Published in final edited form as:

Obstet Gynecol. 2012 February ; 119(2 Pt 1): 233–239. doi:10.1097/AOG.0b013e318240df4f.

Pelvic Floor Disorders After Childbirth: Effect of Episiotomy, Perineal Laceration, and Operative Birth

Victoria L. Handa, MD, MHS^a, Joan L. Blomquist, MD^b, Kelly C. McDermott, BS^c, Sarah Friedman, MD^{a,b}, and Alvaro Muñoz, PhD^c

^aDepartment Gynecology and Obstetrics, Johns Hopkins School of Medicine

^bDepartment of Obstetrics and Gynecology, Greater Baltimore Medical Center

^cDepartment of Epidemiology, Johns Hopkins Bloomberg School of Public Health

Abstract

Objective—To investigate whether episiotomy, perineal laceration, and operative delivery are associated with pelvic floor disorders after vaginal childbirth.

Methods—This is a planned analysis of data for a cohort study of pelvic floor disorders. Participants who had experienced at least one vaginal birth were recruited 5–10 years after delivery of their first child. Obstetric exposures were classified by review of hospital records. At enrollment, pelvic floor outcomes, including stress incontinence, overactive bladder, anal incontinence, and prolapse symptoms were assessed with a validated questionnaire. Pelvic organ support was assessed using the Pelvic Organ Prolapse Quantification system. Logistic regression analysis was used to estimate the relative odds of each pelvic floor disorder by obstetric history, adjusting for relevant confounders.

Results—Of 449 participants, 71 (16%) had stress incontinence, 45 (10%) had overactive bladder, 56 (12%) had anal incontinence, 19 (4%) had prolapse symptoms and 64 (14%) had prolapse to or beyond the hymen on examination. Forceps delivery increased the odds of each pelvic floor disorder considered, especially overactive bladder (odds ratio 2.92, 95% confidence interval 1.44, 5.93) and prolapse (odds ratio 1.95, 95% confidence interval 1.03, 3.70). Episiotomy was not associated with any of these pelvic floor disorders. In contrast, women with a history of more than one spontaneous perineal laceration were significantly more likely to have prolapse to or beyond the hymen (odds ratio 2.34, 95% confidence interval 1.13, 4.86). Our multivariable results suggest that one additional woman would develop prolapse for every 8 women who experienced at least one forceps birth (versus delivering all her children by spontaneous vaginal birth).

Conclusion—Forceps deliveries and perineal lacerations, but not episiotomies, were associated with pelvic floor disorders 5–10 years after a first delivery.

Corresponding author: Victoria L. Handa, MD, MHS, 4940 Eastern Avenue, 301 Building, Baltimore, MD 21224, (410) 550-2787 fax (410) 550-2786, Vhandal1@jhmi.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

INTRODUCTION

Among parous women, cesarean birth reduces the odds of pelvic floor disorders later in life (1). However, most U.S. women deliver vaginally. Therefore, it is important to identify labor interventions that increase the risk of pelvic floor disorders after vaginal childbirth.

One area of substantial controversy is the role of episiotomy and spontaneous perineal laceration. Almost 80 years ago, episiotomy was proposed as a strategy to prevent spontaneous laceration and to thereby reduce “pelvic relaxation” (2). Specifically, superior pelvic organ support was observed 6 weeks postpartum among women who had received episiotomy (2–4). However, more recent studies have suggested that episiotomy may increase the odds of pelvic floor disorders (5–7). Thus, the role of episiotomy is uncertain. A 2005 systematic review concluded that the effect of episiotomy on the development of pelvic floor disorders remains unknown (8).

Also controversial is the association between operative delivery and pelvic floor disorders. While some research has suggested that operative delivery substantially increases the odds for pelvic floor disorders (1), other research suggests that operative birth is not a strong predictor of urinary incontinence (9–14) or pelvic organ prolapse (7).

