studies should consider ultrasound measurements, objective adherence monitoring, and longitudinal design.

L. Overall Summary of Discussion

In summary, structured postpartum exercise supported by validated instructional videos effectively reduced DRA, increased strength, improved mobility, reduced pain, and enhanced quality of life. These improvements were achieved through combined physiological and psychological mechanisms. Despite some limitations, the findings strongly support the integration of postpartum exercise into routine postpartum care.

CONCLUSIONS

This study demonstrates that postpartum exercise is an effective and practical intervention to support maternal recovery in the early postpartum period. The six-week program significantly reduced diastasis recti abdominis, improved abdominal muscle strength and physical mobility, decreased postpartum pain, and enhanced quality of life compared with natural recovery. Although cultural beliefs and access to health services influenced adherence, video-guided instruction successfully increased maternal confidence and participation. Therefore, postpartum exercise should be integrated into routine postpartum care as a safe, accessible, and evidence-based approach to promote holistic maternal health.

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