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Research Article

Diastasis Recti in Postpartum Women: Association with Delivery Method and Health-Related Quality of Life

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Abstract

Diastasis Recti (DR), defined as the separation of the rectus abdominis muscles along the linea alba, is a common postpartum condition resulting from pregnancy-related musculoskeletal changes. Despite its high prevalence, the association between Mode of Delivery (MOD), DR severity, and postpartum Quality of Life (QoL) remains insufficiently explored. This cross-sectional study aimed to determine the frequency and characteristics of DR among postpartum women, compare its occurrence between normal vaginal delivery and Cesarean section (C-section), and evaluate associated QoL outcomes. A total of 344 primigravida postpartum women aged 20–40 years were recruited from PNS Shifa Hospital and Jinnah Postgraduate Medical Centre, Karachi. Participants were assessed at least six weeks postpartum and diagnosed with DR using the inch-tape method. Demographic and obstetric data were collected through a structured proforma, while health-related QoL was evaluated using the SF-36 questionnaire. Data were analyzed using SPSS version 23. Most participants were aged 26–30 years (46.8%), and 43.0% were overweight. DR was most commonly observed both above and below the umbilicus (68%). A highly significant association was found between MOD and DR location, with C-section participants demonstrating more extensive separation ($p < 0.001$). Body mass index showed a near-significant association with MOD ($p = 0.054$). Women who underwent C-sections reported significantly poorer QoL, including greater physical and emotional limitations, higher pain levels, and worse perceived health compared to the previous year. These findings suggest that C-section may be associated with more severe DR and reduced postpartum QoL, highlighting the importance of early screening and targeted physiotherapy interventions.

Keywords: Diastasis recti, Postpartum women, Mode of delivery.

1. Introduction

The human body demonstrates extraordinary adaptability, particularly during pregnancy, which represents a complex and dynamic physiological process unique to women. The female body is inherently structured to support fetal development and sustain childbirth, exhibiting a remarkable capacity for postpartum recovery (Ameer et al. 2023). Throughout pregnancy, women experience extensive physiological adaptations, including progressive weight gain, breast tissue enlargement, changes in skin pigmentation, alterations in posture and biomechanics, and significant hormonal fluctuations, all of which contribute to preparing the body for labor and delivery (Pascual and Langaker 2025, Kazma et al. 2020). Musculoskeletal adaptations are especially prominent during this period and are essential to accommodate the growing fetus. These changes include increased body mass, ligamentous and muscular laxity, peripheral edema, accentuated lumbar lordosis, and decreased elasticity of the abdominal musculature (Kepley et al. 2025, Yousefabadi et al. 2019). These adaptations may persist after

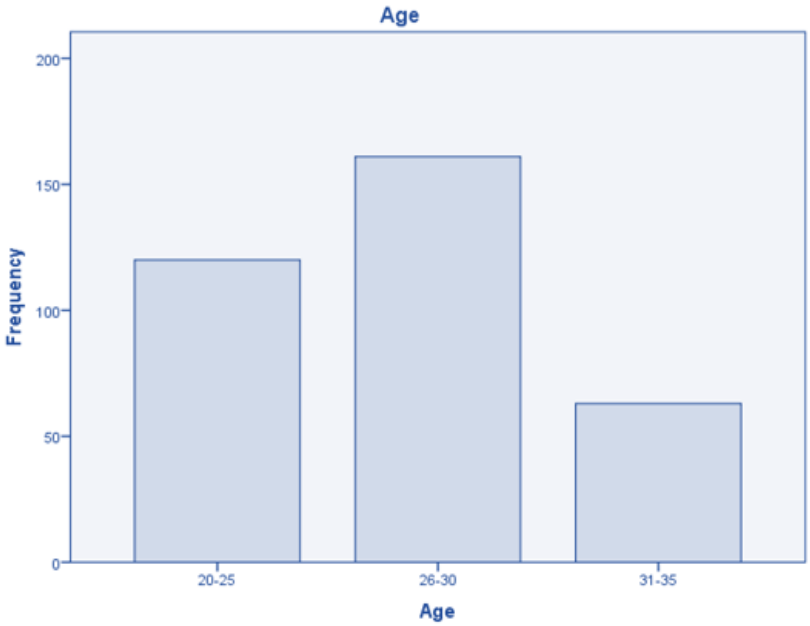

Figure 1: Graphical representation of the frequency of age groups with DR.

