Original Article

# Correlation Between Delivery Type and Pelvic Floor Dysfunction: A Case-Control Study

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## Abstract

**Background:** Mode of delivery is associated with pelvic floor dysfunction (PFD). Therefore, this study aimed to investigate the relationship between delivery type and PFD six-month after delivery.

**Materials and Methods:** This case-control study included primigravida females who had a normal vaginal delivery with episiotomy (VDE) or uncomplicated cesarean section. All participants underwent an evaluation to check the strength and endurance of the pelvic floor muscles (PFM), intravaginal pressure measurement, electromyographic activity recording of the PFM, and Pelvic Floor Distress Inventory-20 (PFDI-20) questionnaire.

**Results:** In total, 260 patients were enrolled in our study and divided equally into two groups: uncomplicated cesarean delivery and VDE. Our findings showed significant differences in PFM dysfunction, electrical activity, strength, endurance, and vaginal pressure between the two groups. Patients who underwent an uncomplicated cesarean delivery had better outcomes.

**Conclusion:** Our study demonstrated that the severity of PFD in women who underwent uncomplicated cesarean section was lower than that in women who underwent VDE. VDE may cause PFM injury.

**Keywords:** Cesarean section, episiotomy, obstetric delivery, pelvic floor disorders

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## Introduction

Females with pelvic floor dysfunction (PFD) may experience a variety of clinical conditions, including sexual problems, an overactive bladder, pelvic organ prolapse (POP), and abnormalities of the lower urinary tract excretory system, such as urine and anal incontinence. POP, urine incontinence (UI), and fecal incontinence (FI) are common in developing nations.[1,2] POP is a significant health issue worldwide.[3] At least one PFD issue affects 10% of females aged 20–39, compared with 50% of females over 80 years of age.[4] Hormonal changes, particularly estrogen deficiency, linked to aging and the duration of the postmenopausal period, can result in the loss of connective tissue and the formation of PFD.[5] However, in the same age group, multiparous females are more likely to have PFD than nulliparous females, highlighting the importance of obstetric trauma.[6]

The mode of delivery is a significant factor linked to PFD.[7] Vaginal delivery is hypothesized to damage pelvic support tissues, including the muscles, connective tissues, and nerve structures, leading to PFD. Research has shown that partial denervation of the pelvic floor is often observed in females with normal vaginal delivery with episiotomy (VDE), and it increases with disease severity, particularly during the first pregnancy.[8,9] However, there is still no concrete evidence suggesting that vaginal delivery (VD) is the sole cause of PFD.

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Therefore, this study investigated the relationship between the delivery method and PFD.

## Materials and Methods

### Study design

This case-control study focused on primigravida females who had given birth within the past six months. They were referred to specific educational hospitals affiliated with the Isfahan University of Medical Sciences, Iran. This study was conducted between January 2022 and December 2023. This study was conducted in accordance with the Helsinki Declaration.

### Inclusion Criteria

The study will focus on primigravida pregnant women aged between 20 and 35 years who have reached full-term pregnancy, defined as 37 to 42 weeks. Participants must be carrying singleton babies in a cephalic presentation. Eligible delivery methods include either a vaginal delivery with an episiotomy or an uncomplicated cesarean delivery.

### Exclusion Criteria

Participants will be excluded from the study if they have a medical history that includes pelvic surgery, chronic kidney disease, spine-related issues, diabetes, hypertension, urinary problems prior to pregnancy, uterine prolapse, or rectocele grades 3 and 4. Additionally, lifestyle factors such as smoking, tobacco use, and alcohol consumption will also result in exclusion.

Complications during pregnancy or delivery that lead to exclusion include pre-eclampsia, vulvovaginitis, urinary or genital infections during pregnancy, a body mass index (BMI) greater than 35 kg/m$^2$, failure to heal the perineum after delivery, any occurrence of third or fourth-degree lacerations during childbirth, severe maternal complications, or the use of delivery instruments.

After obtaining approval from the ethics committee, the information of eligible primigravidas who had given birth within the past six months was extracted from the hospital's Health Information System (HIS). These females were then invited to participate in the study while adhering to ethical considerations. The study objectives were explained to all participants, and their participation was voluntary. Participants were assured that their information would remain confidential and would only be used for research purposes, and there was no financial burden for them. Informed consent was obtained from all patients, and they were included in the study based on inclusion and exclusion criteria.

