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THE CONTRIBUTION OF THE SECOND STAGE OF LABOR TO PELVIC FLOOR DYSFUNCTION: A PROSPECTIVE COHORT COMPARISON OF NULLIPAROUS WOMEN

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Abstract

Objective—Maternal expulsive efforts are thought to damage the pelvic floor. We aimed to compare pelvic floor function and anatomy between women who delivered vaginally (VB) versus cesarean (CD) without entering the second stage of labor.

Design—Prospective cohort

Setting—University Hospital Midwifery practice

Population—Nulliparas

Methods—Pregnant nulliparas were recruited during pregnancy and women who underwent CD prior to the 2nd stage of labor at birth were recruited immediately postpartum. Both groups were prospectively followed to 6 months postpartum.

Main Outcome Measures—POPQ, perineal ultrasound(U/S) and Paper Towel Test(PTT), an objective measure of stress incontinence; Incontinence Severity Index(ISI), Pelvic Floor Impact Questionnaire(PFIQ-7), Wexner Fecal Incontinence Scale(W) and Female Sexual Function Index(FSFI)

Results—336/448(75%)VB and 138/224(62%)CD followed up. The VB group was younger (23.9+/-4.9 vs 26.6+/-6.1 years, $P<.001$) and less overweight/obese (38 vs 56%, $P<.001$); baseline functional measures were similar(all $P>.05$). At followup, urinary incontinence (UI)(55 vs 46% ISI>0, $P=.10$), fecal incontinence(FI) (8 vs 13% FI on W, $P=.12$), sexual activity rates(88 vs 92%, $P=.18$) and PFIQ-7 scores were similar. Positive PTT tests(17 vs 6%, $P=.002$) and Stage 2 prolapse (22 vs 15%, $P=.03$) were higher with VB; differences were limited to points Aa and Ba. U/S findings were not different between groups. Stepwise multivariate analyses controlling for age, BMI, and non-Hispanic White race for prolapse of points Aa and Ba did not alter conclusions (all $P<.004$).

Conclusions—VB resulted in prolapse changes and objective UI, but did not result in increased self-report pelvic floor dysfunction at 6 months postpartum compared to women who delivered by CD without the second stage of labor. The second stage of labor has a modest effect on postpartum pelvic floor function.

Keywords

pregnancy; prolapse; incontinence; cesarean section; vaginal birth

Introduction

Cesarean delivery (CD) is thought to diminish the risk of pelvic floor dysfunction following delivery, including urinary (UI) and anal incontinence (AI), pelvic organ prolapse (POP),

pelvic pain and to preserve sexual function¹⁻³. Recent data confirm that operative vaginal delivery significantly increases the risk of pelvic floor dysfunction 5-10 years after first delivery, however, rates of forceps, vacuum and episiotomy have decreased significantly over the past decade and little is known about the impact of normal birth on the pelvic floor without these interventions³⁻⁵. In a large retrospective cohort study, cesarean delivery prior to the second stage of labor was not associated with an increased risk of UI, AI or POP when compared to women who delivered prior to labor³. While it is thought that delivery of the fetal head poses the greatest threat to pelvic floor function, prior studies have not focused their comparisons on groups who did and did not enter the second stage of labor, choosing instead to include those randomized to cesarean delivery prior to labor as in the Term Breech Trial⁶ or who had a cesarean for a variety of indications making it challenging to describe the contribution of the second stage of labor to subsequent pelvic floor dysfunction.

Alterations in the Pelvic Floor in Pregnancy, Labor and the Ensuing Years (APPLE) is a prospective cohort study of nulliparous midwifery and CD patients from low risk obstetrical services. This study was designed to investigate postpartum pelvic floor changes among women who did and did not enter the second stage of labor by comparing women who underwent cesarean delivery prior to the second stage of labor and women who gave birth vaginally. We aimed to evaluate the full range of pelvic floor function including UI and AI, sexual function, pain and anatomical changes. We recruited women who underwent CD prior to entry into the second stage of labor, as maternal expulsive efforts are thought to pose the greatest damage to the pelvic floor, and offers the attendant the greatest opportunity to vary practice to decrease postpartum pelvic floor changes⁷. We aimed to compare six month postpartum pelvic floor function and anatomical changes between women who delivered by cesarean(CD group) prior to the second stage of labor to those who delivered vaginally (VB group) in order to better define the contributions of the second stage to pelvic floor dysfunction.