childbirth and cause lasting abdominal wall changes (Levytskyy et al. 2024).One of the most frequently observed outcomes of these changes is Diastasis Recti (DR), characterized by a separation of the rectus abdominis muscles along the linea alba, leading to a visible or palpable midline abdominal gap (Belo et al. 2020). The occurrence of DR during pregnancy and the postpartum period is well documented. Evidence suggests that a substantial proportion of women develop DR by the later stages of pregnancy, with prevalence rates reaching up to 60% in the third trimester. Furthermore, approximately one-third of women continue to exhibit signs of DR between six and twelve months following delivery. Several maternal and pregnancy-related factors may increase susceptibility to DR. Advanced maternal age and multiparity, particularly in cases of multiple gestations, have been consistently associated with a higher risk (Yuan et al. 2022, "Frequency of Diastasis Recti Abdominis in Pregnant Women of Third Trimester: Diastasis Recti in Women of Third Trimester | The Healer Journal of Physiotherapy and Rehabilitation Sciences,"2022.).

Additional contributing factors include excessive gestational weight gain, increased fetal size, and inadequate pre-pregnancy core strength (González-Muñoz et al. 2024). Hormonal changes also play a significant role, as elevated levels of relaxin and progesterone promote connective tissue laxity to facilitate childbirth (AlfotouhAmin et al., 2025.), which, when combined with rapid abdominal expansion (Theodorsen et al. 2023), may predispose women to DR. Inadequate or inappropriate postpartum rehabilitation exercises can further delay recovery or worsen muscle separation (Jaiswal1 and Dhankar1 2021). Genetic predisposition and conditions such as obesity, increase mechanical strain on the abdominal wall, may also contribute to the development and persistence of DR (Puri et al. 2021, Ugurlu et al. 2023).DR can have a significant impact on a woman's daily life and functional well-being. The separation of the abdominal muscles inherently weakens the core region (Iqbal et al. 2020, Marander et al. 2024). As a consequence, many women develop lower back pain, as the body compensates for the loss

Table 1. Association of Mode of Delivery (MOD) with Age Groups of Women with DR.

		MOD		Total	p-value
		Cesarean section (C-section)	Normal Delivery		
Age	**20-25**	53	67	120	0.244
	26-30	80	81	161	
	31-35	36	27	63	
Total		169	175	344	

of core stability. DR can also lead to pelvic floor issues, such as urinary incontinence or a sensation of heaviness in the pelvic region, due to the compromised support for internal organs (Hagovská et al. 2024). Additionally, the weakened abdominal wall and increased intra-abdominal pressure raise the risk of developing umbilical or ventral hernias and may contribute to bloating or other digestive discomfort (Tuominen et al. 2024, Chen et al. 2024). Furthermore, because the core muscles play a crucial role in nearly all movements, their weakness can hinder a woman's return to her pre-pregnancy level of physical activity and strength (Edmondson and Ross 2021). Women with unresolved DR often find it difficult to engage in exercise or strenuous activities, which in turn can impede regaining fitness postpartum (Vesting et al. 2024).

Pharmacological treatments are rarely used for DR, as medications do not repair muscle separation or address its underlying causes. Management instead relies on non-pharmacological, conservative strategies, primarily on physiotherapy. The core of treatment involves structured exercise programs such as aerobic and core-strengthening workouts combined with education on posture and body mechanics for safe daily activities (Redi et al. 2023). Supportive aids like abdominal binders or corsets are often used to stabilize the abdominal wall during healing. When conservative therapy fails, surgical correction (typically plication of the linea alba or hernia-repair-type procedures) is reserved for severe or persistent cases. Overall, physiotherapy and guided exercise remain the cornerstone of DR management, while surgery is considered only when non-surgical measures are insufficient (B. Chen et al. 2023).

Physiotherapy remains the frontline treatment for DR, focusing on rebuilding strength in the core muscles while minimizing strain on the healing abdominal wall (Cavalli et al. 2021). Typical exercises include pelvic tilts, gentle abdominal contractions (often starting with isometric holds), breathing exercises that engage the core, and controlled movements that avoid excessive intra-abdominal pressure (Yuan et al. 2022). All of these are designed to strengthen the abdominal muscles without putting unnecessary strain on the linea alba or worsening the separation (Puri et al. 2021).