In this research, we investigated putative risk factors for pelvic floor disorders 5–10 years after childbirth among women who had at least one vaginal birth. This was a planned secondary aim of the Mothers’ Outcomes After Delivery study, a longitudinal cohort study of pelvic floor disorders after childbirth. In this analysis, we focused on whether operative delivery, episiotomy, and spontaneous perineal laceration were associated with the later development of pelvic floor disorders among vaginally parous women. Our goal was to identify modifiable obstetric risk factors for pelvic floor disorders.

METHODS

The Mothers’ Outcomes after Delivery study is a prospective cohort study of pelvic floor outcomes in women recruited 5–10 years after delivery of their first child (1). Institutional review board approval was obtained from Johns Hopkins Medicine Institutional Reviewer Board and the Greater Baltimore Medical Center Review Board and all participants provided written informed consent. Recruitment of women into the study began in 2008 and is ongoing. The recruitment methods have been described in detail elsewhere (1). To be eligible, women must have given birth to their first child at Greater Baltimore Medical Center 5 to 10 years prior to enrollment. Participants were identified from obstetric hospital discharge records. To verify eligibility and to confirm delivery type, each hospital chart was reviewed by a member of our research team who was also an obstetrician.

Obstetric exposures were derived from abstraction of all delivery records for each participant. The exposures of primary interest were forceps and vacuum delivery, episiotomy and spontaneous perineal laceration. These were classified after chart abstraction. If relevant data were missing from the medical record, the participant’s recall was used to classify her birth. With respect to laceration and episiotomy, we considered the following as mutually exclusive at the delivery level: intact perineum, episiotomy (with or without extension to grade 3–4), and grade 1–2 spontaneous perineal laceration (with or without extension to grade 3–4). A delivery without an episiotomy or laceration was classified as intact perineum. Midline and mediolateral episiotomies were considered as a single group because only 8% of episiotomies in this population were classified as mediolateral. Although these perineal exposures (episiotomy, laceration, or intact) were defined in mutually exclusive categories at each delivery, they were combined for each woman across all her deliveries for analysis.

Additional obstetric data were also abstracted from the obstetric chart including the duration of the second stage and the birth weight. The duration of the second stage (the time from complete dilation to delivery) was classified as prolonged if greater than 2 hours. Macrosomia was defined as neonatal birth weight of 4000g or more. Although all participants had their first delivery at our institution, some participants delivered a subsequent child at a different hospital. For these deliveries we relied upon the woman's reported description of all obstetrical events.

In addition to obstetrical exposures, we considered the following confounders: race, parity, maternal age at the time of first delivery, and obesity. Race and parity were self-reported at study enrollment. Obesity was also determined at study enrollment. Specifically, each participant's weight and height were measured and body mass index was calculated (kg/m^2). Obesity was defined as a body mass index of $30 \text{ kg}/\text{m}^2$ or greater.

The outcomes of interest were the presence or absence of pelvic floor disorders, evaluated at the enrollment visit. We used the Epidemiology of Prolapse and Incontinence Questionnaire, a validated self-administered questionnaire (15), to identify women with bothersome symptoms of pelvic floor disorders. This questionnaire generates scores for four pelvic floor disorders: stress urinary incontinence (SUI), overactive bladder (OAB), anal incontinence, and pelvic organ prolapse (POP). In each case, a validated threshold is used to define women who meet criteria for the disorder. Scores greater than these threshold values have been shown to correspond to clinically-significant bother from pelvic floor symptoms (15). We used the published thresholds to distinguish women with and without each pelvic floor disorder.

In addition to the research questionnaire, a gynecological examination was performed to assess pelvic organ support, using the Pelvic Organ Prolapse Quantification examination system (16). The examination was performed by physicians and a research nurse, each of whom demonstrated competency in performing the research examination prior to the study; competency was reconfirmed throughout the study. At the time of each examination, the clinician was blinded to the woman's delivery history and her symptoms. Women were classified as having objective evidence of pelvic organ prolapse if the most dependent point of the vaginal wall or the cervix came to or beyond the hymen (1, 17, 18).