The participating females were divided into two groups based on the type of delivery: Group One: Females with VDE; and Group Two: Females with uncomplicated cesarean delivery (elective cesarean delivery). All the required information for the study, based on the research objectives, including demographic information [age and body mass index (BMI)], was extracted from the participants' electronic files in the hospital database using a structured data collection form and was confidentially recorded in an Excel file format. If the recorded information was incomplete, as much as possible, the incomplete information was completed by accessing the paper file. Incomplete files were excluded from the study. A trained resident in gynecology performed a clinical evaluation to assess the strength and endurance of the pelvic floor muscle (PFM), measuring intravaginal pressure and recording the electromyographic activity of the PFM.

### Assessment of PFM dysfunction

Four questionnaires were used to assess PFM dysfunction: the Pelvic Floor Distress Inventory-20 (PFDI-20), Pelvic Organ Prolapse Distress Inventory-6 (POPDI-6), Colorectal-Anal Distress Inventory-8 (CRADI-8), and Urinary Distress Inventory-6 (UDI-6).

#### PFDI-20

Females from both groups were asked to complete the PFDI-20 to investigate the dysfunction of the PFM. The PFDI-20 has 20 items, all of which range from 0 to 4. To calculate the scale score for PFM dysfunction, first, the mean value of all the answered items should be determined. Then, we multiplied this mean value by 75 to obtain a scale score from 0 to 300. A higher score indicates a greater severity of PFM dysfunction.[10] The questionnaire was translated into Persian and administered to participants.

#### POPDI-6

The POPDI-6 is a concise questionnaire that assesses the degree of bother or distress experienced by women with pelvic organ prolapse symptoms. It consists of six items that evaluate the impact of prolapse on various aspects of a woman's life, including physical discomfort, emotional well-being, and interference with daily activities. The POPDI-6 is a validated and widely used instrument in clinical practice and research to quantify the symptom burden and impact of POP on quality of life.[11]

#### CRAD-8

The CRAD-8 is a self-reported questionnaire designed to measure the level of distress caused by colorectal and anal symptoms such as fecal incontinence, constipation, and rectal prolapse. It consists of eight items that assess the impact of these symptoms on various aspects of an individual's life, including physical discomfort, emotional well-being, and social functioning. The CRAD-8 is a reliable and valid tool used in clinical settings and research to evaluate the burden of colorectal and anal dysfunctions and monitor treatment outcomes.[12]

#### UDI-6

The UDI-6 is a brief questionnaire that evaluates the degree of bother or distress caused by urinary symptoms such as urinary incontinence, urgency, and frequency. It comprises six items that assess the impact of these symptoms on various aspects of an individual's life, including physical discomfort, emotional well-being, and daily activities. The UDI-6 is a widely used and validated instrument in clinical practice and research to quantify

the symptom burden and impact of urinary dysfunction on quality of life, particularly in women with pelvic floor disorders.[13]

### Assessment of vaginal pressure

The participants were placed in the standard lithotomy position to perform clinical examinations. In the first stage, using a perineometer (EPI-NO Libra, TECSANA, Germany), the pressure inside the vagina during PFM contraction was recorded in $cmH_2O$.[14]

### Assessment of PFM strength and endurance

In the next stage, to evaluate the strength of the PFM, the examiner inserted their middle and index fingers up to the s band (approximately 2–3 cm) into the individual's vagina in the lithotomy position and asked them to perform one or two squeezing and inward and upward movements of the vagina to prevent the examiner's finger from exiting. Then, contraction with the maximum possible intensity and maintaining it for 3 to 5 s was requested, and based on the modified Oxford scale, muscle power was scored from zero to 5. Muscle endurance was also scored from 1 to 10 seconds, based on the length of time the individual could maintain contraction or squeeze the examiner's fingers.[14]

### Assessment of PFM electrical activity

Individuals were first asked to empty their bladders to prevent the effect of fullness on the tonic activity of the PFM and to record the electrical activity of the PFM using electromyography (EMG) (YSY Est Evolution 4, France). Surface electromyography recordings were performed using adhesive electrodes over the perineum to assess PFM myoelectrical activity. The participants were placed in a lithotomy position, and a vaginal probe was inserted into the vagina. The probe had two metal sensors that were placed against the lateral vaginal walls. Before insertion, a small amount of hypoallergenic lubricant gel was applied to the probe. A reference electrode was placed on the right side of the anterior superior iliac spine.