In light of the above background and evidence, the present study was designed to address some of the remaining gaps in understanding the understanding the relationship between childbirth methods and DR. Examining the

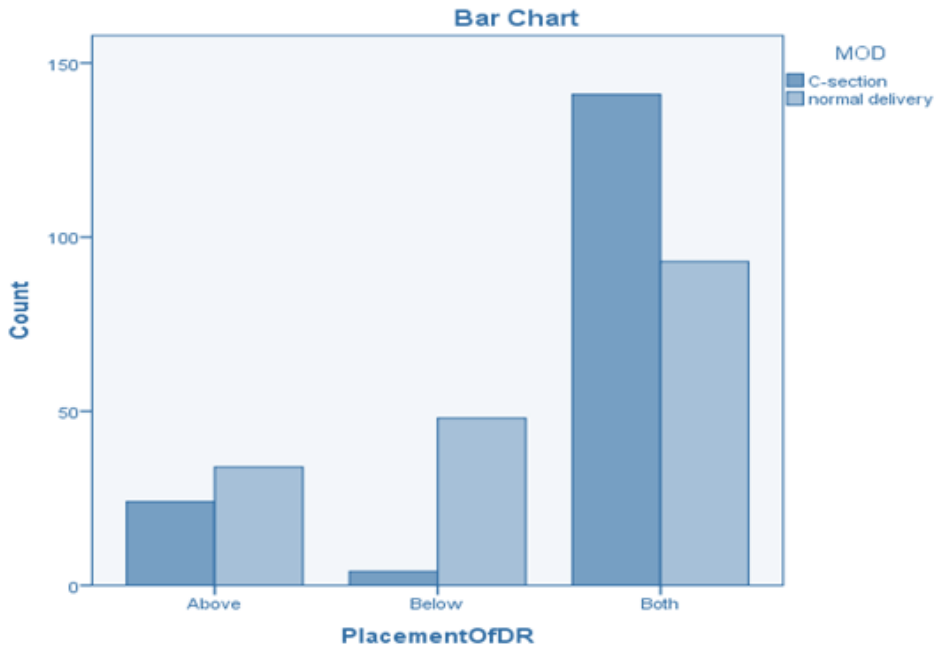

Figure 2: Graphical Representation of the Correlation of MOD with Placement of DR.

Mode of Delivery (MOD) as a contributing factor is important because it may influence both the development and severity of DR, thereby affecting postpartum recovery trajectories. Understanding how different childbirth methods relate to DR can offer valuable insight into the specific risks, functional challenges, and recovery patterns experienced by postpartum women. Such knowledge is essential for informing evidence-based clinical decision-making and optimizing postpartum care.

Identifying MOD that may predispose women to a higher risk or greater severity of DR would allow healthcare professionals, particularly obstetricians, physical therapists, and rehabilitation specialists, to implement targeted preventive strategies and initiate early interventions for at-risk populations. Early identification and tailored rehabilitation may reduce functional limitations and facilitate more effective recovery. Furthermore, recognizing the impact of DR on postpartum Quality of Life (QoL) underscores the importance of integrating QoL assessments and appropriate supportive therapies into routine postpartum care. Addressing both physical impairments and psychosocial well-being is crucial for comprehensive maternal health management.

Accordingly, this study has two primary objectives**.** First, it aims to determine the frequency of DR among postpartum women, comparing those who had normal vaginal deliveries with those who delivered via Cesarean section (C-section).

Second, it aims to assess the changes observed in the QOL of postpartum women that are attributable to DR. By focusing on these objectives, the study seeks to clarify whether and how the MOD influences the occurrence of DR and to what extent DR affects postpartum QoL The significance of this study, therefore, lies in its potential to inform clinical practice by clarifying whether and how the MOD influences the occurrence of DR.

Table 2: Association of MOD with Physical Activity in Women with DR

		MOD		Total	p-value
		C-section	Normal Delivery		
Does your health limit you in these activities? If so, how much	**Vigorous activity**	8	21	29	0.001
	Moderate activities	26	25	51	
	Lifting or carrying	35	34	69	
	Limited a lot	38	14	52	
	Limited a little	60	76	136	
	Not limited at all	2	5	7	
Total		169	175	344	

The findings may guide clinicians in designing individualized rehabilitation programs and personalized treatment plans, ultimately contributing to improved postpartum recovery outcomes and enhanced health-related QoL for women affected by DR.

2. Methodology

The study was carried out at two major healthcare institutions in Karachi, Pakistan: PNS Shifa Hospital and Jinnah Postgraduate Medical Centre. Approval of the institutional review board (IRB) was obtained from the Bahria University of Health Sciences campus in Karachi, with reference number BUHS-IRB/115/24. The study was conducted over six months following synopsis approval. Using the OpenEpi sample size calculator and data from previous studies, the sample size was determined as 169 for C-section participants and 175 for vaginal-delivery participants, resulting in a total of 344 subjects at a 95% confidence level. Participants were selected through a simple random sampling technique to minimize selection bias. We included primigravida women aged 20–40 years who were at least six weeks postpartum and diagnosed with DR, while exclusion criteria eliminated those with prior abdominal surgery chronic health conditions (e.g., diabetes, hypertension), or active participation in structured postpartum exercise programs to maintain sample homogeneity.

