Journal of Obstetrics, Gynecology and Cancer Research | ISSN: 2476-5848

The Correlation between Infant Birth Weight and Changes in Pelvic Floor Muscle Strength among Primigravida Women

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Article Info

10.24200/jogcr.12.1.42

Received: 2026-06-03
Accepted: 2026-07-20
Published Online: 01 Nov. 2026

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ABSTRACT

Background & Objective: Vaginal delivery is the major risk factors for pelvic floor dysfunction. Stretching and trauma of the levator ani muscle and pelvic connective tissues during childbirth may lead to decreased Pelvic Floor Muscle Strength (PFMS). Neonatal birth weight may contribute to the degree of pelvic floor injury. This study was conducted with aims to determine the relationship between neonatal birth weight and changes in pelvic floor muscle strength in primigravida women.

Materials & Methods: This prospective, longitudinal, analytical observational study was conducted among primigravida women undergoing spontaneous vaginal delivery at several hospitals in Makassar and Gowa, Indonesia. Pelvic floor muscle strength was measured using a perineometer during the antepartum period, the active intrapartum phase, and six weeks postpartum. Data related to birth weight were obtained from medical records. Data were analyzed using SPSS software (version 29.0). Kruskal Wallis test was used to analysis the relationship between neonatal birth weight and changes in pelvic floor muscle strength. P<0.05 was considered significant.

Results: A total of 80 primigravida women were included. Pelvic floor muscle strength decreased significantly immediately after vaginal delivery and partially recovered by six weeks postpartum. Women who delivered infants weighing≥3000 gr showed a greater decrease in pelvic floor muscle strength than women who delivered infants weighing <3000 gr (-9(-44–26) vs. -1(-44–43)); however, the differences was not statistically significant (P=0.651).

Conclusion: Birth weight does not appear to be a dominant factor influencing early postpartum PFMS changes.

Keywords: Birth weight, Pelvic floor, Delivery, Women

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1. Introduction

The pelvic floor muscles, or pelvic diaphragm, are a group of muscles that extend from the pubic rami to the coccyx and serve as a barrier between the pelvic cavity and the perineum. These muscles work synergistically to support the pelvic organs and maintain urinary and fecal continence through tonic and voluntary contractions in response to increased intra-abdominal pressure **(1,2)**.

Pregnancy and vaginal delivery are the major risk factors for pelvic floor muscle dysfunction. During labor, the pelvic floor muscles, particularly the levator ani, are subjected to extreme stretching and mechanical stress, which can lead to muscle and nerve injury, including the pudendal nerve, which plays a crucial role in the innervation of the pelvic floor muscles. The degree of pelvic floor muscle injury during labor has been associated with an increased risk of pelvic organ prolapse and continence problems later in life **(3)**.

Birth weight contributes to the amount of mechanical stress placed on the pelvic floor muscles during vaginal delivery. Theoretically, a larger birth weight increases the strain and load on the pelvic floor muscles, potentially leading to a greater reduction in muscle strength. A large cross-sectional study in Italy involving over 21,000 women found no significant association between birth weight and uterine prolapse **(2)**. Conversely, some research suggests that functional changes in the pelvic floor muscles, characterized by a decrease in maximal voluntary contractions, are associated with vaginal delivery and pelvic organ prolapse **(2,4)**. Perineometry is a simple, minimally invasive, and reliable method for evaluating pelvic floor muscle strength through intravaginal pressure

generated during voluntary muscle contraction **(5)**. Therefore, this study was conducted with aim to evaluate the relationship between neonatal birth weight and changes in pelvic floor muscle strength among primigravida women.

2. Materials and Methods

This prospective longitudinal analytic observational study was conducted at Regional Special Hospital for Mothers and Children Siti Fatimah, Mothers and Child Hospital Sitti Khadijah I Makassar, and Regional Public Hospital Syekh Yusuf Gowa from March 2025 to January 2026. Participants included primigravida women who underwent spontaneous vaginal delivery. PFMS was assessed using a Perineometer (Beier Perineometer, Korea) at three different time points: Third-trimester antepartum period, Active phase of labor, and Six weeks postpartum.

PFMS values were expressed in cmH2O, and PFMS changes (ΔPFMS) were calculated based on differences between measurements. ΔPFMS was then calculated by subtracting the postpartum PFMS from the antepartum PFMS. Neonatal birth weight data were collected from medical records.