Methods

Nulliparous patients cared for by the Midwifery service and primiparous CD patients were recruited prospectively from December 2006 to January 2011 in Albuquerque, New Mexico. Eligibility criteria were age ≥ 18 years of age, ability to read either English or Spanish, singleton gestation, absence of serious medical problems, gestational age of ≤ 36 weeks and no late second trimester pregnancy losses. All midwife patients were eligible for midwifery care until birth. Midwife patients who delivered vaginally comprised the vaginal birth (VB) group and included women who underwent episiotomy and operative delivery. The CD group was recruited from the low risk obstetrical ward cared for by the Obstetrics and Gynecology or the Family Medicine service, and were eligible if they had not entered the second stage of labor. Cesarean delivery on maternal request is rare in our institution, and the women enrolled in this study planned to undergo vaginal delivery. Fetal malpresentation was not an indication for exclusion. Women who underwent CS were recruited on the first postpartum day and followed prospectively until 6 months postpartum. Midwife patients who underwent CD without entering the second stage of labor were included in the CD group for analyses. Low risk women seeking care for pregnancy at UNM can either choose to be followed by the midwifery service or cared for by physicians. Each

service follows their patients during pregnancy, at delivery and postpartum. The study was approved by the Institutional Review Board of the University of New Mexico, and all women gave written informed consent.

Physical exam and pelvic floor functional data were assessed during early and late pregnancy and at 6 months postpartum for all midwife patients. Physical exam data collected included Pelvic Floor Quantification Exams (POPQ)⁸, assessment of pelvic floor muscle strength using the Brinks scale⁹, and visual inspection of the perineum. All certified nurse-midwife (CNM) examiners underwent POPQ training with live models prior to the conduct of the study. In addition, a subset of exams was repeated by a second CNM examiner to determine inter-rater reliability at the six month follow-up visit. Functional data were gathered by using the following quality of life and symptom severity scales: the Incontinence Severity Index (ISI)¹⁰ the Questionnaire for Urinary Incontinence Diagnosis (QUID)¹¹, the Pelvic Floor Impact Questionnaire (PFIQ-20)^{12, 13}, the Wexner Fecal Incontinence Scale (W)¹⁴, the Present Pain Intensity Scale (PPI)¹⁵ and the Female Sexual Function Index (FSFI)^{16, 17}. Any UI was defined as ISI scores > 0; moderate to severe UI was defined as ISI scores ≥ 3 ¹⁰. Any AI (flatus, liquid or solid stool) was defined as a Wexner score > 0; fecal incontinence was defined as an affirmative answer to the questions regarding leakage of liquid or solid stool.

Intrapartum data were collected at delivery by the attendant midwife, or shortly thereafter for the CD group, and included maternal, fetal and labor characteristics. Race/ethnicity was self-defined by participants. The VB group underwent a detailed mapping of perineal trauma. For perineal lacerations greater than or equal to a second degree laceration, a second observer assessed the perineum. Perineal trauma suturing was standardized as previously described¹⁸ and midwives participated in annual laceration repair workshops.

Recruitment of the CD group was accomplished by daily review of labor and delivery records. Primiparous women who delivered by CD were identified, the patient's chart was reviewed to determine if she had entered the second stage of labor, and if not, the woman was approached for participation. Once formal consent was obtained, women in the CD group were asked to provide pelvic floor functional data as experienced in the last 3 months of pregnancy. This group was then followed prospectively with the VB group.

At the six-month postpartum visit, in addition to giving functional data and undergoing the POPQ examination, all women underwent transperineal ultrasound (US). Women were placed in the lithotomy position and were imaged immediately after voiding. Disruption of the internal or external anal sphincters at the proximal, mid and/or distal levels were counted as not intact. Women also completed a Paper Towel Test (PTT)¹⁹. With a full bladder, women were asked to cough three times within a 10 second time span, with the paper towel applied to the perineum. Staining of the paper towel with fluid was recorded as a positive test. Physical exam of the perineum included observation of a "dovetail sign", loss of perianal anterior radial folds, and/or perianal dimpling both thought to represent separation of the anal sphincter. Postpartum ultrasound and physical exam examiners were blinded to mode of delivery and participating women were instructed not to inform the examiner of delivery mode. Women were compensated \$75.00 at the six-month visit for travel and

babysitting costs. If women could not present for appointments, they were mailed questionnaires.

