NEW POSTNATAL URINARY INCONTINENCE : OBSTETRIC AND OTHER RISK FACTORS IN PRIMIPARAE

Running Title: New postnatal urinary incontinence in primiparae

Authors Glazener CMA, Herbison GP, MacArthur C, Lancashire R, McGee M, Grant A, Wilson PD

Corresponding author Cathryn MA Glazener

Dr Cathryn MA Glazener (corresponding author and guarantor of paper)
Senior Clinical Research Fellow
Health Services Research Unit
University of Aberdeen Medical School
Foresterhill
AB25 2ZD, Aberdeen, Scotland

Phone number 00 44 (0)1224 553732
Fax number 00 44 (0)1224 663087
Email c.glazener@abdn.ac.uk

Authors

Dr Cathryn MA Glazener
Health Services Research Unit
University of Aberdeen Medical School
Foresterhill
AB25 2ZD, Aberdeen, Scotland
Senior Clinical Research Fellow
Email c.glazener@abdn.ac.uk

Professor G Peter Herbison
Department of Preventive and Social Medicine
Dunedin School of Medicine
University of Otago
PO Box 913, Dunedin, New Zealand
Associate Professor
Email peter.herbison@otago.ac.nz

Professor Christine MacArthur
Department of Public Health and Epidemiology
University of Birmingham
PO Box 363, Edgbaston
B15 2TT, Birmingham, UK
Professor of Maternal and Child Epidemiology
Email c.macarthur@bham.ac.uk

Mr. Robert Lancashire
Department of Public Health and Epidemiology
University of Birmingham
Birmingham B15 2TT, UK
Statistician
Email R.J.Lancashire@bham.ac.uk

Mr. Magnus A. McGee
Health Services Research Unit
University of Aberdeen Medical School
Foresterhill
AB25 2ZD, Aberdeen, Scotland
Statistician
Email magnusmcgee@hotmail.com

Authors (continued)

Professor Adrian M. Grant
Health Services Research Unit
University of Aberdeen Medical School
Foresterhill
AB25 2ZD, Aberdeen, Scotland
Director, Health Services Research Unit
Email a.grant@abdn.ac.uk

Professor P Don Wilson
Department of Women's and Children's Health
Dunedin School of Medicine
University of Otago
PO Box 913, Dunedin, New Zealand
Professor of Obstetrics and Gynaecology
Email don.wilson@stonebow.otago.ac.nz

ABSTRACT

Objective

To identify obstetric and other risk factors for urinary incontinence which occurs during pregnancy or after childbirth.

Design

Questionnaire survey of women.

Setting

Maternity units in Aberdeen (Scotland), Birmingham (England) and Dunedin (New Zealand).

Population

3405 primiparous women with singleton births delivered during one year.

Methods

Questionnaire responses and obstetric casenote data were analysed using multivariate analysis to identify associations with urinary incontinence.

Main outcome measures

Urinary incontinence at three months after delivery first starting in pregnancy or after birth.

Results

The prevalence of urinary incontinence was 29%. New incontinence first beginning after delivery was associated with higher maternal age (oldest versus youngest group, odds ratio, OR 2.02, 95% CI 1.35 to 3.02); and method of delivery (caesarean section versus spontaneous vaginal delivery, OR 0.28, 95% CI 0.19 to 0.41). There were no significant associations with forceps delivery (OR 1.18, 95% CI 0.92 to 1.51) or vacuum delivery (OR 1.16, 95% CI 0.83 to 1.63).

Incontinence first occurring during pregnancy and still present at three months was associated with higher maternal body mass index (BMI > 25, OR 1.68, 95% CI 1.16 to 2.43), and heavier babies (birthweight in top quartile, OR 1.56, 95% CI 1.12 to 2.19). In these women, caesarean section was associated with less incontinence (OR 0.39, 95% CI 0.27 to 0.58) but incontinence was not associated with age.

Conclusions

Women have less urinary incontinence after a first delivery by caesarean section whether or not that first starts during pregnancy. Older maternal age was associated with new postnatal incontinence, and higher body mass index and heavier babies with incontinence first starting during pregnancy. The effect of further deliveries may modify these findings.

INTRODUCTION

Urinary incontinence in women is known to be related to childbirth[1,2], and it would appear that elements of both pregnancy and delivery predispose to this problem. Electrophysiological research suggests that vaginal delivery may be important in the aetiology of urinary incontinence by causing pudendal nerve damage and subsequent pelvic floor[3-6] and urethral striated muscle[7] denervation. Constitutional factors may play a role[8]. It is also possible that biomechanical damage may cause disruption of fascial or muscular tissues necessary for continence[9].