At enrollment into our cohort study, participants were asked about prior treatment for pelvic floor disorders, including surgery and pelvic muscle exercises (if the program was professionally supervised). Participants were also asked about current therapy, including medications for urinary incontinence or current pessary use for treatment of prolapse. Women who reported prior surgery, prior supervised pelvic muscle exercises, or any current therapy for a specific pelvic floor disorder were considered to have that condition, regardless of current symptoms.

Contingency tables were used to estimate univariable associations between each exposure of interest and possible confounders and then with each pelvic floor disorder. P-values were obtained using a Fisher's exact test. Next, logistic regression models were employed to estimate the relative odds of each specific pelvic floor disorder, given a woman's history of forceps or vacuum delivery, episiotomy, and spontaneous perineal laceration. In these analyses, each of the five pelvic floor disorders of interest (SUI, OAB, anal incontinence, POP symptoms, and POP by exam) was considered separately. The logistic models were adjusted for relevant confounders, as determined in univariable analyses. In the models estimating the relative odds associated with episiotomy, the reference group was no episiotomy (regardless of a history of spontaneous perineal laceration in another delivery) and there were two comparison groups: one episiotomy and more than one episiotomy. A

similar approach was taken with respect to modeling the relative odds associated with spontaneous perineal lacerations. For all analyses, $p \leq 0.050$ was considered statistically significant.

RESULTS

This study focused on 451 participants who had at least one vaginal birth and who had completed the enrollment assessment at the time of this analysis. The 451 participants reported a total of 820 vaginal births and 86 cesarean births. In total, medical record documentation was not sufficient to classify 100 deliveries (12%) with respect to at least one of the exposures of interest (episiotomy, laceration, or operative delivery), including 56 deliveries that occurred at other hospitals. In those cases, maternal recall of delivery events was used to classify these exposures. However, even including maternal recall, two women could not be classified with respect to the exposures of interest and these two women were therefore excluded, leaving 449 women for this analysis.

At enrollment, the median age was 40 years (range 22.7, 54.4), 51 (11%) were African-American, and 122 (27%) had their first delivery after age 35. Also, 337 (75%) were multiparous, and 74 (16%) were classified as obese. The median interval between first delivery and enrollment was 7.5 years (range 5.1, 11.0).

Of 449 participants, 125 (28%) had a history of at least one operative delivery and six women had two operative deliveries (49 had delivered by vacuum extraction, 71 by forceps, and 5 had experienced both vacuum and forceps). Two hundred and seventy-three women (61%) had experienced at least one episiotomy and 256 women (57%) experienced at least one spontaneous perineal laceration. Sixty-eight women (15%) experienced more than one episiotomy and 88 women (20%) experienced more than one spontaneous perineal laceration. Only 14 women (3%) delivered without any lacerations or episiotomies across all deliveries. Ninety-four women (21%) had a history of both episiotomy and spontaneous perineal laceration. Anal sphincter laceration was experienced by 96 women (21%). This outcome was significantly associated with a history of operative delivery (42% versus 13%, $p < 0.001$) and episiotomy (29% versus 9%, $p < 0.001$).

As shown in Table 1, women with a history of at least one spontaneous perineal laceration were more likely to be multiparous ($p < 0.001$) and were more likely to have been less than 35 at the time of first birth ($p = 0.004$). Women with a history of prolonged second stage were more likely to have a history of operative birth ($p < 0.001$) or episiotomy ($p = 0.004$). In contrast, race, obesity, and macrosomia were not significantly associated with any of the exposures of interest.

Pelvic floor disorders in this population are summarized in Table 2. Seventy-one women (16%) had stress incontinence, 45 (10%) had overactive bladder, 56 (12%) had anal incontinence, 19 (4%) had prolapse symptoms and 64 (14%) had prolapse to or beyond the hymen on examination. Women with at least one forceps delivery were more likely to report each of the pelvic floor disorders considered, although this association was statistically significant only for OAB ($p = 0.006$). Episiotomy was not significantly associated with any of the pelvic floor disorders considered. In contrast, women who had experienced multiple spontaneous perineal lacerations were significantly more likely to have prolapse to or beyond the hymen (24%, versus 12% for women with 0–1 laceration, $p = 0.021$) and were significantly less likely to have OAB (3% for women with two lacerations versus 12% for women with 0–1 laceration, $p = 0.036$).

