Obstetric risk factors and symptoms of pelvic floor dysfunction-twenty year follow-up

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PH conceived the study and contributed to development of the study protocol and writing of the manuscript.

Abstract

Hypothesis: Intrapartum events at first delivery and subsequent childbearing are associated with long-term pelvic floor dysfunction (PFD).

Methods: Primigravidae delivered between 1983-86 were identified; current addresses traced through the UK National Health Service database (N=3002). Women completed screening and Sheffield Pelvic Floor Questionnaires (Sheffield-PAQ ©). Maternity data were obtained from Standard Maternity Information System. Primary outcomes were urinary incontinence (UI), anal incontinence (AI), and prolapse (POP).

Results: Primary response was 62.1%. 53.8%(n=985) had ≥1 PFD symptom and in 71.5% symptoms were bothersome. UI (OR 0.47 95%CI 0.28, 0.81) and fecal incontinence (FI) (OR 0.32 95%CI 0.13, 0.77) risks were lower after cesarean section (CS). However, 25% had UI and 12% had FI after delivering exclusively by CS. Obesity was a risk factor independent of obstetric history.

Conclusions: CS provides incomplete or poorly sustained pelvic floor protection by middle age. Obese women were at highest risk and had the most severe symptoms.

Keywords: Anal incontinence, cesarean section, pelvic organ prolapse, pregnancy, prevalence, urinary incontinence

Brief summary

Half of all women suffer some pelvic floor dysfunction 20years after first childbirth; cesarean section confers limited protection; obesity is a consistent risk factor.

Introduction

Pregnancy and childbirth are considered key in the multi-factorial etiology of pelvic floor dysfunction (PFD). Most women give birth in their twenties yet they commonly seek treatment years later and population prevalence for SUI peaks in middle-aged women.(1) Practical difficulties in following sequential pregnancies, acquisition of accurate maternity data and attrition bias are significant impediments to the longitudinal study of obstetric antecedents. The paucity of information available for counseling on long-term sequelae, contrasts with the growth in maternal requests for elective cesarean section to protect the pelvic floor. Most studies published to date are cohorts within 12 months of delivery(2-6), none have examined all aspects of PFD, others present cross-sectional data at variable intervals;(7, 8) only one large longitudinal study has extended as long as six years.(9, 10)

Between 1982 and 1993 an electronic obstetric and perinatal database was operational in the Northern Regional Health Authority in England, UK. The Standard Maternity Information System (SMIS) was set up with the support of the Royal College of Obstetricians and Gynaecologists (UK) to provide annual returns for national maternity statistics. Data were entered by trained hospital clerks and included 46,115 women delivered in two hospitals in the city of Newcastle upon Tyne. The NHS Strategic Tracing Service (NSTS) is used as an administrative database for the National Health Service in England and Wales. The NSTS enables a person's current address to be traced by entering their former address registered on the database. By combining these electronic facilities, we designed a study to examine obstetric antecedents in an historical cohort of known obstetric history, and similar obstetric starting point. Our hypothesis was that events at first delivery and subsequent childbearing are associated with an increased risk of symptoms of PFD two decades later.

Materials and methods

Consecutive women who gave birth to their first child (primigravidae) at the Princess Mary Maternity Hospital, Newcastle upon Tyne, UK, from January 1983 onwards were identified from birth registers and matched to their SMIS obstetric record using postcode and date of birth. Birth register and SMIS data were compared for discordance (0.3% discordance). Obstetric data identified are shown in Table 1. Current addresses were traced sequentially through the National Strategic Tracing Service (NSTS). Our calculated sample size *(vide infra)* was achieved having reviewed birth registrations up to August 1986 at which stage 4421 primigravidae had been identified and of them 3002 were eligible for contact. General Practitioners (GPs) were contacted by post to establish whether any of these women should not be contacted. Reasons for exclusion from mailing were: duplicate birth register records (n=25), missing postcode on the birth register (n=960), other missing data on birth registers (n=59), >1 match on the NSTS (n=49), stillbirth (n=16), known to be deceased (n=11), or GP advised against contact due to ill health or recent bereavement (n=5). Women found living out of region, where ethical approval was not effective, were excluded (n=294).