Participants were divided into two groups: (1) postpartum women with normal delivery and (2) postpartum women with C-section delivery. DR measurements were performed by a consultant obstetrician using the inch-tape method, with the umbilicus as the central reference point and measurements taken above and below it. All findings were documented in a structured proforma designed to record demographic, obstetric, and clinical information. Additionally, participants completed the SF-36 questionnaire to evaluate health-related QoL, offering insights into the physical and emotional effects of DR.

Data collected on paper forms and questionnaires were securely stored under lock and key, while electronic data entered into SPSS version 23 was password-protected to ensure confidentiality. Together, these standardized methods and ethical safeguards ensured comprehensive, reliable, and secure data collection on DR and its impact on postpartum women.

3. Results

A total of 344 postpartum women participated in the study, all providing valid data for analysis. The majority (46.8%) were aged 26–30 years, followed by 34.9% aged 20–25, and 18.3% aged

Table 3: Association of MOD with ADL Performance Due to Physical Health in Women with DR

		MOD		Total	p-value
		C-section	Normal Delivery		
During the past 4 weeks, have you had any of the following problems with ADLs as a result of your physical health?	Cut down the amount of time spent on work and other activities	46	39	85	0.004
	Accomplished less than you would like	24	36	60	
	Were limited in the kind of work or other activities	29	30	59	
	Yes	36	16	52	
	No	34	54	88	
Total		169	175	344	

31–35, indicating that DR was most frequent among women in their late twenties. In terms of body mass index (BMI), 43.0% of participants were overweight, 29.1% had normal weight, and 27.9% were underweight, showing that nearly Three-quarters of participants fell outside the normal BMI range. With respect to DR placement, the majority (68.0%) exhibited separation both above and below the umbilicus, while 16.8% and 15.1% had DR above or below the umbilicus, respectively. When comparing age groups and MOD, women aged 26–30 showed the highest frequency of DR across both C-section and normal delivery groups, with no statistically significant association between ages and MOD ($p = 0.244$). However, a notable trend emerged between BMI and MOD overweight women undergoing C-sections, who showed a higher prevalence of DR, while underweight women were more frequent among normal deliveries, a relationship approaching statistical significance ($p = 0.054$). A highly significant association was observed between MOD and DR placement, as women with C-sections were more likely to exhibit separation both above and below the umbilicus ($p < 0.001$).

Regarding self-perceived health, women with normal deliveries more frequently rated their health as "good" or "very good," whereas poorer ratings predominated among C-section participants ($p < 0.001$). Analysis of physical activity limitations revealed that C-section participants reported greater restriction in vigorous and moderate activities and were more often classified as "limited a lot" ($p = 0.001$). Similarly, C-section participants more frequently reported physical health-related interference with activities of daily living (ADLs) ($p = 0.004$) and emotional health-related limitations ($p = 0.041$).

Although no significant difference was found regarding how often participants felt "full of life" ($p = 0.283$), women with normal deliveries reported feeling calm and peaceful "most of the time" significantly more often ($p = 0.015$) no significant relationship was found between MOD and interference of physical or emotional health with social activities ($p = 0.099$). However, body pain levels showed a strong association with MOD. C-section women reported moderate to severe pain significantly more often ($p < 0.001$). Furthermore, when comparing current health status with that of the previous year, women with C-sections were more likely to rate their health as "somewhat worse" or "much worse," whereas those with normal deliveries rated it as "somewhat better" or "about the same" ($p = 0.001$) Finally, occupation showed no significant correlation with MOD, with

housewives forming the majority in both groups ($p = 0.412$)

Overall, these results indicate that DR was more prevalent and severe among women who underwent C-section, especially those who were overweight and exhibited muscle separation both above and below the umbilicus. Additionally, C-section participants demonstrated poorer self-perceived health, greater pain intensity, and lower physical and emotional functioning, underscoring the substantial impact of MOD on postpartum QoL.