However, when the vaginal probe was not used owing to either cost or discomfort, adhesive electrodes were used instead. Two electrodes were placed on each side of the labia majora, and one electrode was placed on each side of the static spine.

The evaluation program for electromyography was conducted as follows: the participant rested for 60 s as a baseline. Following this, they were asked to perform five rapid 5-s contractions with maximum effort to activate phasic muscle fibers. After each contraction, a rest period of 10 s was provided to prevent muscle fatigue. Throughout the test, the individual was verbally encouraged to look at the device display and try to increase the number of displays with effort. Following this, the tonic muscle fibers were activated, which included five 10-second contractions with a 10-second rest period between each contraction. A 1-min rest period was observed between the first and second stages to prevent muscle fatigue. For the analysis of electromyography data, the middle 5 s of the recorded wave in microvolts at each stage was selected. The root mean square (RMS) was calculated and used as an index to reflect the electrical activity of the pelvic floor muscles (PFM) for comparison between the two groups. A trained female resident performed a clinical evaluation to examine the strength and endurance of the PFM, measure intravaginal pressure, and record the electromyographic activity of the PFM.[15]

### Statistical analysis

The data were analyzed using SPSS version 27.0 (SPSS version 27 from IBM, Chicago, IL, USA). Scale variables are presented as mean ± standard deviation. Normality of the data distribution was assessed using the Kolmogorov-Smirnov test.

An independent samples *t*-test was used to compare the two groups in the unadjusted analysis. Subsequently, an adjusted analysis was conducted using a one-way ANOVA test with adjustment for age, BMI, and postpartum period. Statistical significance was set at $P < 0.05$, and all $P$ values were considered two-sided.

## Results

After sampling, we enrolled 130 participants each in the VDE group and 130 participants in the uncomplicated cesarean delivery groups. The basic demographic information for both groups is shown in Table 1. Age, weight, height, and BMI were similar in both groups.

Table 1 indicates no significant differences in age, height, weight, or BMI ($P < 0.05$) between the two groups. Therefore, it can be inferred that the individuals in both groups matched these aspects.

As shown in Table 2, the VDE group exhibited a mean intravaginal pressure 12.4% higher than that of their uncomplicated cesarean counterparts ($P < 0.001$). In contrast, the PFDI-20 scores of the VDE group were 25.3% higher than those of the uncomplicated cesarean group ($P < 0.001$). In terms of PFM metrics, the uncomplicated cesarean section group outperformed the VDE group: their strength and endurance were higher by 21.9% and 13.2%, respectively ($P < 0.001$ for

**Table 1: Demographic information of study groups**

| Delivery type | Age, year (Mean±SD) | Height, cm (Mean±SD) | Weight, kg (Mean±SD) | BMI, kg/m² (Mean±SD) | Postpartum period (Mean±SD) |
|---|---|---|---|---|---|
| VDE (*n*=130) | 25.86±4.62 | 165.94±6.77 | 67.19±13.37 | 24.40±4.62 | 3.32±1.52 |
| Uncomplicated cesarean delivery (*n*=130) | 26.26±4.64 | 166.52±7.78 | 69.40±11.87 | 25.05±4.08 | 3.49±1.72 |
| *P** | 0.297 | 0.519 | 0.160 | 0.232 | 0.402 |

*Independent *t*-test. VDE=Vaginal delivery with episiotomy, BMI=Body mass index; SD=Standard deviation

both), and their electrical activity exceeded that of the VDE group by 18.2% ($P < 0.001$). In summary, while the VDE group had higher vaginal pressure, they had higher PFDI-20 scores, and the uncomplicated cesarean section group demonstrated superior PFM metrics.