A letter of invitation, short screening questionnaire and invitation to complete more detailed questionnaires in a further posting, were mailed to women. The short screening questionnaire consisted of ten questions. Four symptom questions were taken directly from introductory questions on the bladder, bowel and vaginal domains of the validated Sheffield Pelvic Floor Assessment Questionnaire (Sheffield-PAQ ©). The remainder enquired about previous bowel, bladder or prolapse surgery, parity, chronic cough, weight and height. The symptom questions were: Do you have any awareness of a prolapse? Do you have any awareness of a lump in the vagina? Do you have any leakage of urine? Do you have any leakage of flatus (wind) or feces (stool)? The use of ‘any’ created binary symptom outcomes to facilitate logistic regression analysis. Women were also invited to rate bothersomeness of symptoms by

indicating whether the symptom was ‘not a problem’, ‘a bit of a problem’, ‘quite a problem’, or ‘a serious problem’. All women were invited to complete the SF-12 *v 2* and Sheffield-PAQ © in a second posting. The Sheffield-PAQ © (31pages) was validated initially on paper (11) and then electronically (12). The Sheffield-PAQ © comprised 4 sections with 14 domains and internal consistency (Cronbach’s $\alpha \geq 0.7$) in 11 of these domains. Non-responders to the screening questionnaire were sent a reminder and repeat screening questionnaire after three months. Data were entered onto a *Microsoft Access* database in batches by single data entry.

Three primary outcomes were reported on the screening questionnaire and dichotomized into present or absent: ‘any leakage of urine’ (UI), ‘any leakage of stool or flatus’ (AI), ‘any awareness of prolapse or lump in the vagina’ (POP). Secondary outcomes on the Sheffield-PAQ © were: Stress urinary incontinence (SUI): ‘at least occasional leakage of urine when sneezing, coughing, exercising, lifting, jumping or running during the previous 12 months’**,** Urge urinary incontinence (UUI): ‘at least occasional urgency associated with urinary leakage before making it to the toilet or urinary leakage when washing hands, hearing the sound of running water or opening or unlocking the door to your home in the previous 12months’and mixed urinary incontinence (MUI): Combination of SUI and UUI, flatal incontinence: ‘accidental leakage of wind most or all of the time’, fecal incontinence (FI): ‘any accidental leakage of solid or liquid stool or leakage of stool before getting to the toilet’.

UI severity was assigned by a severity index calculated according to amount (5 categories) and frequency (3 categories) of UI in the previous 12 months assigned from the highest frequency reported on any one of the UI questions**.** A score 1 or 2 was designated as mild, 3-5 as moderate and >5 as severe UI. Mild POP was defined as ‘a bulge or lump coming down in the vagina but not out of the vagina’ and moderate/severe POP ‘as a bulge or lump coming

out of the vagina altogether so that it is felt on the outside'. Impact on quality of life (QoL) was assessed by interference in enjoyment of life, physical or social activities.

The study was powered to assess risk factors for any UI, AI, or POP. Given that further deliveries (*i.e.* after the first pregnancy) might have bearing on the prevalence and/or severity of symptoms, we sought to analyze risk factors in women who had only ever had one delivery (designated as 'parity=1') separately from the total cohort and powered accordingly. It was assumed that 15% of women would not have had further children, 50% would respond to the postal questionnaire, prevalence of 50% for UI, 20% for POP, and 10% for AI. Hence a sample size of 225 women with final parity=1 and total cohort of 3000, was estimated to give 80% power to detect a 10% difference in prevalence of UI between groups and an 80% power to detect a 9% difference in POP and 7.5% difference in AI.

Statistical analysis was performed using parametric and non-parametric tests as appropriate (Table 1). Risk factors were examined using logistic regression. For the analysis women who had undergone previous UI or POP surgery were classified as having symptoms and those with a multiple pregnancy were excluded (n=16). Variables were entered in a fixed fashion and categorical variables and cut-offs were specified *a priori*. On univariate analysis there was no significant difference between emergency (n=100) and elective (i.e. non-laboring) cesarean section (n=158) which were combined as a single variable on logistic regression as where breech (n=27) with normal births as 'normal vaginal delivery', and ventouse (n=20) with forceps as 'instrumental delivery'. The adjusted odds ratio (OR) was interpreted from trend within a group, the 95% confidence interval (CI), and the *p* value after conventional hypothesis testing. Explanatory variables used in primary and secondary analyses were similar.

Results

Figure 1 illustrates the women in the obstetric cohort. There were 0.6% and 1% missing items on the screening questionnaire and Sheffield-PAQ © respectively. Characteristics of responders and non-responders are shown in Table 1.

UI prevalence was 42.9% (95%CI 41.1 to 45.5, *n*=800), AI 20.3%(95%CI 18.7 to 22.4, *n*=378), and POP 13.4%(95%CI 12.0 to 15.1, *n*=250). Prevalence of bothersome symptoms was high: UI 31.1% (95%CI 29.5 to 33.8, *n*=578), AI 15.4% (95%CI 14.1 to 17.4, *n*=287) and POP 7.0% (95%CI 6.0 to 8.4, *n*=131). 1831 women responded to all three symptoms. 53.8% (n=985) of them had at least one pelvic floor symptom and 71.5% (704) of them described at least one of their symptoms as bothersome. There were 45.9 % (n=452) with UI only, 10.1% (n=100) with AI only and 6.9% (n=68) with POP only. In addition, 18.8% (n=185) had both UI and AI, 9.4% (n=93) had UI and POP, 2.7% (n=27) had POP and AI and 6.1% (n=60) had all three symptoms.