We aimed to recruit 765 women; 630 nulliparas from the Midwifery service, and an additional 135 primiparous women delivered by cesarean from the low risk Obstetrical and Family Medicine services. We anticipated that 20% of women recruited from midwifery clinics would not deliver with the midwives secondary to early pregnancy loss, relocation, insurance changes or medical complications of pregnancy. In addition, 50 midwife patients were expected to deliver by cesarean. Since the majority of the CD group was recruited immediately after delivery, baseline comparisons between groups included those VB patients who gave functional data late in pregnancy (after 36 completed weeks of pregnancy) and functional data given by non-midwife CD patients at birth who were asked to recall functional symptoms during their third trimester.

Two of the authors performed statistical analyses (RGR and CQ). With an assumption of 75% follow-up, we estimated that 119 CD and 375 VB women would give data at 6 months postpartum. We also assumed that the prevalence of bothersome UI and/or AI would be low, and the proportion of women who reported sexual activity would be high. With 494 women and an alpha of 0.05 we had 80% power to detect any of the disorders where the two groups had a prevalence of UI or AI, or sexual inactivity that differed by at least 10% if prevalence was low (<10%) or high (>80%). Descriptive statistics were used to compare groups at baseline and follow-up; categorical data were compared using Fisher's Exact test or chi-square analyses, POPQ stage was evaluated with the Jonckheere-Terpstra trend test. Continuous variables were compared using t tests. In order to evaluate the impact of baseline differences between groups on POPQ measures and sexual function, a stepwise regression multivariate analysis was performed which included variables found to be different at baseline between groups as well as known predictors of outcomes. All analyses were conducted with SAS version 9.3.

Results

We consented 782 women; 627 midwife patients and 155 CD patients. Of the midwife group, 541 women delivered at the University of New Mexico; 448 women gave VB and 93 underwent CD. As planned, the 69 midwife patients who underwent CD prior to the second stage of labor were combined with the CD group recruited immediately postpartum; for a total of 224 women in the CD group. Study participation is outlined in Figure S1. Overall, 474/672 (71%) of eligible women gave data at 6 months postpartum, with 138/224(62%) women in the CD group and 336/448(75%) in the VB group.

Women who followed up (N=474) were slightly older than women who did not (N= 199) (25.2 +/- 5.5 vs 23.9 +/- 5.3, P=.006) had more years of education (14.1 +/- 2.8 vs 13.1 +/- 2.7, P<.001) and had slightly lower BMI (25.1 +/- 5.6 vs 26.2 +/- 6.2, P=.02). At baseline, follow up groups did not differ in rates of UI, AI or sexual activity, sexual function scores, BMI, or race/ethnicity (Table S1). We were able to collect prospective data on a third of the CD group who were cared for by midwives during pregnancy (N=69); their reports of function in the third trimester of pregnancy were not different than the functional reports of

CD participants recruited postpartum, although these comparisons were limited to questionnaire responses and not physical exam findings (Table 1). The VB group was younger (23.9 ± 4.9 vs 26.6 ± 6.1 years, $P < .001$) and less overweight/obese (38 vs 56%, $P < .001$) but groups did not differ in years of education, tobacco use, ethnicity, fetal birth weight, weight gain during pregnancy or epidural and oxytocin use. Native American women, who represented 8% of the study population, were more likely to undergo CD than VB, however did not vary in baseline functional assessment when compared to other race/ethnicities.(data not shown) Among women who gave VB, eight women (2%) underwent episiotomy and 22 (5%) sustained third or fourth degree lacerations. Of the women who sustained second degree lacerations or greater ($n=129$), 69% had a second observer, all but one of whom agreed with the second degree diagnosis. One woman had a forceps delivery and 25(6%) a vacuum delivery. Among women who delivered vaginally, the mean length of the second stage of labor was 72.2 ± 63.9 minutes. (Table 1)

At six months postpartum, while approximately half of women in each group reported some UI, less than 10% of women in either group reported moderate to severe UI. The CD group did not report more UI than the VB group on self-report measures whether evaluated by presence, severity scores or quality of life impact (all $P = NS$). Of those with UI, ISI and IIQ-7 mean scores were similarly low. Women who gave VB were more likely than those who delivered by CD to have QUID stress greater than urge scores (27 vs 16%, $P = .02$). The PTT was performed by 445/474 (94%) of women who followed up. Most women had no leakage of urine (86%). Women in the VB group were more likely to have a wet paper towel than those who delivered by cesarean (17% vs 6%, $P = .002$).