Analysis of the PFDI-20 subscale scores revealed significantly higher levels of POPDI-6 (24.5%, $P = 0.002$), CRAD-8 (21.2%, $P = 0.001$), and UDI-6 (30.3%, $P < 0.001$) in the uncomplicated cesarean section group than in the VDE group.

## Discussion

Giving birth is one of the most significant events in a female's life. Studies have shown that PFDs are more common during the two stages of life, pregnancy and childbirth, especially after VDE. These variables are known to affect PFD significantly.[16,17] Although severe morbidity in females with postpartum depression is rare, PFD can have a significant negative impact on quality of life. Females with sustained PFM damage may experience severe symptoms during the postpartum period. Fortunately, PFDs can be treated using conservative therapies such as pelvic muscle training, electrical stimulation, and biofeedback.[18,19] Future research should focus on studying PFM injuries and disorders in the postpartum period. Practical strategies should be developed to restore pelvic floor function and improve the quality of life of women.

This study was conducted on primigravida mothers to determine the correlation between delivery type and PFD. Our findings indicate that women undergoing VDE are more likely to experience PFD. Therefore, based on our data, VDE may result in more severe PFD and disease. This finding has been previously reported, and a study conducted by Blomquist *et al*.[20] revealed that PFM strength was most prominent in primigravida pregnant women. Conversely, women who underwent VD had the lowest muscle strength, which is consistent with our findings. Moreover, Friedman *et al*.[21] reported that females who delivered via cesarean section had a higher PFM strength than comparison to females with delivered vaginally. Blomquist *et al*.[20] discovered that women who underwent vaginal deliveries exhibited lower peak pressure during pelvic floor muscle contraction than those who underwent cesarean delivery 5-10 years postpartum. The findings of these studies are consistent with those of our study.

The findings of the current study on decreased PFM strength and endurance in the VDE group could be crucial in guiding future clinical practice and postpartum PFM follow-up. However, several clinical trials have found no significant differences in outcomes based on the mode of delivery.[22-24] This finding may be because, as demonstrated by many of the females in the study by Elenskaia *et al*.,[22] there is natural recovery during the first year after childbirth. In 2022, a study by Wattanakrai *et al*.[23] conducted on primigravida mothers who had undergone vaginal deliveries and cesarean sections found that the group that underwent cesarean section had a significantly higher mean perineometer power and FSFI score than those who underwent vaginal delivery. In a study by Zhao *et al*.[24] 2018, 4769 healthy Chinese females who had recently given birth were surveyed 6-8 weeks postpartum. They were divided into two groups based on their delivery methods: cesarean delivery and vaginal delivery. The study found that women who had cesarean deliveries had stronger PFM than those who had vaginal deliveries.

Studies have revealed that for primiparas delivering vaginally, those with perineal laceration had stronger PFM than those

**Table 2: Mean vaginal pressure, PFM dysfunction, strength of PFM, and endurance of PFM of study groups**

| Factor | | Delivery type | (Mean±SD) | *P* | |
|---|---|---|---|---|---|
| | | | | Unadjusted[1] | Adjusted[2] |
| Mean vaginal pressure | $cmH_2O$ | VDE | 39.50±5.02 | <0.001 | <0.001 |
| | | Uncomplicated cesarean | 35.20±5.60 | | |
| Strength of PFM | Modified Oxford Score | VDE | 3.22±0.94 | <0.001 | <0.001 |
| | | Uncomplicated cesarean | 3.96±0.69 | | |
| Endurance of PFM | S | VDE | 7.58±1.46 | <0.001 | <0.001 |
| | | Uncomplicated cesarean | 8.56±1.19 | | |
| Electrical activity of PFM | µV | VDE | 30.20±6.03 | <0.001 | <0.001 |
| | | Uncomplicated cesarean | 35.73±5.49 | | |
| PFM dysfunction | PFDI- 20 Score | VDE | 153.85±56.58 | <0.001 | <0.001 |
| | | Uncomplicated cesarean | 122.69±48.56 | | |
| | POPDI-6 | VDE | 46.73±25.74 | 0.002 | <0.001 |
| | | Uncomplicated cesarean | 37.50±22.28 | | |
| | CRAD-8 | VDE | 52.50±24.87 | 0.001 | <0.001 |
| | | Uncomplicated cesarean | 43.26±21.29 | | |
| | UDI-6 | VDE | 54.61±23.87 | <0.001 | <0.001 |
| | | Uncomplicated cesarean | 41.92±23.33 | | |