679 women reported UI on the urinary domain of the Sheffield-PAQ©. 40.1% (n=272) had pure SUI, 51.8% (n=352) had MUI and 8.1% (n=55) had pure UUI. 27.2% (185/679) of them had moderate or severe UI. 27.7% (248/895) of women wore pads and 25.8% (231/895) reported impairment in QoL on the bladder domain. 888 women completed the bowel section. 205 (23.1%) had FI, which occurred occasionally in 97.1%(n =199) caused a problem in all women described as quite a problem (n=194) or a serious problem (n=11). 48 (5.4%) women had incontinence of solid stool. 25 (2.8%) women wore pads because of bowel symptoms in 178 (20.0%) women they had impaired QoL. 125 women reported POP on the Sheffield-PAQ© of whom 72% (n=90) had mild and 28% (n=35) had moderate/severe symptoms; 57.6% (n=72) had POP that was bothersome.

Rate of cesarean section rate was 13.9% (n=258). Tables 2-4 show the results of the logistic regression analysis for the primary outcomes. From the SMIS maternity records, 58.6% (n=147) of women with a singleton did not have a subsequent vaginal delivery after cesarean section. There were 25.9% (n=65) who did not have any further children, 41.5% (n=61) had 1 further child born by cesarean section, 12.2%(n=18) had 2 more by cesarean section and 2% (n=3) had 3 more by cesarean section. Odds of UI were lower in women with one child (adjusted OR 0.24, 95%CI 0.06 to 0.98) than the total cohort although '*p*' reached statistical significance in the total cohort only where the number of primary cesarean sections was greater.

The SMIS records were searched to determine the absolute number with UI in women of BMI after delivery exclusively by cesarean section. In women of parity 1 or 2 whose SMIS records indicated caesarean only deliveries (n=47), 22.7% (5/22) and 24.0% (6/25) respectively had UI. Similarly SMIS records showed that 11.8% (9/76) women had symptoms of FI after giving birth exclusively by cesarean section. However, only 1 of the 9 women with FI (parity=1 and BMI<25kg/m^2) had never labored, 4 others had BMI>25kg/m^2 and none had undergone anorectal surgery. Obesity was an independent risk factor for all three symptoms (Tables 2,3,4). In the secondary analysis examining risk factors, according to type and severity of symptoms, there was a gradient effect where obese women had the most severe symptoms of SUI (Table 5).

Discussion

Almost 50% of this middle-aged parous cohort had at least one symptom of PFD and 38% of women had symptoms they found bothersome. Women delivered by cesarean section in their first pregnancy had lower risk of UI (OR 0.47) and FI (OR 0.32) two decades later. The majority of primigravidae (60%) delivered by caesarean section did not have a subsequent vaginal birth. In the cohort with further children there was a higher risk of UI than women with a single child born by cesarean section. We might speculate that this represents a deleterious impact if women have a vaginal delivery after cesarean section.(9) Despite lower risks of UI and FI after cesarean section, there were 12% of women with FI and 25% (without any identifiable risk factors) with UI after delivering exclusively by cesarean section. Our results suggest that pelvic floor protection was either incomplete or poorly sustained over time.

Women who were obese were at significantly higher risk of any one of the three pelvic floor symptoms independently of their mode of first delivery. Obesity was the only identifiable risk factor for POP in women with one child. We found no relationship between obstetric variables and severity of PFD, although there were weak associations with birth weight and parity for POP. Instead, BMI was the sole marker of symptom severity. We observed an almost 4-fold increased likelihood of severe SUI in obese women. This study does not allow us to comment on whether the risk is due to antenatal obesity or weight gain later in life. Obese pregnant women are known to experience greater operative morbidity(13) and taken with our results we might consider that they have the least to gain from cesarean section.

The rate of delivery by forceps was high at 36% of first births and might account for the high prevalence of FI in this cohort. Forceps increases the risk of immediate(14) and persistent postnatal FI,(10) and the incidence of third degree tear(15) although the longer term impact on FI and role of cesarean section is uncertain.(10, 16) We found that women whose first

child was born by forceps had a higher risk of both flatal (OR 2.76) and fecal (OR 1.72) incontinence. However, cesarean section reduced the risk only for FI (OR 0.32) and is the most probable reason for not identifying a relationship between AI and cesarean section in the primary analysis. These results suggest different etiologies for flatal incontinence and fecal incontinence although forceps appears common to both. A weakness of our study is that perineal tears were not classified by degree on the SMIS although we did find an association with surrogates namely perineal tear and episiotomy. We established from the SMIS that all except one woman who developed FI after exclusive cesarean section had labored at least once. Pudendal neuropathy occurs after cesarean section performed late but not early in labor.(17) Neurogenic injury during labor could explain our findings although we cannot exclude other non-obstetric etiologies.