The inclusion criteria were 1) Primigravida women with singleton pregnancies, cephalic fetal presentation, and third trimester age; 2) No history of pelvic anatomical abnormalities or medical disorders that could affect pelvic floor muscle function; 3) Willingness to participate in the study and written consent (informed consent). The exclusion criteria were 1) Women who underwent operative delivery, including section caesarea, vacuum extraction, or forceps; 2) Women with abnormality of position, malpresentation or experiencing shoulder dystocia during labor; 3) Women with a history of previous surgical procedures on the vagina, perineum, or pelvic organs; 4) Women with medical conditions that could affect pelvic floor muscle strength, such as nerve disorders or chronic cough. The dropout criteria were 1) Subjects who could not be contacted or were not present at the six-week postpartum follow-up measurement (lost to follow-up); 2) Subjects who withdrew consent and were not willing to continue participating in the study.

Measurement of pelvic floor muscle strength was performed using a Perineometer (Beier Perineometer, Korea). Before performing the perineometer examination, the perineometer is calibrated. To calibrate the perineometer, turn on the device and press the Zero or Reset button, or follow the calibration instructions on the on-screen application. The display will then display 0. After 0 is displayed, the subject is examined. First, the subject is placed in a relaxed lithotomy position. Second, a vaginal perineometer probe coated with water-based lubricant is gently inserted into the vagina to a depth equivalent to the introitus. Third, the subject is asked to maximally contract the pelvic floor muscles (as if holding back urination) without contracting the abdominal, buttock, or thigh muscles. Three contractions are performed, each held for several seconds, with a 10-second rest interval between contractions to prevent muscle fatigue. Pelvic floor muscle strength is then recorded in cmH2O, and the final result is determined based on the average of the three maximal contractions. Values between 7.5 to 14.5 cmH2O correspond to very weak pressure; 14.6 to 26.5 cmH2O represent weak pressure; 26.6 to 41.5 cmH2O moderate pressure; 41.6 to 60.5 cmH2O good pressure, and values above 60.6 cmH2O correspond to strong pressure **(6)**.

Data analysis was conducted using SPSS software (version 29.0). Univariate analysis was performed to describe the characteristics of the study subjects, including maternal and newborn characteristics. Numerical data are presented as mean±SD or median (min - max), while categorical data are presented as frequencies and percentages. Differences in characteristics between the two groups (based on birth weight) were assessed using independent t-tests for age, body mass index, and birth weight. Chi-square tests were used for labor duration, and independent t-tests for socioeconomic variables, education, and perineal rupture. The Mann-Whitney test was used to compare pelvic floor muscle strength scores by time (antepartum, in the active phase of labor, and 6 weeks postpartum). The relationship between birth weight and changes in pelvic floor muscle strength was determined using the Kruskal-Wallis test. The significance value was P-value<0.05, with a 95% confidence level.

3. Results

A total of 80 primigravida women completed the study protocol. Subjects' characteristics are presented in Table 1.

Table 2 presents the Pelvic Floor Muscle Strength (PFMS) scores measured at three time points: before delivery (antepartum), during labor (intrapartum), and six weeks postpartum. The median PFMS before delivery was 69 cmH2O (range: 41-89 cmH2O). During labor, the median PFMS decreased to 8 cmH2O (range: 3-84 cmH2O). At six weeks postpartum, the median PFMS returned to 69 cmH2O (range: 41-85 cmH2O).

Table 3 shows the Pelvic Floor Muscle Strength (PFMS) values across three measurement time points based on the infant birth weight categories. During the antepartum period, the median PFMS in the <3000 gr birth weight group was 69 cmH2O (41-89), while in the ≥3000 gr group, it was 80 cmH2O (41-85), with no significant difference between the two groups (P=0.898). During labor (intrapartum), a decrease in PFMS occurred in both groups. The median PFMS in the <3000 gr group was 8 cmH2O (3-84), and in the ≥3000 gr group, it was also 8 cmH2O (3-83). There

was no significant difference between the two groups at this measurement time point (P=0.949). At six weeks postpartum, the PFMS values showed a recovery in both groups. The median PFMS in the <3000 gr group was 69 cmH2O (41-85), whereas in the ≥3000 gr group, it was 67 cmH2O (41-85). The difference between the two groups remained statistically non-significant (P=0.079). Overall, the pattern of PFMS changes from antepartum, intrapartum, to six weeks postpartum appeared similar across both infant birth weight categories.