Due to the small number of women with bothersome symptoms of prolapse ($n = 19$), this outcome was not considered further. For the remaining disorders, the effect of operative

delivery, episiotomy and spontaneous perineal laceration were further investigated in multivariable models (Table 3). For women with a history of at least one forceps delivery, the relative odds of OAB were increased almost threefold (OR 2.92, 95% CI 1.44, 5.93) and the odds of prolapse to or beyond the hymen were almost doubled (odds ratio 1.95, 95% CI 1.03, 3.70). Vacuum delivery did not appear to increase the odds for any pelvic floor disorder. To put the observed effect of forceps birth into perspective, we calculated the number needed to harm (19), a measure of the magnitude of risk associated with an exposure. Assuming a causal relationship between forceps delivery and prolapse, for example, our multivariable results suggest that one additional woman would develop prolapse for every 8 women who experienced at least one forceps birth (versus delivering all her children by spontaneous vaginal birth).

As also shown in Table 3, episiotomy was not associated with any of the pelvic floor disorders considered. Specifically, the relative odds for each pelvic floor disorder were similar among women with a history of no episiotomies, one episiotomy, or multiple episiotomies. In contrast, the relative odds of prolapse to or beyond the hymen was doubled for women with two or more spontaneous lacerations, compared to women zero or one laceration (OR 2.34, 95% CI 1.13, 4.86). Because this finding was relevant only for multiparous women (e.g., multiple spontaneous perineal lacerations could be experienced only by women with multiple vaginal births), we performed an additional analysis of this association, restricted to women who had experienced at least two vaginal births. In this subset of 283 women, the relative odds of prolapse remained significantly elevated among those with two or more spontaneous perineal lacerations (OR 2.26, 95% CI 1.00, 5.09).

DISCUSSION

Our findings suggest that forceps deliveries and perineal lacerations (but not episiotomies) are associated with pelvic floor disorders 5–10 years after a first delivery. Women with perineal lacerations in two or more deliveries were at significantly higher risk of prolapse. In contrast, even among women with multiple episiotomies across multiple pregnancies, the odds for incontinence and prolapse were not elevated. Our data do not suggest a “dose response” relationship between perineal laceration and prolapse. Specifically, the increase in prolapse was statistically significant only in women with at least two lacerations. It is unclear whether this represents a threshold effect or whether a larger study would be required to demonstrate an association between prolapse and a single spontaneous perineal laceration.

The observed association between spontaneous laceration and the later development of prolapse is biologically plausible, given recent evidence of the role of levator ani injuries in the genesis of prolapse. Magnetic resonance imaging suggests that avulsion of the levator from the pubis is associated with prolapse later in life (20). Biomechanical models of the pelvic floor predict that avulsion of the levator ani occurs with excessive stretching of the levator hiatus during crowning of the fetal head (21). We speculate that spontaneous perineal laceration may be a marker of excessive stretch at the time of delivery.

Episiotomy was relatively common in this population: 61% of vaginally parous women experienced an episiotomy in at least one birth. In contemporary obstetrical practice, episiotomy is performed at 25–35% of U.S. deliveries (8, 22, 23). Thus, our participants' episiotomy rate may be higher than other centers. An argument in favor of restricted use of episiotomy is the prevention of anal sphincter lacerations (23, 24), theoretically reducing anal incontinence (25). However, despite the association between episiotomy and anal sphincter laceration among our participants, we did not find an association between episiotomy and anal incontinence. Ideally, our findings should be replicated in a low-

episiotomy setting to investigate whether a more restrictive use of episiotomy would yield different findings.