Previous studies of the relationship of obstetrical practice to urinary incontinence have suffered from a lack of power to examine specific factors and, in particular, have failed to focus on women having their first pregnancy who did not have incontinence before that pregnancy. Only in this group of women is it likely that any effect of the pregnancy on urinary incontinence can be isolated. The present multi-centre study was, therefore, carried out to examine the relationship between the mode of delivery and other obstetrical factors with the prevalence of new urinary incontinence three months after pregnancy.

METHODS

The study was approved by the relevant Ethics Committees in the three centres. Between January 1994 and March 1995, 10,985 postnatal questionnaires were sent at three months postpartum to all women who had delivered in three Maternity Units in Dunedin (New Zealand), Aberdeen (Scotland) and Birmingham (England). Non-respondents were sent two reminders. The survey was used to identify women with postnatal incontinence who were then invited to enrol in a randomised controlled trial of conservative treatment, reported elsewhere.[10] The analyses reported here are restricted to the 3405 respondents to the survey at three months postpartum who were primiparae and who did not have a twin pregnancy.

Enquiry was made about the prevalence, type, frequency and effect on quality of life of urinary incontinence and other urinary symptoms at that time. Question wording and definition of incontinence is given in the Appendix. Incontinent women were further asked about the onset of their incontinence in relation to their pregnancy and delivery: 'when did you first start to lose urine when you didn't mean to?', responses were '**after** this last delivery' [classed as new postnatal incontinence], '**during** this last pregnancy' [classed as persistent antenatal incontinence] and '**before** this last pregnancy'. Information was also collected about faecal incontinence and the performance of pelvic floor muscle training (PFMT) (see Appendix).

Obstetric data were collected from the women's case notes relating to labour and delivery, or from computerised records held for those women. The birth weight and neonatal measurements of the baby and the women's heights and the pre and post pregnancy weights, along with the weight gain during pregnancy, were recorded. The pre- and post-pregnancy body mass index (BMI, weight (kg)/height (metres)^2) was calculated for each woman.

Statistical analysis

Respondents were compared with non-respondents by chi-squared test or Student's t-test as appropriate to determine how representative the sample was of the total population.

We defined incontinence status using the questions regarding occurrence or frequency of urinary incontinence or pad use: a positive response to any one of these indicated urinary incontinence (see Appendix). Time of onset was determined as first occurring before, during or after the index pregnancy, and type was determined by the circumstances under which it occurred. Quality of life was assessed in five areas (hygiene, home, work, social and sex life). Performance of PFMT at

different times (during, immediately after and at 3 months after the index pregnancy) was ascertained retrospectively at 3 months after delivery. Method of delivery was classified as spontaneous vaginal delivery (SVD), forceps (including vaginal breech delivery), vacuum, and caesarean section (CS).

We carried out a univariate analysis to describe the relationship of onset of urinary incontinence with the obstetric, neonatal and maternal variables.

In order to focus on incontinence more likely to be attributable to delivery, continent women were compared with those whose incontinence first started after delivery. The first analysis was a multivariate logistic regression using variables of clinical or statistical significance in order to identify the variables that were significantly associated with incontinence. The significant variables identified by this process were then entered into a final multivariate logistic regression to produce the Final Model using the 1% level of significance. This higher level of significance was chosen to compensate for the use of multiple comparisons.

A similar comparison was made between continent women and those still incontinent at three months after delivery but whose incontinence first started during pregnancy.

RESULTS

In the original survey, 7,879 questionnaires were returned (71.7% response rate), of whom 3489 were primiparous. A comparison of the primiparous responders and non-responders is shown in Table 1: 102 had twin pregnancies and were excluded from further study, leaving 3405 women in the analysis. The response rate amongst eligible primiparae was 76%: it was highest in Aberdeen (84%) and lowest in Birmingham (70%, Table 1).

The prevalence, onset, type and frequency of incontinence and other urinary and faecal symptoms in primiparae, the effect on quality of life and the performance of PFMT are shown in Table 2. At three months postpartum, 29% of the women had some degree of urinary incontinence: 3% had daily or more frequent leakage, and 3% needed to wear a pad for this. The type of incontinence was associated with time of onset: stress incontinence alone more often started during or after pregnancy, urge incontinence alone more often afterwards and mixed/other incontinence started either before or during pregnancy (data not shown).

The significant univariate associations with urinary incontinence at three months postpartum are shown in Table 3. Other variables tested but which were rejected due to non-significance or because they post-dated the onset of incontinence included: previous urinary tract infections; smoking; antenatal problems; duration of first stage; total duration of labour; analgesia in labour; baby's sex; delivery position; BMI after delivery; change in BMI from pre- to post-delivery; performing PFMT at time of discharge from hospital; performing PFMT at 3 months after delivery; frequency of contractions when performing PFMT at 3 months after delivery.