Table 4 shows the changes in pelvic floor muscle strength analyzed by infant birth weight categories. In the group of infants with a birth weight <2500 gr, the median ΔPFMS was -2 cmH2O (range: -40 to 43 cmH_2O). In the 2500-3000 gr birth weight group, the median ΔPFMS was -1 cmH2O (range: -44 to 43 cmH_2O). Meanwhile, in the infant group with a birth weight ≥3000 gr, the median ΔPFMS was -9 cmH2O (range: -44 to 26 cmH2O). Descriptively, the group with a birth weight ≥3000 gr showed a larger median decrease in PFMS compared to the other groups; however, the Kruskal-Wallis test results showed that the difference among infant birth weight categories was not statistically significant (P=0.651).

Table 1. Demographic Characteristics of the Research Subjects

Participants	Birth Weight		P-value
	< 3000 gr (n=59)	> 3000 gr (n=21)	
Maternal Characteristics			
Age (years), mean+SD	24.32+5.53	25.19+5.56	0.480[a]
Socio-economic, n(%)			
Low	21(26.3%)	10(12.5%)	0.476[b]
Middle	36(45%)	11(13.8%)	
High	2(2.5%)	N/A	
Education, n (%)			
Elementary School	2(2.5%)	3(3.8%)	
Junior High School	18(22.5%)	5(6.3%)	0.209[b]
Senior High School	31(38.8%)	8(10%)	
Diploma-3	N/A	1(1.3%)	
Bachelor-1	5(6.3%)	2(2.5%)	
Body Mass Index (kg/m2), mean+SD	26.26+4.90	30.75+5.43	0.001*[a]
Obstetric Characteristics			
Total duration of labor, n (%)			
< 6 hours	28(35%)	8(10%)	0.610[c]
> 6 hours	31(38.8%)	13(16.3%)	
Perineal Rupture, n(%)			
No rupture	3(3.8%)	N/A	0.571[b]
Rupture, grade I	3(3.8%)	1(1.3%)	
Rupture, grade II	53(66.3%)	20(25%)	
Birth Weight (gram), median (min-max)	2700(2140-2990)	3150(3000-4100)	<0.001*[a]

Data are presented in the form of numbers (percentages) for ordinal variables and mean+SD for normally distributed numerical data and median (min-max) for non-normally distributed numerical data. *The P-value is considered significant if <0.05. Numerical tests are performed using the T testa, and categorical tests using the Chi-Square b/Fisher Exact Testc

Table 2. Pelvic Floor Muscle Strength Scores by Measurement Time Points

Measurement time	PFMS (cmH2O), median (min-max)
Antepartum Period	69(41-89)
Inpartu in active phase	8(3-84)
6 weeks postpartum	69(41-85)

Data are presented as frequencies (percentages) for ordinal variables and medians (min-max) for numerical data. PFMS: Pelvic Floor Muscle Strength

Table 3. Pelvic Floor Muscle Strength Scores by Measurement Time Points and Birth Weight

Measurement Time	PFMS (cmH_2O)		P-value
	Bodyweight < 3000 gram (n=59)	Bodyweight > 3000 gram (n=21)	
Antepartum	69(41-89)	80(41-85)	0.898
Inpartu in active phase	8(3-84)	8(3-83)	0.949
6 weeks postpartum	69(41-85)	67(41-85)	0.079

Data are presented as medians (min-max) for numerical data. PFMS: Pelvic Floor Muscle Strength, This tests are performed using Mann-Whitney

Table 4. Relationship between Infant Birth Weight and Pelvic Floor Muscle Strength Changes (ΔPFMS)

Infant Bodyweight	ΔPFMS (cmH2O), median (min-max)	P-value
< 2500 gr (n=20)	-2 (-40 – 43)	
2500-3000 gr (n=39)	-1 (-44 – 43)	0.651[a]
> 3000 gr (n=21)	-9 (-44 – 26)	

Data are presented as medians (min-max) for numerical data. PFMS: Pelvic Floor Muscle Strength; non-parametric statistical analysis was performed using the Kruskal-Wallis testa, and P-values<0.05 were considered statistically significant