Another important finding from this research is that forceps delivery increased the odds of pelvic floor disorders 5–10 years after first delivery. The increase was statistically significant only for OAB and prolapse. Given the relatively low prevalence of pelvic floor disorders in this population, we had limited power to exclude an association between forceps birth and either SUI or anal incontinence. With longitudinal follow up of this cohort, we will have an opportunity to investigate whether continence and pelvic organ support deteriorate more in some groups than others. We considered only the first 5–10 years after childbirth and this interval may not be sufficient to see the effect of some exposures on the incidence of pelvic floor disorders. We intentionally recruited women 5–10 years from first childbirth, in the hopes of capturing the onset of pelvic floor disorders as the population ages. The relative differences between groups are expected to grow with time and will be a major focus of the ongoing longitudinal study.

A potential weakness of this study is that 12% of obstetrical exposures were classified by maternal recall (e.g, the hospital record was unavailable or relevant data were missing from the record). Furthermore, although this study employed validated measures for the assessment of pelvic floor disorders, misclassification cannot be excluded. Nondifferential misclassification of either exposures or outcomes would have the effect of reducing our ability to detect important associations. Also, this is an observational study and interventions such as operative birth and episiotomy were not randomly assigned. Thus, unmeasured factors could confound the observed associations.

A strength of this study is the relatively large sample size, facilitating the investigation of a variety of obstetrical interventions. Also, the duration of follow up was longer than most prior studies. This provided an opportunity for us to investigate the effect of interventions across multiple deliveries for multiparous women. Finally, the use of an objective, quantitative assessment of pelvic organ support is uncommon in epidemiologic research and enhances the value of this research by providing objective evidence of prolapse. The importance of these objective anatomic data is highlighted by the relatively low prevalence of prolapse symptoms in this cohort. Research based only on symptoms might not capture some of the associations observed in this research.

While these data demonstrate a significant increase in the odds of prolapse among women who have experienced forceps birth or multiple perineal lacerations, the “big picture” is that the differences *between* vaginal birth and cesarean birth (1) are more notable than the differences identified *among* those who deliver vaginally. The mechanisms responsible for the incidence of pelvic floor disorders after vaginal childbirth may not yet be recognized and indeed the most “risky” aspects of vaginal childbirth may not be measured and recorded during routine obstetrical care. Our findings argue for further investigation of the mechanisms underlying the critical links between childbirth and pelvic floor function later in life.

Acknowledgments

Supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (R01HD056275).