The main strength of this study is that we have examined PFD in a cohort at the end of reproductive life with similar obstetric starting point and complete sets of electronic maternity records. Unlike other obstetric cohorts we undertook a sample size estimation,(9, 10, 18, 19) avoided attrition bias, (18, 19) and did not rely on maternal recall or maternity case notes.(9, 16, 18, 19) The age distribution was optimal for studying obstetric antecedents for SUI and AI. However, the age distribution is likely to have been sub optimal for POP. The estimated sample size was achieved although low rate of cesarean section rate meant that some subgroup analyses were probably underpowered. The observational design does not allow us to establish causation however steps were taken to control for confounding and absolute risks were reported for exclusive cesarean section. Women were not asked to state the time of onset of their symptoms for fear of recall bias.(20) We cannot determine whether symptoms predated pregnancy although clinically significant pelvic floor symptoms are uncommon in nulliparae.(21, 22) Obstetric parameters did not differ between non-responders and responders. There was reporting bias in favor of higher social classes and BMI could not be

compared for non-response bias. We used a short screening questionnaire to encourage a high response rate and used dichotomized responses to facilitate the risk factor analysis. This might have contributed to UI prevalence being at the higher end of the published range. (1) However, AI prevalence was similar to another parous cohort that combined fecal and flatal incontinence.(23) There are limited comparable prevalence data for POP in non-gynecological populations. (23-25) In the primary analysis, we included the single most predictive question for POP (26) from the Sheffield-PAQ© and asked specifically about a prolapse. However, assessment of POP in epidemiological study is complicated and some women may not have understood the concept.

Almost 50% of this parous middle-aged cohort had symptoms of PFD and 25% had moderate or severe symptoms that caused impairment in quality of life. A single vaginal delivery was the only significant obstetric risk factor and exclusive delivery by cesarean section was not completely protective. Women who were obese were at highest risk of all aspects of PFD and had the most severe symptoms independently of their obstetric history.

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Disclosures

Neither author has any competing interests to disclose

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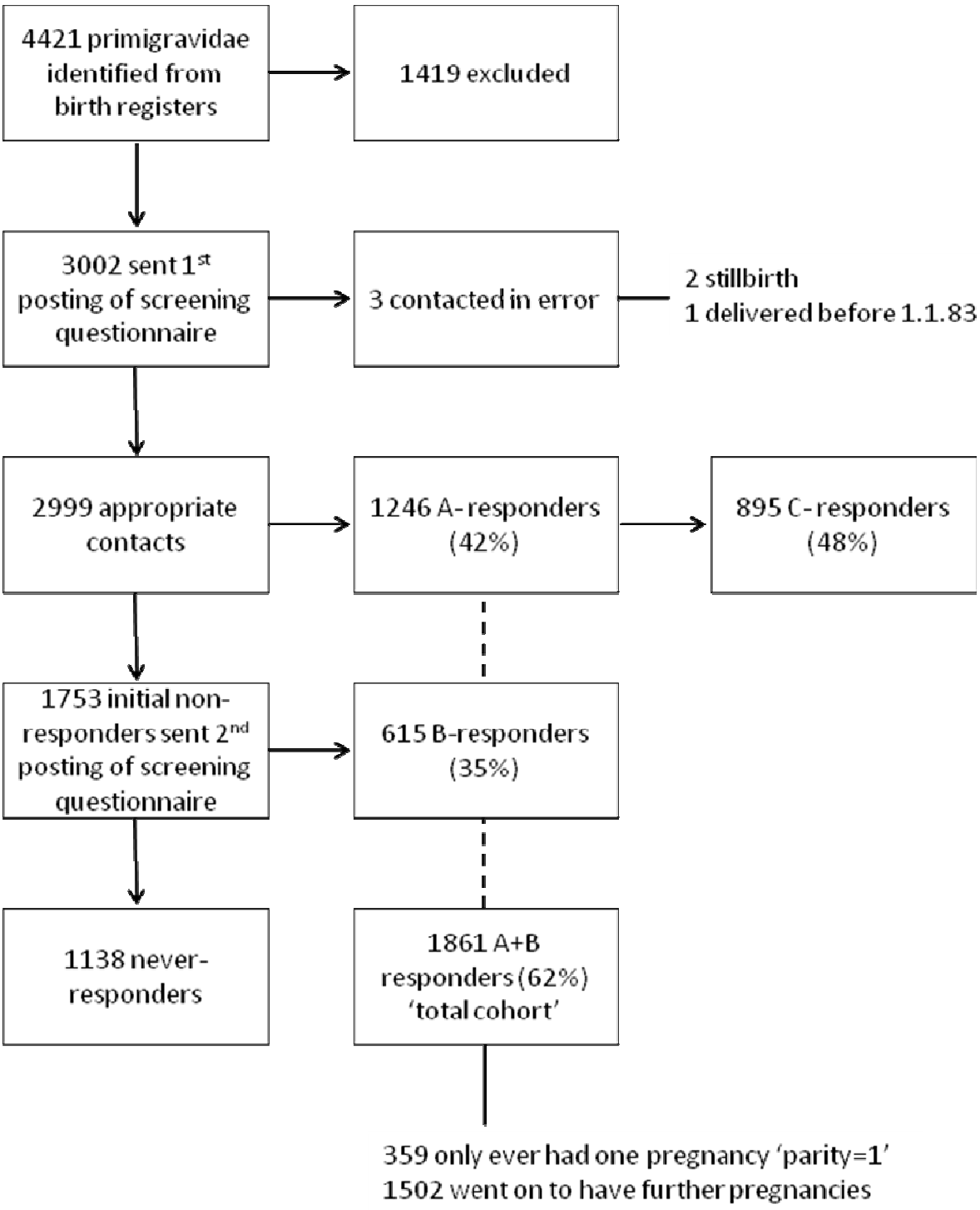