4. Discussion

The results of the present study showed a decrease in pelvic floor muscle strength during labor, followed by partial recovery at six weeks postpartum. Overall, the median change in PFMS from antepartum to six weeks postpartum was relatively small, suggesting recovery of pelvic floor muscle function in the early postpartum period. The biomechanical concept of labor explains that the levator ani complex, particularly the pubovisceral portion, experiences maximum stretching as the fetal head passes through the urogenital hiatus, which can lead to microtrauma to muscle fibers and injury to muscle attachments to the pelvic wall. These injuries can be functional or structural and are associated with decreased pelvic floor muscle contractility in the early postpartum period **(7)**. In addition, compression and stretching of the pudendal nerve during the second stage of labor can cause temporary neuropraxia which reduces the transmission of motor impulses to the pelvic floor muscles, the ability to voluntarily contract is reduced in the acute phase after labor **(8)**. This decrease may be exacerbated by perineal tissue edema and neuromuscular inhibition due to postpartum pain, which may affect vaginal pressure measurements using a perineometer without necessarily reflecting permanent structural damage **(9)**. Despite the initial decline, the results of this study also showed a rebound in pelvic floor muscle strength at six weeks postpartum, which reflects the neuromuscular recovery process reported in the literature, where resolution of edema, pain relief, and partial reinnervation of the levator ani muscle fibers contribute to improved contractile function **(8)**. In addition, remodeling of the pelvic floor connective tissue plays a role in increasing structural stability after the acute phase of childbirth injury **(10)**.

Regarding the relationship with birth weight, the results of this study indicate that although there was a numerical trend towards a greater decrease in PFMS in infants with birth weight ≥3000 gr, the difference was not statistically significant. Thiss result is consistent with the result reported in a systematic review by Manzotti et al., (2024), which showed no difference in short-term postpartum PFM strength between primiparous women undergoing cesarean section or vaginal delivery. However, PFM strength was lower in

women undergoing episiotomy or instrumental vaginal delivery compared to those undergoing cesarean section **(11)**. This is also in line with a systematic review by Driusso et al., (2024), which showed no difference in short-term pelvic floor muscle strength after delivery between primiparous women who underwent cesarean section or vaginal delivery, as assessed by vaginal manometry. However, they also identified decreased PFM strength in women who underwent episiotomy or instrumental vaginal delivery compared with those who underwent cesarean section **(12)**. This is not in line with the research of Zhu et al., (2023), which showed that the baby's birth weight is associated with decreased vaginal pressure in women after vaginal delivery and can be considered a risk factor for decreased pelvic floor muscle strength in the population undergoing vaginal delivery **(13)**. Birth weight may not be the primary independent determinant of changes in pelvic floor muscle strength in the early postpartum period. The insignificant results of this study were due to several factors influencing pelvic floor muscle strength which were not controlled. These factors included pre-pregnancy exercise history and episiotomy history. Furthermore, this study only measured up to 6 weeks postpartum, the final results were not yet available. The relatively homogeneous distribution of birth weight was also a factor, as the limited sample size. A recent meta-analysis suggests that levator ani avulsion and structural pelvic floor injuries are more influenced by the factors such as duration of the second stage of labor, tissue trauma, and obstetric interventions than by birth weight alone **(7)**. In addition, PFMS measurements immediately after delivery are greatly influenced by non-mechanical factors such as edema and pain, variations due to differences in fetal weight can be masked by these factors **(8,9)**. Several studies have also shown that fetal head diameter and labor dynamics have a more direct biomechanical influence on pelvic floor injury than the baby's total weight **(13)**. A large population study by Zhu et al., (2023) found an association between higher birth weight and lower vaginal pressure, but the effect weakened after controlling for other obstetric factors **(13)**. Meanwhile, a longitudinal cohort study by Bø et al., (2022) showed that the main determinant of long-term PFMS decline was the presence of levator ani injury, not just fetal weight **(9)**. Other studies also reported that the relationship between birth weight and pelvic floor disorders was more apparent in long-term outcomes such as pelvic organ prolapse, rather than in the acute postpartum phase **(6)**. Thus, the results of this study strengthen the view that changes in pelvic floor muscle strength after childbirth are multifactorial.