REFERENCES

1. Handa VL, Blomquist JL, Knoepp LR, Hoskey KA, McDermott KC, Muñoz A. Pelvic floor disorders 5–10 years after vaginal or cesarean childbirth. *Obstet Gynecol.* 2011; 118:777–784. [PubMed: 21897313]
2. Aldridge AH, Watson P. Analysis of end-results of labor in primiparas after spontaneous versus prophylactic methods of delivery. *J Obstet Gynecol.* 1935; 30:554–565.
3. Nugent FB. The primiparous perineum after forceps delivery. *Am J Obstet Gynecol.* 1935; 30:249–256.
4. Gainey HL. Postpartum observation of pelvic tissue damage: further studies. *Am J Obstet Gynecol.* 1955; 70:800–807. [PubMed: 13258672]
5. Viktrup L, Lose G. The risk of stress incontinence 5 years after first delivery. *Am J Obstet Gynecol.* 2001; 185:82–87. [PubMed: 11483909]
6. Casey B, Schaffer J, Bloom S, Heartwell S, McIntire D, Leveno KJ. Obstetric antecedents for postpartum pelvic floor dysfunction. *Am J Obstet Gynecol.* 2005; 192:1655–1662. [PubMed: 15902173]
7. Tegerstedt G, Miedel A, Maehle-Schmidt M, Nyrén O, Hammarström M. Obstetric risk factors for symptomatic prolapse: a population-based approach. *Am J Obstet Gynecol.* 2006; 194:75–81. [PubMed: 16389012]
8. Hartmann K, Viswanathan M, Palmieri R, Gartlehner G, Thorp J, Lohr KN. Outcomes of routine episiotomy: a systematic review. *JAMA.* 2005; 293:2141–2148. [PubMed: 15870418]
9. MacArthur C, Glazener CM, Wilson PD, Lancashire RJ, Herbison GP, Grant AM. Persistent urinary incontinence and delivery mode history: a six-year longitudinal study. *BJOG.* 2006; 113:218–224. [PubMed: 16412001]
10. Thom DH, Brown JS, Schembri M, Ragins AI, Creasman JM, Van Den Eeden SK. Parturition events and risk of urinary incontinence in later life. *Neurourol Urodyn.* 2011 Jul 20. (Epub ahead of print).
11. Schytt E, Lindmark G, Waldenstrom U. Symptoms of stress incontinence 1 year after childbirth: prevalence and predictors in a national Swedish sample. *Acta Obstet Gynecol Scand.* 2004; 83:928–936. [PubMed: 15453888]
12. Fritel X, Schaal JP, Fauconnier A, Bertrand V, Levet C, Pigné A. Pelvic floor disorders 4 years after first delivery: a comparative study of restrictive versus systematic episiotomy. *BJOG.* 2008; 115:247–252. [PubMed: 17970794]
13. Goldberg RP, Abramov Y, Botros S, et al. Delivery mode is a major environmental determinant of stress urinary incontinence: results of the Evanston-Northwestern Twin Sisters Study. *Am J Obstet Gynecol.* 2005; 193:2149–2153. [PubMed: 16325632]
14. Burgio KL, Zyczynski H, Locher JL, Richter HE, Redden DT, Wright KC. Urinary incontinence in the 12-month postpartum period. *Obstet Gynecol.* 2003; 102:1291–1298. [PubMed: 14662217]
15. Lukacz ES, Lawrence JM, Buckwalter JG, Burchette RJ, Nager CW, Luber KM. Epidemiology of prolapse and incontinence questionnaire: validation of a new epidemiologic survey. *Int Urogynecol J Pelvic Floor Dysfunct.* 2005; 16:272–284. [PubMed: 15856132]
16. Bump RC, Mattiasson A, Bø K, Brubaker LP, DeLancey JO, Klarskov P, Shull BL, Smith AR. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol.* 1996; 175:10–17. [PubMed: 8694033]
17. Bradley CS, Nygaard IE. Vaginal wall descensus and pelvic floor symptoms in older women. *Obstet Gynecol.* 2005; 106:759–766. [PubMed: 16199633]
18. Handa VL, Nygaard I, Kenton K, Cundiff GW, Ghatti C, Ye W, Richter HE. Pelvic Floor Disorders Network. Pelvic organ support among primiparous women in the first year after childbirth. *Int Urogynecol J Pelvic Floor Dysfunct.* 2009; 20:1407–1411. [PubMed: 19777148]
19. Nuovo J, Melnikow J, Chang D. Reporting number needed to treat and absolute risk reduction in randomized controlled trials. *JAMA.* 2002; 287:2813–2814. [PubMed: 12038920]
20. DeLancey JO, Morgan DM, Fenner DE, Kearney R, Guire K, Miller JM, Hussain H, Umek W, Hsu Y, Ashton-Miller JA. Comparison of Levator Ani Muscle Defects and Function in Women

With and Without Pelvic Organ Prolapse. *Obstet Gynecol.* 2007; 109:295–302. [PubMed: 17267827]