[1]Independent *t*-test. [2]One-way ANOVA adjusted for age, BMI, and postpartum period. SD=Standard Deviation, PFM=Pelvic Floor Muscles, VDE=Vaginal delivery with the episiotomy, PFDI-20=Pelvic Floor Disability Index, POPDI-6=Pelvic Organ prolapse Distress Inventory 6, CRAD-8=Colorectal-Anal distress Inventory 8, UDI-6=Urinary distress Inventory 6

with episiotomy or forceps-assisted vaginal birth. This is because episiotomy may injure the pudendal nerve integrity and PFM. Routine episiotomy in low-risk females wiv th vaginal delivery has been a controversial practice.[25,26] Therefore, it can be concluded that the nature of episiotomy is associated with PFM injury, and this finding may partially explain our observations that PFM is stronger in cesarean deliveries patients than in VDE patients.

Based on the findings of our study and a review of the literature, the use of the VDE method may be associated with complications that could reduce its suitability for childbirth. Supporters believe that routine episiotomy can protect against anal sphincter injury.[27] Simultaneously, opponents argue that it can increase the rates of postpartum bleeding, postpartum perineal incision infection, and postpartum pain.[28] However, there is still a need for more research on this topic because of the limitations of the existing study, which had a small sample size, short research period, and inability to assess essential factors, such as participants' diets, lifestyles, and physical activity levels.

## Conclusion

This comprehensive study offers valuable insights into the correlation between method of delivery and PFD in primigravida pregnant women. The results indicate that VDE is linked to compromised pelvic floor muscle metrics and heightened levels of pelvic floor distress compared to uncomplicated cesarean delivery. Specifically, women in the VDE group demonstrated elevated intravaginal pressure but reduced pelvic floor muscle strength, endurance, and electrical activity. Additionally, they had higher scores on the Pelvic Floor Distress Inventory (PFDI). While further research with larger sample sizes is necessary, these findings suggest that VDE may increase the risk of postpartum PFD. Given the significant impact of pelvic floor disorders on quality of life, these findings emphasize the importance of thoughtfully considering delivery methods, instituting preventive measures, and conducting appropriate postpartum pelvic floor assessments and rehabilitation when necessary. Ultimately, this study contributes to a deeper understanding of obstetric risk factors for PFD and may inform clinical practices to enhance pelvic health outcomes in new mothers.

### Limitations of the study

This retrospective design prevents the establishment of causality between the mode of delivery and PFD, as other unmeasured confounding factors may have influenced the results. In addition, the study was conducted at a single center with a relatively small sample size, which may limit the generalizability of the findings to other populations. Furthermore, the study focused exclusively on primigravida women, and the results may not apply to multiparous women or those with previous pelvic floor disorders. The assessments of pelvic floor muscle strength, endurance, and electrical activity were subjective and may have been subject to inter-observer variability. Moreover, the study did not account for potential confounders, such as participants' lifestyle factors, physical activity levels, or other obstetric factors that could impact pelvic floor function. Finally, this study evaluated PFD at a single time point (six months postpartum), and a longitudinal follow-up would provide valuable insights into the long-term effects of delivery mode on pelvic floor function. Given the importance of population rejuvenation and increasing pregnancy rates, studies conducted in this area hold significant value. Considering the known complications associated with cesarean delivery and the recommendation of most guidelines to prioritize vaginal delivery, along with the general fear of natural childbirth among women in society, the findings of the aforementioned study may negatively impact individuals' willingness to opt for vaginal delivery. However, due to the valuable outcomes of this research, further complementary studies are necessary to propose solutions for mitigating these complications.

### Authors' contributions

All authors contributed equally to all stages of the article, including the conception and design of the study, acquisition, analysis, and interpretation of data, drafting and revising the manuscript, and final approval of the version to be published.

### Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

### Consent to participate

Informed consent was obtained from all individual participants included in the study.

### Ethics approval and consent to participate

This cohort study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Isfahan University of Medical Sciences (IR.MUI.MED.REC.1402.301).

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### Conflicts of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflicts of interest.

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