4. Discussion

The findings of this study involving 344 postpartum women offer important insights into the factors associated with DR, a prevalent postpartum condition with implications for both physical function and emotional well-being. The results demonstrate partial alignment with existing literature, revealing significant associations between MOD, the anatomical placement of DR, and maternal health outcomes. Several studies have explored the relationship between MOD and DR prevalence, with evidence suggesting that women undergoing C-sections are at greater risk. (Yuan et al. 2022) found that women who underwent CD were 4.5 times more likely to develop DR compared to those who delivered vaginally (Levytskyy et al. 2024). Our study supports this observation, as women exhibiting DR both above and below the umbilicus were significantly more likely to have undergone C-section ($p < 0.001$). This reinforces the idea that surgical incisions during C-section may disrupt abdominal wall integrity, predisposing women to more extensive DR. These findings align with Khalid et al. (2020), who reported a high prevalence of DR (75.8%) across MOD, however they found no statistically significant association between delivery type and DR occurrence ($p = 0.09$) (Boissonnault and Blaschak 1988). The variation in outcomes between studies may reflect differences in population demographics, diagnostic techniques, and sample composition across MOD.

Age was not found to be significantly associated with DR in our study ($p = 0.244$), contrasting with (Yuan et al. 2022), who observed an earlier onset of DR in non-cesarean groups ($p = 0.017$) (Yaseen et al. 2022). This discrepancy may stem from variations in the definition of age groups, postpartum timelines, or sample characteristics. In contrast, BMI emerged as a more influential factor. (Puri et al. 2021) highlighted the high proportion of postpartum women with abnormal BMI values, a finding reflected in our cohort, where 43.0% were overweight, and 27.9% were underweight (Gluppe et al. 2021). Overweight women who had C-sections demonstrated a higher prevalence of DR, supporting the notion that excess body weight contributes to abdominal wall strain and muscle weakness ($p = 0.054$). (Gluppe et al. 2021) also found that women with DR had lower maximal abdominal strength and higher abdominal pain scores ($p = 0.026$) (Olsson et al. 2021). Similarly, our participants reported greater pain intensity and functional limitations ($p < 0.001$), emphasizing BMI as a modifiable factor influencing DR severity and postpartum recovery.

The present study further underscores the substantial effect of DR on QoL. Women who underwent C-section were significantly more likely to rate their health as "poor" ($p < 0.001$) and report worsened health compared to the previous year ($p = 0.001$). These findings correspond with (Gluppe et al. 2021), who observed that DR-associated pain and weakness negatively impacted both physical and emotional well-being (Olsson et al. 2021). Our results also indicated that C-section participants reported greater limitations in physical activity ($p = 0.001$) and emotional role functioning ($p = 0.041$), reflecting the broader physical and psychological burden of DR. In support of this, (Olsson et al. 2021) demonstrated that surgical repair of DR significantly improved core

strength, stability, and overall QoL, suggesting that early identification and intervention can enhance recovery outcomes.While our findings generally align with earlier research, the inconsistencies across studies highlight the multifactorial nature of DR. For instance, while (Levytskyy et al. 2024) found no significant relationship between MOD and DR (Wan et al. 2025) and our study identified a strong association, suggesting that differences in measurement tools, diagnostic thresholds, and study designs may account for the variation. Standardizing DR assessment techniques, such as adopting ultrasound-based measurements, could help reduce discrepancies and enhance comparability across future research. We acknowledge several limitations of our study. As a cross-sectional study, it cannot establish causation, and the inclusion of only primiparous women restricts generalizability to multiparous populations.

Furthermore, the study relied primarily on subjective measures such as self-reported QoL outcomes, without incorporating objective parameters like pelvic floor strength, urinary incontinence, or low back pain. Future longitudinal research should include these objective indicators and track DR progression over time to better understand long-term impacts on women's health and function.

5. Conclusions

Our findings show that women who underwent C-sections had more severe DR, particularly with muscle separation above and below the umbilicus. These women also reported poorer self-perceived health, more physical limitations, and higher pain levels. The study emphasizes the need for early screening and targeted physiotherapy interventions, especially for those with C-sections, to improve postpartum recovery and QoL. Future research should incorporate more objective measures and track the long-term effects of DR.

Conflict of Interest

All the authors declare no conflicts of interest.

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Study Approval

Approval of the institutional review board (IRB) was obtained from the Bahria University of Health Sciences campus in Karachi, with reference number BUHS-IRB/115/24

Consent Forms

Each and every participant signed a consent form before participating in the research.

Authors Contributions

Prem Lata, Syeda Sana Waheed: manuscript write-up, Syed Kazim Raza analysis data, Samiya, Summaiya Sahar, Syeda Taneem Rizvi collected data.

Data Availability

All the data relevant to this study are with the authors.

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