Figure 1: Cohort of primigravidae delivered between 1983-1986.

A=Responders to first posting of screening questionnaire; B=Responders to second posting of screening questionnaire; C=Responders to Sheffield-PAQ©.

Table 1: Characteristics of responders and non-responders to screening questionnaire

Cohort characteristics and events at first delivery			Responders N=1861	Nonresponders N=1138	*p*
Age at delivery (years)		mean(*s.d.*)	26.2(4.8)	24.2(4.9)	<0.0001
Current age (years)		mean(*s.d.*)	45.7(4.8)	na	
Social class	1,11,	n(%)	572(30.7)	210(18.5)	
	111a, 111B, IV, V	n(%)	869(46.7)	471(41.4)	
	Unclassified	n(%)	420(22.6)	457(40.2)	<0.0001
Previous surgery for SUI		n(%)	12(0.6)	na	
Previous surgery for POP		n(%)	13(0.7)	na	
Previous hysterectomy		n(%)	42(2.3)	na	
Current BMI (kg/m2)		median(range)	24.8(14.6-55.0)	na	
Time since delivery (years)		median(range)	19.5(17.7-21.7)	na	
Current parity		median(range)	1.6(1-5)	na	
Delivery at term (37-41weeks)		n(%)	1623(87.2)	1002(88.0)	0.56
Singleton pregnancy		n(%)	1845(99.1)	1124(98.8)	0.35
Spontaneous onset of labour		n(%)	1362(73.3)	829(72.8)	0.35
Length 1st stage (minutes)		median(IQR)	735(505-1050)	720(505-1030)	
Length 2nd stage (minutes)		median(IQR)	53(30-120)	50(31-115)	0.29
Delivery mode	Normal	n(%)	896(48.2)	568(49.9)	
	Vaginal breech	n(%)	28(1.5)	24(2.1)	
	Instrumental	n(%)	675(36.3)	391(34.4)	
	Csection(elective)	n(%)	158(8.5)	91(8.0)	
	Csection(in labor)	n(%)	100(5.4)	62(5.4)	0.58
Birth weight (grammes)		median(IQR)	3285(2970-3600)	3250(2905-3590)	0.06
Epidural/Caudal analgesia		n(%)	963(51.7)	620(54.5)	0.15
Perineum	Intact	n(%)	343(18.5)	215(18.9)	
	Episiotomy	n(%)	1317(71.0)	810(71.4)	
	Tear	n(%)	196(10.6)	110(9.7)	0.73

na=not available. Chi-squared except age (two-sample t-test), singleton/analgesia (Fisher's Exact Test) gestation, birthweight, 1st and 2nd stages (Wilcoxon rank sum test). N values differ due to missing data

Table 2: Results of primary analyses of antecedents of urinary incontinence in women with one child and in the total cohort