Incontinence after delivery

In order to isolate the effect of delivery alone, a logistic regression was carried out amongst women whose first onset of incontinence occurred after their index delivery, compared to the continent primiparae. Multivariate analysis showed significant associations with maternal age and method of delivery (Table 4a).

When multivariate analysis was carried out, restricted to variables with significant association at the 1% level or greater, only maternal age and method of delivery remained in the model (Table

4b). The chance of incontinence was significantly increased with age and the odds were significantly reduced after caesarean section compared to after spontaneous vaginal delivery. Forceps (including vaginal breech delivery) and vacuum delivery were not significantly associated with urinary incontinence compared to spontaneous vaginal delivery.

Incontinence during pregnancy and persisting after delivery

We carried out a second multivariate analysis in women who were still incontinent at three months after delivery but whose incontinence first started during their index pregnancy ('persistent antenatal incontinence'). Maternal age was not significantly associated with incontinence during pregnancy, but delivery type, baby's birthweight and maternal BMI before pregnancy all were (Table 5a). These three variables remained in the final model (Table 5b). Caesarean section was associated with a lower chance of incontinence whereas mothers with babies whose weight was in the top two quartiles were more likely to be incontinent compared to lighter babies. Higher maternal body mass before pregnancy was also a risk factor for women in the top quartile of BMI.

DISCUSSION

This large multi-centre study has shown that 29% of the primiparae surveyed reported urinary incontinence. Of the 989 incontinent women, 9% had daily or more frequent leakage (10% used a pad every day) and 33% wore a pad for their incontinence at least occasionally. Incontinence posed a hygiene problem for half the women, and a similar proportion reported an effect on home, work or social life. In total 17% of the women considered that their sex life was affected by leakage. Urinary incontinence at three months postpartum therefore appears to have a significant effect on the quality of life for many women.

We found that mode of delivery and older maternal age were significantly related to the chance of developing new urinary incontinence three months after delivery. The likelihood increased most for the oldest women (35 and over). Compared to spontaneous vaginal delivery, the likelihood of incontinence after a caesarean section was about three-fold lower. There was no significant association with forceps (including vaginal breech) or vacuum delivery relative to spontaneous vaginal delivery.

However, in women whose incontinence first occurred during their pregnancy, their own body size and the weight of the baby were the significant risk factors (rather than maternal age), but caesarean section remained associated with a lower rate of incontinence.

The demographic characteristics of the non-respondents were typical of other non-responders to such surveys[11]: they were less likely to be incontinent because they were younger, had smaller babies, and were more likely to have spontaneous vaginal deliveries.

The strengths of the study lie in the large number of women who participated, the high response rate, and the representation of obstetric practice in three countries, albeit now 12 years ago. This lends weight to the validity of the data and increases the generalisability of the findings. With responses from around 3405 women who were primiparae, this is the largest study to date examining the relationship between onset of incontinence, pregnancy and other potential confounding factors.

The prevalence of incontinence amongst 3405 primiparae (29%) was of the same order as in our previous study in postnatal women (30% prevalence in 607 primiparae)[12]. In a general population survey in Norway[13], 17% of primiparous women in a similar age range (20 to 34 years) had

urinary incontinence. In Denmark[14], 26% of 1232 primiparae were incontinent a year after delivery, and 16% were incontinent during the pregnancy. In Sweden[15], 18% of 1051 primiparae had stress incontinence a year after childbirth.

In primiparous women 3 months after a vaginal delivery in Italy[16], 8% had stress incontinence and 6% urge incontinence: this compares with 13% and 6% in the current study. The distribution of type of incontinence in our study amongst the incontinent women (stress 48%; urge 23%; and mixed 30%) was broadly similar to that reported in Norway (50%; 11%; and 36% respectively)[17], although the Norwegian information was not confined to primiparae and the population was older.

Onset of incontinence

Postpartum urinary incontinence in primiparae was mostly related to their pregnancy or delivery. Just over half of the 989 incontinent primiparous women (51%, or 15% of the total number of primiparae) stated that their incontinence first began after delivery. These findings are similar to our earlier study[12], in which 41% of the incontinent primiparae (12% of the total number) had new urinary incontinence after delivery. A small study of primiparae focusing on stress incontinence found that 7% reported new incontinence at 3 months postpartum, and 4% were already incontinent before pregnancy[18], similar to our own findings of 3%. In a study of incontinence during pregnancy in Denmark[19], 5% of 352 women in their first pregnancy reported incontinence before the pregnancy but postnatal rates were not given. In Ireland[20], 5% of primiparae were incontinent before pregnancy, as were 7% of primiparae in Canada[21] who still had postnatal incontinence after delivery.