Many women reported some AI including loss of flatus (50%), however, few women (less than 10%) reported fecal incontinence. The VB group was not more likely to report greater presence, severity or quality of life impact of AI symptoms than women who gave birth by CD (all $P = NS$). (Table 2) Dovetail signs were few and not different between groups, and no woman was observed to have perianal dimpling. Of women who agreed to US ($N=410$ (87%)), there were 34 internal and 4 external anal sphincter disruptions, with no differences between groups (all $P = NS$). While the CD group was not more likely to report perineal pain or be sexually inactive, six month FSFI scores were significantly lower; this difference was explained by lower Desire domain scores.(Table 2)

On physical exam, the VB group was more likely to have a higher stage of prolapse than the CD group at 6 months postpartum; the POPQ differences were limited to the anterior vaginal wall. (Table 2) Seventeen women underwent repeat exams for inter-rater reliability testing of the POPQ exam; agreement between examiners was high (82% complete agreement) for prolapse stage, and all POPQ points were within 1 cm of agreement for 76% of measures. Although differences were noted between groups on physical exam, prolapse quality of life impact scores did not differ between groups ($P = NS$).

Because our CD group was recruited from both the midwifery and physician services, we performed a comparison of outcomes between these two groups. No differences were found in urinary or anal incontinence, sexual activity, sexual function scores or perineal pain. The MD cesarean patients were more likely to have stage 2 prolapse, although all prolapse was

at least 1 cm above the hymen as measured on all seven POPQ points. Given the very small differences in measurable prolapse, we feel that these results are not clinically significant. (data not shown). When entered into a stepwise regression model including baseline variables that were different between groups (Age, BMI and weight gain) as well as non-Hispanic White race/ethnicity, a known predictor of prolapse, delivery mode remained a significant predictor of POPQ points Aa and Ba and FSFI scores (Table 3).

Discussion

Main Findings

We found that pelvic floor dysfunction among primiparous women following either a vaginal or cesarean birth without entry into the second stage of labor was uncommon. In this study, use of interventions such as episiotomy and operative delivery, already known to negatively impact pelvic floor function, were quite low. Self-reported rates of UI, AI, pain and sexual activity were similar between groups. Women who gave VB were more likely to have greater descent of the anterior vaginal wall; however differences were small and POP quality of life impact was not different between groups. In addition, women who gave VB were more likely to have objective loss of urine on PTT; although most women were dry on objective testing and few women reported moderate to severe UI symptoms. Finally, women who underwent CD were more likely than women who delivered vaginally to report lower sexual function scores; again, these differences were small between groups and confined to the Desire domain of the FSFI. Our findings support that the second stage of labor does not significantly negatively impact global postpartum pelvic floor function at 6 months postpartum in a low-episiotomy, low-operative delivery setting. While our vaginal birth group was cared for by midwives, the low rates of episiotomy and operative delivery are reflective of the low rates of these interventions of all practitioners who attend birth in our labor and delivery unit^{20,21}. In addition, our practices are reflective of US national trends in the performance of episiotomy and operative delivery and are reflective of evidence based care^{22, 23}.

We found that changes in pelvic floor function following birth in either group were small, unlikely to affect quality of life, and did not vary greatly by mode of delivery. This study is unique because we chose to focus on the impact of the second stage of labor rather than planned cesarean without labor. While maternal choice cesarean delivery has gained traction in some settings, entry into labor remains the norm for most primiparous women²⁴. Our findings can reassure women that birth in a low operative delivery and episiotomy setting results in a low incidence of postpartum pelvic floor dysfunction at six months. We found pelvic floor dysfunction present at low levels in both cohorts, indicating that there may be contributions to pelvic floor dysfunction that result from pregnancy or the postpartum period or changes that occur in the first stage of labor.

Strengths and Limitations

Unique aspects that strengthen our study include that we recruited women during pregnancy and immediately after CD and followed them prospectively postpartum. We evaluated the full range of pelvic floor function using validated questionnaires and pelvic floor

examinations rather than focusing on a single aspect of pelvic floor function. Unlike prior studies, we included measures of sexual function, a pelvic floor outcome important to young healthy women. We took care to standardize perineal repair and consistency of pelvic floor measurements between examiners and blinded examiners to mode of delivery. We also included multiple measures of each type of pelvic floor problem; for example, we evaluated the presence, severity, type and quality of life changes associated with UI, as well as an objective measure for UI with a PTT. The overall consistency between measures that we observed further supports our conclusions.