Potential risk factors for UI	Parity=1 (N=349) Unadjusted OR 95% CI	Adjusted OR 95% CI	p	Total cohort (N=1788) Unadjusted OR 95%CI	Adjusted OR 95%CI	p
Age (years)						
<45	1	1	0.54	1	1	0.3
45-50	1.20(0.70,2.03)	1.39(0.75,2.58)		0.99(0.81,1.21)	1.08(0.86,1.36)	
>50	1.07(0.61,1.90)	1.42(0.71,2.83)		1.05(0.79,1.39)	1.29(0.94,1.78)	
BMI (kg/m^2)						
<25.0	1	1	*0.0008*	1	1	*<0.0001*
25.0-30.0	2.17(1.29,3.66)	*2.21(1.26,3.86)*		1.63(1.32,2.01)	*1.67(1.35,2.08)*	
>30.0	2.52(1.42,4.48)	*2.82(1.52,5.24)*		2.24(1.71,2.94)	*2.34(1.77,3.09)*	
Social Class						
1 or 11	1	1	0.61	1	1	0.77
111	1.38(0.82,2.34)	1.18(0.67,2.08)		0.97(0.77,1.22)	0.93(0.73,1.18)	
IV or V	1.74(0.83,3.62)	1.75(0.78,3.96)		1.10(0.78,1.57)	1.08(0.74,1.56)	
Missing	1.24(0.66,2.30)	1.29(0.62,2.67)		1.13(0.88,1.47)	1.05(0.78,1.41)	
Parity						
1				1	1	0.24
2				1.20(0.94,1.55)	1.24(0.96,1.62)	
3 or more				1.28(0.97,1.69)	1.24(0.92,1.67)	
Gestation (weeks)						
37 or more	1	1	0.96	1	1	0.32
<37	1.23(0.60,2.52)	0.98(0.41,2.37)		1.32(0.94,1.86)	1.23(0.82,1.83)	
Birthweight (kgs)						
<3.0	1.17(0.71,1.94)	1.32(0.73,2.39)		1.27(1.00,1.06)	1.25(0.96,1.62)	0.13
3.0-3.5	1	1	0.64	1	1	
>3.5	0.90(0.53,1.53)	1.05(0.59,1.86)		1.21(0.97,1.51)	1.21(0.97,1.52)	
Mode of delivery						
Spontaneous/breech	1	1	0.13	1	1	*0.008*
Instrumental	0.80(0.50,1.29)	0.95(0.5,1.81)		0.81(0.66,1.0)	0.83(0.64,1.08)	
Cesarean section	0.50(0.27,0.94)	*0.24(0.06,0.98)*		0.65(0.49,0.87)	*0.47(0.28,0.81)*	
Onset (vaginal births)						
Spontaneous	1	1	0.15	1	1	0.073
Induced	0.64(0.36,1.16)	0.62(0.32,1.19)		0.78(0.61,1.01)	0.79(0.60,1.02)	
Length 1st stage(hours)						
<4	1.58(0.78,3.19)	1.23(0.56,2.7)		1.22(0.89,1.66)	1.18(0.85,1.63)	
4-8	1	1	0.38	1	1	0.6
>8	0.74(0.44,1.24)	0.73(0.41,1.29)		1.01(0.82,1.26)	1.04(0.82,1.31)	
Length 2nd stage(hours)						
<30	1.56(0.81,3.02)	1.26(0.59,2.7)		1.18(0.90,1.54)	1.04(0.79,1.38)	
30-60	1	1	0.38	1	1	0.95
>60	0.77(0.45,1.31)	0.86(0.45,1.63)		0.93(0.74,1.17)	1(0.77,1.29)	
Epidural/caudal						
No	1	1	0.94	1	1	0.85
Yes	0.78(0.48,1.25)	1.02(0.57,1.85)		0.89(0.73,1.09)	0.98(0.77,1.24)	
Perineum						
Episiotomy	1	1	0.63	1	1	0.48
Spontaneous tear	1.10(0.30,3.98)	0.88(0.22,3.5)		0.80(0.53,1.23)	0.73(0.44,1.22)	
Intact (vaginal births)	0.81(0.26,2.48)	0.64(0.19,2.19)		0.77(0.47,1.26)	0.84(0.54,1.32)	

Logistic regression analyses with UI as dependent variable (p<0.05 in italics).
Women whose first delivery was a singleton and with information on UI and all potential risk factors were included.

Table 3: Results of primary analyses of antecedents of anal incontinence in women with one child and in the total cohort