In addition to the direct mechanical factors of labor, several studies have shown that changes in the biomechanical properties of connective tissue during pregnancy also influence the response of pelvic floor muscles to the stress of labor. Increased levels of hormones such as relaxin and progesterone decrease the stiffness of collagen fibers, making the pelvic support tissues more distensible but also more susceptible to permanent deformation when subjected to extreme stretching during labor **(10)**. On the other hand, individual variation in neuromuscular control of the pelvic floor is also an important factor. Modern electromyography studies have shown that the ability to voluntarily activate pelvic floor muscles is influenced by neuromuscular coordination established before delivery, women with good muscle control before delivery tend to experience faster functional recovery **(9)**. This suggests that antepartum functional status may be an important determinant of postpartum PFMS changes, independent of infant birth weight.

Differences in measurement methods may also explain the variation in the findings reported by various studies. Those studies that found a strong association between birth weight and pelvic floor dysfunction often used structural outcomes such as levator ani avulsion via ultrasound or Magnetic Resonance Imaging (MRI), whereas manometry/perineometer-based studies better capture contractile functional aspects that may recover over time **(7)**. Thus, the results of this study, which used a functional approach, may better reflect short-term recovery dynamics rather than permanent anatomical damage. The time period over which the measurements were taken plays a crucial role in interpreting the results. The studies evaluating the pelvic floor over a longer period have reported that the effects of mechanical factors such as fetal weight are more pronounced on medium- to long-term outcomes, including pelvic organ prolapse, than in the acute postpartum phase **(13)**. Therefore, the insignificance of the relationship in the results of this study may also be influenced by the relatively early evaluation period, where the neuromuscular recovery process is still actively ongoing

Clinically, the results of this study confirm that postpartum PFMS decline is a common phenomenon after vaginal delivery, screening efforts and education on pelvic floor muscle exercises need to be provided widely to primigravidas, not only in cases of large babies **(9)**. The use of the perineometer as an objective measuring tool is also supported by modern literature which shows good reliability and validity in assessing pelvic floor muscle strength; it can be used in clinical practice to monitor postpartum recovery **(14)**.

This study has several strengths, including its longitudinal design with three measurement points, the absence of dropout, and the use of an objective instrument for measuring PFMS. The focus on a primigravida population also provided sample homogeneity in evaluating the impact of first birth on pelvic floor function. However, limitations of this study include the absence of imaging examinations such as transperineal ultrasonography or MRI to detect levator ani avulsion, a limited follow-up period of up to six weeks postpartum, and the possible influence of other obstetric factors that have not been fully controlled.

5. Conclusion

Vaginal delivery in primigravida women results in decreased pelvic floor muscle strength in the immediate postpartum period, with a trend toward improved function at six weeks postpartum. However, birth weight is not a major contributing factor to decrease pelvic floor muscle strength.

6. Declarations

Acknowledgments

The authors would like to thank the medical staff at Dr. Wahidin Sudirohusodo and Hasanuddin University Academic Hospital for their assistance in data collection.

Ethical Considerations

In conducting this research, every procedure was performed with the permission of the client or their family through the signing of an informed consent form. The researcher first explained the purpose of the study, the research procedures, and the perineometer examination technique to each subject. This study was declared to have fulfilled the ethical requirements for carrying out research from the Human Biometric Research Ethics Commission of the Faculty of Medicine, Hasanuddin University with a letter of recommendation for ethical approval and the Health Research Ethics Commission (HREC) of Hasanuddin University State College Hospital-Dr. Wahidin Sudirohusodo Central General Hospital, Number: 562 / UN4.6.4.5.31 / PP36 / 2025

Authors' Contributions

A.R.S.N conceived, researched, and compiled the research. A.M.T, D.L, S.R, A.N.B, and S.N.A supervised the research. All the authors read and approved the final version of the article.

Conflict of Interest

The authors declare no conflicts of interest.

Fund or Financial Support

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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How to Cite This Article:

Rafika Surya Ningsih A, Tahir A.M, Lotisna D, Rambulangi S, Bangsawan A.N, Nur Asni S. The Correlation between Infant Birth Weight and Changes in Pelvic Floor Muscle Strength among Primigravida Women. J Obstet Gynecol Cancer Res. 2027;12(1):42-48.

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