Our findings are limited to the short term following pregnancy. While 6 month follow-up is short, others have shown that women with persistent UI and 3 months following birth have a 92% risk of UI at 5 years^{25,26}. In addition, urethral needle EMG testing has been shown to improve and stabilize between 6 weeks and 6 months postpartum, findings supportive of pelvic floor stabilization following birth at 6 months postpartum²⁷. Whether this cohort will show differences in the longer term is unknown; others have found differences in as short as 18 months and as long as 5-10 years after delivery^{3,28}. Other weaknesses of this study include that the majority of the CD group was recruited immediately after delivery and these women were asked to recall their pelvic floor function in the third trimester. Asking women to recall function is subject to bias, and may have led to under or overestimation of pelvic floor problems during pregnancy. We were able to collect prospective data on a third of the CD group who were cared for by midwives during pregnancy (N=69); their reports of baseline function in the third trimester of pregnancy were not different than the functional reports of CD participants recruited postpartum, although these comparisons were limited to questionnaire responses and not physical exam findings. In addition, functional outcomes at 6 months postpartum were not different between these women in the CD group who were followed through pregnancy and those who were recruited postpartum. The examiners at the six month followup were blinded to mode of delivery, however experienced midwives may be able to ascertain mode of delivery through the appearance of the perineum. Our overall follow-up rate of 71% is slightly lower than anticipated. We did compare women who followed up to those who were lost to follow up and found differences in age, educational level and BMI; however, differences were small in this largely homogeneous group of first time mothers, and multivariate analyses controlling for age and BMI did not affect our findings. Our followup rates were lower in the CD compared to the VB group; however, baseline differences with the CD group between those who followed up compared to those who did not were limited to a small difference in years of education and unlikely to significantly alter results. It is possible that there are unmeasured differences between midwife and physician care that may affect outcomes, and that we cannot account for. Finally, we cannot extrapolate our findings to women who undergo maternal choice cesarean prior to entry into labor, because all of our patients anticipated giving vaginal birth.

Interpretation

A recent cohort survey study of nulliparous women followed through pregnancy and birth to 18 months postpartum in Australia found an increased risk of persistent UI among women who gave VB when compared to those delivered by CD; prolonged second stage of labor and operative delivery increased the odds of postpartum UI.^{17,28,29} Another cohort study of

US women recruited 5 -10 years after delivery found an increased risk of UI in the VB compared to the cesarean without labor group. In addition, the VB group in that study was more likely to have prolapse when compared to women delivered by CD, with the greatest difference seen in the group that underwent operative vaginal delivery^{3,4}. Both of these cohorts had high rates of operative delivery (31% in the Australian group and 39% in the US group), and may not be representative of current evidence-based obstetrical practice. In contrast to these prior reports, we did not find that women who gave VB were more likely to report any UI on self-report measures than those delivered by CD at 6 months postpartum. We did find that UI type varied between groups, and that those who had given VB were more likely to leak than those who underwent CD. Our lack of difference in self report UI may be because we chose to include only women recruited from low risk services who had low exposures to operative delivery and episiotomy, or that our sample size, powered to observe differences of 10% or greater was unable to detect smaller differences. We chose a difference of 10% between groups because we believe differences in functional outcomes less than 10% are unlikely to be clinically significant. Interestingly, both the Australian and US studies found that AI was not increased in women giving VB compared to CD^{30,31}. Like these prior studies, we also found that AI was not related to mode of delivery. Recent work has suggested that anal sphincter laceration risk with subsequent anal incontinence may be a result of inherited familial risk³².

Conclusion

The second stage of labor experienced by low risk women who had a midwife managed vaginal birth with low exposure to operative vaginal delivery and episiotomy does not contribute to bothersome pelvic floor dysfunction 6 months after delivery when compared to women who undergo cesarean delivery prior to the second stage of labor.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Maternal, newborn and labor characteristics