Potential risk factors for AI	Parity=1 (N=347) Unadjusted OR 95% CI	Adjusted OR 95% CI	p	Total cohort (N=1777) Unadjusted OR 95%CI	Adjusted OR 95%CI	p
Age (years)						
<45	1	1	0.94	1	1	0.057
45-50	1.05(0.55,2.03)	1.15(0.55,2.40)		1.10(0.85,1.42)	1.18(0.89,1.56)	
>50	0.93(0.46,1.90)	1.10(0.48,2.53)		1.38(0.99,1.94)	1.59(1.09,2.33)	
BMI (kg/m^2)						
<25.0	1	1	0.59	1	1	*0.013*
25.0-30.0	1.04(0.54,2.00)	0.99(0.50,1.98)		1.36(1.05, 1.76)	*1.39(1.07,1.81)*	
>30.0	1.50(0.77,2.94)	1.43(0.70,2.90)		1.46(1.06,2.01)	*1.49(1.08,2.08)*	
Social Class						
1 or 11	1	1	0.81	1	1	0.4
111	1.21(0.63,2.33)	1.16(0.58,2.32)		1.08 (0.8, 1.43)	1.16(0.86,1.56)	
IV or V	1.50(0.61,3.68)	1.61(0.61,4.24)		1.18(0.77,1.82)	1.27(0.81,1.99)	
Missing	1.26(0.58,2.71)	1.29(0.54,3.12)		1.18(0.86,1.62)	1.35(0.95,1.94)	
Parity						
1				1	1	0.38
2				1.13(0.83,1.53)	1.22(0.89,1.68)	
3 or more				0.99(0.70, 1.4)	1.06(0.74,1.53)	
Gestation (weeks)						
37 or more	1	1	0.36	1	1	0.22
<37	1.36(0.58,3.15)	1.61(0.58,4.49)		1.29(0.87,1.93)	1.34(0.84,2.15)	
Birthweight (kgs)						
<3.0	0.99(0.52,1.86)	0.91(0.44,1.88)		1.10(0.83,1.46)	1.08(0.78,1.49)	0.89
3.0-3.5	1	1	0.79	1	1	
>3.5	1.13(0.59,2.15)	1.18(0.60,2.33)		1.03(0.79,1.35)	1.01(0.76,1.33)	
Mode of delivery						
Spontaneous/breech	1	1	0.31	1	1	0.063
Instrumental	1.11(0.62,1.98)	1.59(0.72,3.51)		1.37(1.07,1.75)	1.36(0.99,1.87)	
Cesarean section	0.84(0.39,1.80)	0.38(0.07,1.98)		0.95(0.65,1.37)	0.62(0.32,1.19)	
Onset (vaginal births)						
Spontaneous	1	1	0.19	1	1	0.067
Induced	0.53(0.24,1.19)	0.56(0.24,1.33)		0.76(0.55,1.04)	0.73(0.53,1.02)	
Length 1st stage(hours)						
<4	1.63(0.73,3.65)	1.40(0.57,3.40)		1.00(0.67,1.48)	1.02(0.68,1.52)	
4-8	1	1	0.7	1	1	0.78
>8	0.88(0.46,1.69)	0.94(0.46,1.92)		1.18(0.91,1.54)	1.10(0.83,1.46)	
Length 2nd stage(hours)						
<30	1.47(0.66,3.26)	1.00(0.41,2.47)		0.89(0.64,1.25)	0.83(0.58,1.17)	
30-60	1	1	0.93	1	1	0.56
>60	1.21(0.62,2.34)	1.15(0.53,2.52)		1.08(0.82,1.42)	0.92(0.67,1.25)	
Epidural/caudal						
No	1	1	0.082	1	1	0.71
Yes	0.55(0.31,0.99)	0.53(0.25,1.09)		1.10(0.86,1.41)	0.95(0.71,1.26)	
Perineum						
Episiotomy	1	1	0.69	1	1	0.44
Spontaneous tear	0.81(0.17,3.81)	0.75(0.15,3.9)		0.68(0.36,1.30)	0.67(0.35,1.29)	
Intact (vaginal births)	0.74(0.19,2.85)	0.57(0.13,2.45)		1.04(0.62,1.76)	0.85(0.49,1.48)	

Logistic regression analyses with AI as dependent variable. ($p<0.05$ in italics)
Only women whose first delivery was a singleton and with information on AI and all potential risk factors were included.

Table 4: Results of primary analysis of antecedents of pelvic organ prolapse in women with one child and in the total cohort