21. Lien KC, Mooney B, DeLancey JO, Ashton-Miller JA. Levator Ani Muscle Stretch Induced by Simulated Vaginal Birth. *Obstet Gynecol.* 2004; 103:31–40. [PubMed: 14704241]
22. Hale, RW.; Ling, FW. Episiotomy: procedure and repair techniques. Washington DC: American College of Obstetricians and Gynecologists; 2007.
23. ACOG Practice Bulletin No. 71: Episiotomy. American College of Obstetricians and Gynecologists. *Obstet Gynecol.* 2006; 107:957–962. [PubMed: 16582142]
24. Albers LL, Sedler DK, Bedrick EJ, Teaf D, Peralta P. Midwifery care measures in the second stage of labor and reduction of genital tract trauma at birth: a randomized trial. *J Midwifery Womens Health.* 2005; 50:365–372. [PubMed: 16154062]
25. NIH state-of-the-science conference statement on prevention of fecal and urinary incontinence in adults. *NIH Consens State Sci Statements.* 2007 Dec 12–14; 24(1):1–37. [PubMed: 18183046]

Table 1

Frequency of Operative Birth, Episiotomy, and Spontaneous Perineal Laceration Among 449 Vaginally Parous Women

	Operative Birth[*] n=125 (28%)	Episiotomy[*] n=273 (61%)	Spontaneous Laceration[*] n=256 (57%)
African American	(<i>P</i> = 0.324)	(<i>P</i> = 0.365)	(<i>P</i> = 0.766)
No (n= 398)	114 (29)	245 (62)	228 (57)
Yes (n= 51)	11 (22)	28 (55)	28 (55)
Aged older than 35 at first birth	(<i>P</i> = 0.637)	(<i>P</i> = 0.448)	(<i>P</i> = 0.004)
No (n= 327)	89 (27)	195 (60)	200 (61)
Yes (n= 122)	36 (30)	78 (64)	56 (46)
Multiparous[†]	(<i>P</i> = 0.274)	(<i>P</i> = 0.315)	(<i>P</i> < 0.001)
No (n=112)	36 (32)	73 (65)	37 (33)
Yes (n= 337)	89 (26)	200 (59)	219 (65)
BMI ≥ 30kg/m²[†]	(<i>P</i> = 0.121)	(<i>P</i> = 0.301)	(<i>P</i> = 0.898)
No (n= 375)	110 (29)	232 (62)	213 (57)
Yes (n= 74)	15 (20)	41 (55)	43 (58)
Macrosomia[*]	(<i>P</i> = 0.453)	(<i>P</i> = 0.784)	(<i>P</i> = 0.785)
Never (n= 385)	110 (29)	233 (61)	218 (57)
Ever (n= 64)	15 (23)	40 (63)	38 (59)
2nd stage longer than 2 hrs[*]	(<i>P</i> < 0.001)	(<i>P</i> = 0.004)	(<i>P</i> = 0.006)
Never (n= 322)	62 (19)	182 (57)	197 (61)
Ever (n=127)	63 (50)	91 (72)	59 (46)

Data are n(%) unless otherwise specified.

^{*} Ever-present across all deliveries prior to enrollment. "Operative birth," "Episiotomy" and "Laceration" are not mutually exclusive.

[†] Measured at the time of enrollment (5–10 years after first delivery).

Table 2
Frequencies of Pelvic Floor Disorders at Enrollment* Among 449 Vaginally Parous Women

	Stress Urinary Incontinence n=71 (16%)	Overactive Bladder n=45 (10%)	Anal Incontinence n=56 (12%)	POP _{sx} n=19 (4%)	POP _{exam} n=64 (14%)
Operative birth[†]	(P=0.239)	(P=0.006)	(P=0.250)	(P=0.056)	(P=0.065)
Never (n= 324)	47 (14)	24 (7)	37 (11)	10 (3)	43 (13)
Vacuum only (n=49)	7 (14)	6 (12)	5 (10)	2 (4)	4 (8)
Forceps (n= 76)	17 (22)	15 (20)	14 (18)	7 (9)	17 (22)
Episiotomy[†]	(P= 0.470)	(P= 0.718)	(P= 0.925)	(P= 0.249)	(P= 0.999)
Never (n= 176)	32 (18)	17 (10)	21 (12)	8 (5)	25 (14)
One (n= 205)	31 (15)	23 (11)	27 (13)	6 (3)	29 (14)
Two or more (n= 68)	8 (12)	5 (7)	8 (12)	5 (7)	10 (15)
Spontaneous laceration[†]	(P= 0.901)	(P= 0.036)	(P= 0.560)	(P= 0.750)	(P= 0.021)
Never (n= 193)	32 (17)	25 (13)	28 (15)	8 (4)	22 (11)
One (n= 168)	25 (15)	17 (10)	19 (11)	6 (4)	21 (13)
Two or more (n= 88)	14 (16)	3 (3)	9 (10)	5 (6)	21 (24)

Data are n(%) unless otherwise specified.