	Vaginal Birth N=448	Cesarean Delivery N=224	P
Age (mean +/- SD)	23.9 +/- 4.9	26.6 +/- 6.1	<0.001
Years Education(mean +/- SD)	13.8 +/- 2.7	13.8 +/- 3.1	0.87
BMI(kg/m2) (mean +/- SD)	24.6 +/- 5.3	27.1 +/- 6.3	<0.001
Overweight/obese * (%)	168(38)	126(56)	<0.001
Weight gain in pregnancy(pounds)(mean +/- SD)	16.1 +/- 6.2	15.6 +/- 7.2	0.30
Fetal birth weight(grams)(mean +/- SD)	3216 +/- 425	3211 +/- 533	0.91
Race (%) **			0.05
Non-Hispanic White	193(43)	79(35)	
Hispanic	201(45)	104(46)	
Native American	26(6)	25(11)	
Other	28(6)	14(6)	
Tobacco Use (%)	30(7)	15(7)	1.00
Epidural (%)	269(60)	139(62)	0.68
Oxytocin (%)	212(47)	124(55)	0.07
Length of second stage (minutes)(mean +/- SD)	72.2 +/- 63.9	Not applicable	
Perineal Trauma		Not applicable	
Intact	210(47)		
First degree laceration	87(19)		
Second degree laceration	129(29)		
Third and fourth degree lacerations	22(5)		
Episiotomy (%)	8(2)	Not applicable	

Baseline Functional data in the 3 rd trimester				
	N=412	N=208		P
Any urinary incontinence (ISI*>0) (%)	300(73)	143(69)		0.30
		Midwife CD, N= 69	Physician CD, N=155	
		41(68)	102(69) p=1.0	
Any Anal Incontinence (W***>= 1) (%)	279(68)	149(74)		0.19
		Midwife CD, N= 69 38(66)	Physician CD, N=155 111(77) p = .11	
% Women Sexually Active	265(76)	131(72)		0.29

Baseline Functional data in the 3 rd trimester				
	N=412	N=208		P
Any urinary incontinence (ISI*>0) (%)	300(73)	143(69)		0.30
		Midwife CD, N= 69	Physician CD, N=155	
		Midwife CD, N= 69 36(72)	Physician CD, N=155 95(72) p = 1.0	
Female Sexual Function Index Scores (mean +/- SD)	26.4 +/- 5.9	26.2 +/- 6.0		0.98
		Midwife CD, N= 69 26.5 +/- 5.6	Physician CD, N=155 26.1 +/- 6.0 p=.65	

* Overweight/obese defined as BMI>25 kg/m2

** Race was self-defined; 2 women in the CD group failed to provide race/ethnicity data.

Table 2

Pelvic Floor Outcomes 6 Months after Delivery

Urinary Incontinence	Vaginal Birth N=336	Cesarean Delivery N=138	P
Any urinary incontinence (ISI [*] >0)	183(55)	63(46)	0.08
Moderate/Severe ISI [*] Scores (%)	30(9)	8(6)	0.35
Paper towel test wet (%)	56 (17)	8 (6)	0.002

Women with any urinary incontinence	N=183	N=63	
ISI [*] scores among those with any incontinence (mean +/- SD)	1.76 +/- 1.1	1.73 +/- 1.0	0.30
IIQ ^{**} scores among those with any urinary incontinence (mean +/- SD)	5.3 +/- 11.3	6.6 +/- 13.6	0.51
Questionnaire for Urinary Diagnosis			
Stress > urge scores (%)	88(27)	22(16)	0.02
Urge > stress scores (%)	68(21)	34(25)	0.33

Anal Incontinence	Vaginal Birth N=336	Cesarean Section N=138	
Any Anal Incontinence (W ^{***} >= 1) (%)	163(50)	76(55)	0.26
Fecal Incontinence (Positive response on W scale)(%)	27(8)	18(13)	0.12
Anal sphincter separation on physical exam (%)	11(3)	3(2)	0.77

Women with Any Anal Incontinence	N=163	N=76	
Wexner Scores among those with any anal incontinence (mean +/- SD)	2.0 +/- 1.8	1.9 +/- 1.1	0.53
Colorectal Anal Impact Questionnaire Scores (mean +/- SD)	2.5 +/- 9.7	2.0 +/- 7.1	0.70

Pelvic Organ Prolapse	Vaginal Birth N=336	Cesarean Section N=138	
Stage prolapse			0.03 ^{****}
0	46(14)	28(22)	
1	209(65)	81(63)	
2	66(21)	19(15)	
3	1(0)	0(0)	
4	0(0)	0(0)	
Aa (mean +/- SD)	-1.9 +/- 0.8	-2.1 +/- 0.7	<0.001
Ba (mean +/- SD)	-1.9 +/- 0.8	-2.1 +/- 0.7	<0.001
Ap (mean +/- SD)	-2.6 +/- 0.5	-2.7 +/- 0.4	0.16
Bp (mean +/- SD)	-2.6 +/- 0.5	-2.7 +/- 0.4	0.18
C (mean +/- SD)	-5.2 +/- 1.4	-5.1 +/- 1.5	0.80
D (mean +/- SD)	-6.7 +/- 1.6	-6.6 +/- 1.8	0.48