Potential risk factors for POP	Parity=1 (N=359) Unadjusted OR 95% CI	Adjusted OR 95% CI	p	Total cohort (N=1787) Unadjusted OR 95%CI	Adjusted OR 95%CI	p
Age (years)						
<45	1	1	0.53	1	1	0.17
45-50	1.17(0.53, 2.57)	1.13(0.45,2.80)		1.09(0.82,1.46)	1.22(0.88,1.69)	
>50	0.69(0.27, 1.74)	0.67(0.23,2.01)		1.15(0.77,1.71)	1.53(0.97,2.39)	
BMI (kg/m^2)						
<25.0	1	1	*0.028*	1	1	0.33
25.0-30.0	*1.04(0.44, 2.50)*	*1.19(0.47,3.03)*		1.01(0.75,1.37)	0.98(0.72,1.34)	
>30.0	*2.85(1.32, 6.12)*	*3.08(1.32,7.16)*		1.32(0.92,1.90)	1.30(0.89,1.88)	
Social Class						
1 or 11	1	1	0.56	1	1	0.94
111	0.71(0.32, 1.55)	0.56(0.24,1.31)		1.03(0.74,1.42)	1.06(0.75,1.49)	
IV or V	0.71(0.22, 2.29)	0.64(0.18,2.23)		0.97(0.58,1.61)	1.08(0.63,1.83)	
Missing	0.84 (0.34,	0.58(0.19,1.75)		1.08(0.75,1.55)	1.14(0.76,1.72)	
Parity						
1				1	1	0.12
2				1.27(0.87,1.85)	1.30(0.88,1.92)	
3 or more				1.52(1.02,2.28)	1.56(1.02,2.39)	
Gestation (weeks)						
37 or more	1	1	0.48	1	1	0.82
<37	1.04 (0.35, 3.13)	1.68(0.40,6.96)		0.98(0.60,1.60)	1.07(0.60,1.90)	
Birthweight (kgs)						
<3	0.82 (0.35, 1.91)	0.71(0.26,1.89)		1.09(0.77,1.54)	1.08(0.73,1.59)	*0.013*
3.0-3.5	1	1	0.34	1	1	
>3.5	1.57(0.73, 3.38)	1.49(0.65,3.41)		*1.57(1.15,2.13)*	*1.58(1.15,2.17)*	
Mode of delivery						
Spontaneous/breech	1	1	0.52	1	1	0.15
Instrumental	0.93 (0.45, 1.92)	1.14(0.43,3.02)		0.92(0.69,1.22)	0.79(0.55,1.13)	
Cesarean section	0.72(0.27, 1.88)	0.32(0.05,2.28)		0.55(0.34,0.88)	0.57(0.26,1.24)	
Onset (vaginal births)						
Spontaneous	1	1	0.51	1	1	0.69
Induced	1.12(0.48,2.62)	1.38(0.53,3.61)		1.07(0.76,1.51)	1.08(0.75,1.54)	
Length 1st stage(hours)						
<4	1.96(0.79,4.90)	2.51(0.84,7.45)		1.20(0.80,1.82)	1.23(0.80,1.88)	
4-8	1	1	0.18	1	1	0.52
>8	0.66(0.28,1.52)	0.89(0.34,2.31)		0.93(0.68,1.26)	0.94(0.68,1.30)	
Length 2na stage(hours)						
<30	0.75 (0.25,2.21)	0.41(0.11,1.46)		1.21(0.84,1.75)	1.25(0.85,1.85)	
30-60	1	1	0.37	1	1	0.46
>60	1.09(0.50,3.39)	0.90(0.34,2.40)		1.13(0.81,1.56)	1.19(0.83,1.70)	
Epidural/caudal						
No	1	1	0.076	1	1	0.92
Yes	0.48(0.23,1.01)	0.43(0.17,1.10)		0.95(0.72,1.25)	1.02(0.73,1.41)	
Perineum						
Episiotomy	1	1	0.3	1	1	0.14
Spontaneous tear	0.36(0.04,2.83)	0.22(0.02,1.97)		0.66(0.3, 1.37)	0.61(0.29,1.29)	
Intact (vaginal births)	0.79(0.17,3.74)	0.73(0.13,3.94)		1.01(0.56,1.83)	1.04(0.56,1.91)	

Logistic regression analyses with POP as dependent variable. (p <0.05 in italics)
Only women whose first delivery was a singleton and with information on AI and all potential risk factors were included.

Table 5: Antecedents according to severity of stress urinary incontinence and pelvic organ prolapse, flatal and fecal incontinence on a secondary analysis

Risk factor*		Secondary outcomes defined by responses on Sheffield-PAQ				
	N	n (%)	Adjusted OR (95%CI)	n (%)	Adjusted OR (95%CI)	*p*
		Mild stress incontinence *vs*. none		**Severe stress incontinence *vs.* none**		
BMI (kg/m^2)						
<25.0	463	168 (36)	1	45 (10)	1	
25.0-30.0	285	124 (44)	1.59 (1.14, 2.22)	42 (15)	1.82 (1.11, 2.96)	
>30.0	124	46 (37)	*1.7 (1.06, 2.72)*	*30(24)*	*3.61 (2.00, 6.50)*	
Total	872	**338 (38.8)**		**117 (13.4)**		
						<0.0001
		Flatal incontinence only *vs.* mild/none		**Faecal with/ without flatal incontinence *vs*. none**		
Delivery mode						
Spontaneous	432	18 (4)	1	94 (22)	1	
Instrumental	324	22 (7)	*2.76 (1.18, 6.46)*	93 (29)	*1.72 (1.10, 2.71)*	
C section	130	8 (6)	0.76 (0.13, 4.36)	18 (14)	*0.32 (0.13, 0.77)*	
Total	886	**48 (5.4)**		**205 (23.1)**		
						0.004
		Mild pelvic organ prolapse *vs*. none		**Severe pelvic organ prolapse *vs*. none**		
Birth weight (kg)						
<3.0	217	15 (7)	0.54 (0.25, 1.18)	15 (7)	2.94 (1.17, 7.40)	
3.0-3.5	390	36 (9)	1	7 (2)	1	
>3.5	278	39 (14)	*1.71 (1.04, 2.82)*	13 (5)	*2.29 (0.98, 5.37)*	
Total	885	**90 (10.2)**		**35 (3.9)**		
						0.004

*12 explanatory variables included as before in 3 logistic regression analyses. Significant variables shown(p<0.05)
N values vary due to missing data. 865 women had information on all variables in each analysis.