POP_{sx}, prolapse symptoms; POP_{exam}, prolapse to or beyond the hymen on physical examination.

* Measured at the time of enrollment (5–10 years after first delivery).

[†] Ever-present across all deliveries prior to enrollment.

Table 3

Unadjusted and Adjusted Relative Odds of Pelvic Floor Disorders (With 95% Confidence Intervals) for History of Operative Delivery, Episiotomy, and Spontaneous Laceration Among 449 Vaginally Multiparous Women

	Stress Urinary Incontinence	Overactive Bladder	Anal Incontinence	POP _{exam}
Operative Birth[*]				
Vacuum:				
Unadjusted:	0.98 (0.42, 2.32)	1.74 (0.68, 4.51)	0.88 (0.33, 2.36)	0.58 (0.20, 1.70)
Adjusted [†]	0.99 (0.42, 2.34)	1.76 (0.68, 4.57)	0.90 (0.34, 2.43)	0.61 (0.21, 1.78)
Forceps:				
Unadjusted	1.70 (0.91, 3.16)	3.07 (1.53, 6.20)	1.75 (0.89, 3.44)	1.88 (1.01, 3.53)
Adjusted [†]	1.65 (0.88, 3.08)	2.92 (1.44, 5.93)	1.66 (0.84, 3.28)	1.95 (1.03, 3.70)
Episiotomy[‡]				
One episiotomy:				
Unadjusted	0.80 (0.47, 1.38)	1.18 (0.61, 2.29)	1.12 (0.61, 2.06)	1.00 (0.56, 1.77)
Adjusted [§]	0.71 (0.41, 1.25)	0.90 (0.45, 1.81)	0.98 (0.52, 1.85)	1.01 (0.55, 1.84)
More than two episiotomies:				
Unadjusted	0.60 (0.26, 1.38)	0.74 (0.26, 2.10)	0.98 (0.41, 2.34)	1.04 (0.47, 2.30)
Adjusted [*]	0.57 (0.24, 1.35)	0.67 (0.23, 2.01)	1.01 (0.41, 2.48)	0.87 (0.38, 1.98)
Spontaneous Laceration[‡]				
One laceration:				
Unadjusted	0.88 (0.50, 1.56)	0.76 (0.39, 1.46)	0.75 (0.40, 1.40)	1.11 (0.59, 2.10)
Adjusted [†]	0.96 (0.54, 1.73)	0.87 (0.44, 1.72)	0.84 (0.44, 1.60)	1.16 (0.60, 2.24)
More than two lacerations:				
Unadjusted	0.95 (0.48, 1.89)	0.24 (0.07, 0.81)	0.67 (0.30, 1.49)	2.44 (1.26, 4.72)
Adjusted [*]	1.14 (0.54, 2.39)	0.33 (0.10, 1.18)	0.80 (0.34, 1.90)	2.34 (1.13, 4.86)

POP_{exam}, prolapse to or beyond the hymen on physical examination.

* Models were run with two indicator variables: "Vacuum" indicates a history of at least one vacuum delivery but no forceps birth, and "forceps" indicates a history of forceps with or without a history of vacuum delivery.

[†] Odds ratios are adjusted for maternal age older than 35 at first delivery and multiparity at enrollment.

[‡] Models were run with two indicator variables, one for one episiotomy or /laceration, and one for two or more episiotomies or lacerations.

[§] Odds ratios are adjusted for maternal age older than 35 at first delivery, multiparity at enrollment, and history of any operative delivery.