Pelvic Organ Prolapse	Vaginal Birth N=336	Cesarean Section N=138	
Pb (mean +/- SD)	3.4 +/- 0.8	3.3 +/- 0.8	0.06
GH (rest) (mean +/- SD)	2.6 +/- 0.9	2.7 +/- 0.7	0.11
GH (strain) (mean +/- SD)	3.0 +/- 1.0	3.3 +/- 0.8	<0.001
Total Vaginal Length (mean +/- SD)	7.4 +/- 1.4	7.1 +/- 1.7	0.07
Pelvic Organ Prolapse Impact Questionnaire Scores (mean +/- SD)	2.2 +/- 8.7	1.7 +/- 6.6	0.53

Women with stage 2 or greater prolapse	N=67	N=19	
Pelvic Organ Prolapse Impact Scores among women with stage 2 or greater POP (mean +/- SD)	3.5 +/- 11.8	1.3 +/- 4.5	0.21

Transperineal Ultrasound	N = 291	N=119	
External anal sphincter separation	2(<1)	2(<1)	0.58
Internal anal sphincter separation (%)	29 (10)	5 (4)	0.07

Sexual function	Vaginal Birth N=336	Cesarean Section N=138	
Sexually active (%)	281 (88)	123(92)	0.14
Female Sexual Function Index Scores (mean +/- SD)	28.5 +/- 5.4	26.6 +/- 6.3	0.004
Desire(mean +/- SD)	3.8 +/- 1.2	3.3 +/- 1.2	<0.001
Arousal(mean +/- SD)	4.1 +/- 1.8	4.1 +/- 1.5	0.89
Lubrication(mean +/- SD)	4.5 +/- 2.0	4.4 +/- 4.1	0.73
Orgasm(mean +/- SD)	4.2 +/- 2.0	4.3 +/- 1.7	0.52
Satisfaction(mean +/- SD)	4.7 +/- 1.4	4.6 +/- 1.3	0.49
Pain(mean +/- SD)	5.1 +/- 1.2	4.9 +/- 1.3	0.37

Pain			
No perineal pain (PPI= none) (%)	301(92)	131(95)	0.27

* ISI= Incontinence Severity Index

** IIQ Incontinence Impact Questionnaire

*** Wexner Fecal Incontinence Scale

**** Jonckheere-Terpstra trend test

Table 3

Stepwise multivariable Analysis of impact of mode of delivery on anterior vaginal wall descent and sexual function scores

Univariate analysis				Multivariable analysis			
Outcome	Factor	Standardized Beta ^{xx}	P	Outcome	Factor ^x	Standardized Beta ^{xx}	Adjusted P
Aa	Delivery mode [*]	-0.16	0.002	Aa	Delivery mode [*] Age (years) BMI (Kg M2) NHW ^{***}	-0.14 -0.02 -0.13 -0.06	0.004 0.66 0.007 0.19
Ba	Delivery mode [*]	-0.16	0.001	Ba	Delivery mode [*] Age (years) BMI (Kg/m2) NHW ^{***}	-0.14 -0.04 -0.13 -0.06	0.004 0.47 0.006 0.19
FSFI ^{**} total scores	Delivery mode [*]	-0.15	0.004	FSFI ^{**} total scores	Delivery mode [*] Age (years) BMI (Kg/m2) NHW ^{***}	-0.16 -0.05 0.11 -0.05	0.002 0.37 0.04 0.33

^xWeight gain during pregnancy was also included but did not remain significant in the regression model

^{*} Delivery Mode: Mode of delivery was coded as vaginal birth = 1, and cesarean delivery = 2

^{**} Female Sexual Function Index

^{***} NHW - non-Hispanic White

^{xx} Standardized beta: Is the log odds regression coefficient standardized by the standard deviation of the predictor variable. In plain language, standardized beta represents the effect of a one standard deviation change in the predictor variable on log odds of the outcome variable. Standardized betas are equivalent to ORs since exponentiated standardized beta is related to the odds ratios as a function of the ratio of standard deviations of the outcome to predictor variables.