Pelvic floor muscle training

There was no relationship between performance of PFMT during pregnancy and onset of incontinence (Table 3). All women reported an increase in doing the exercises immediately after delivery, presumably reflecting postnatal advice, but this fell off sharply with time.

Effect of method of delivery

The main focus of the analyses was on new postnatal incontinence which could be attributed to having a baby. The chief obstetric associations with postnatal urinary incontinence were factors associated with delivery. As the effect of gestation, length of labour, birthweight and head circumference are likely to interact with method of delivery, we used multivariate analysis to assess their relative effects.

In order to focus on delivery factors, we first analysed the primiparae whose incontinence only began after delivery ('new postnatal incontinence', Table 4) and compared this group with the primiparous women who were continent at three months. Although some of the reference group might have been incontinent during or immediately after pregnancy, they were dry when we surveyed them at three months. Women were significantly more likely to be dry after caesarean section (with little difference between elective caesarean sections and those carried out in the first and second stages of labour, data not shown). Only 6% of women delivered by caesarean section developed new urinary incontinence at three months, in comparison to those women having a vaginal delivery (18% after spontaneous vaginal delivery, 22% after forceps and 22% after vacuum delivery, Table 4b).

We also examined the effect of delivery on women who first became incontinent during their pregnancy but who were still wet at 3 months after delivery ('persistent antenatal incontinence'). The lower risk associated with caesarean section was still apparent. Although their incontinence could clearly not have been caused by the delivery itself, it seems likely that delivery factors determined whether the incontinence persisted or not.

The association between one caesarean section and less urinary incontinence at three months postpartum is consistent with the results of our previous smaller study in 607 primiparous women (OR 0.2, 95% CI 0.0 to 0.6)[12]. These findings accord with the electrophysiological work of Snooks et al[5], who found increased pudendal nerve terminal motor latencies (indicative of nerve injury) in 42% of women, 48-72 hours after vaginal delivery, but in none of the women delivered by caesarean section. They postulated that the most likely explanation for this pudendal nerve damage was a combination of direct and traction injury caused by elongation of the birth canal during a vaginal delivery.

Two recent population surveys have drawn attention to the lower risk of incontinence after caesarean delivery[1,2]. However, these included women from all age groups and all parities, and were unable to separate out the effects of the first delivery from those due to subsequent deliveries, nor to identify separately the effects of spontaneous vaginal deliveries, assisted vaginal deliveries and caesarean section (because women might have had more than one type of delivery). In a related paper published in this issue, we have now explored the effects of different types of deliveries on the risk of persistent urinary incontinence six years later [22].

The risk of urinary incontinence was not significantly different after forceps or vacuum delivery compared to spontaneous vaginal delivery (Tables 4b, 5b), despite evidence of excess neurological damage after forceps delivery[5].

Effect of age and method of delivery

Clearly age and method of delivery had independent and additive effects on the chance of new onset incontinence (although age was not associated with incontinence which began during pregnancy). Indeed, using community survey data, even women who never have children can expect a 10% lifetime risk of developing urinary incontinence[2,17]. This suggests that the effect of age on incontinence is independent of pregnancy, and is mediated by other unknown factors.

These data should not therefore be viewed as support for the promotion of delivery by caesarean section. The effect of subsequent deliveries and increasing maternal age must be taken into account when counseling women about method of delivery**.** In the light of the implications for future deliveries and the higher morbidity associated with caesarean delivery, all the long term consequences require careful consideration.

Effect of age and body mass index

Age is a well known risk factor for incontinence, but in our study, age (over 35 years) was only significant for incontinence first starting after delivery, not during pregnancy. In contrast, body mass index and baby's birth weight were both associated with incontinence first starting during pregnancy but not if it started thereafter. This suggests that different mechanisms are operating in the two groups.

The separate effects of age and body mass index on incontinence were also reported in a Norwegian survey[23], but neither their interaction nor their relation to parity or obstetric factors were explored.

Faecal incontinence

In contrast with the current findings for urinary incontinence, an increased risk of faecal incontinence was associated with forceps delivery (OR 1.94, 95% CI 1.30 to 2.89) but only marginally with a decreased risk after caesarean section (OR 0.58, 95% CI 0.35 to 0.97)[24].

Conclusions

In conclusion, the results of this large multi-centre study have shown that maternal age and vaginal delivery are the adverse risk factors for new urinary incontinence at three months after a first birth.. Pre-pregnancy body mass index and weight of the baby were additionally associated with urinary incontinence starting during pregnancy and persisting at 3 months, but age was not. Caesarean section was associated with significantly fewer symptoms but these still occurred in 6 to 7% of women who were continent before pregnancy. Other obstetric risk factors were found to be non-significant. A long term follow up six years later has now been carried out to ascertain the effect on incontinence of further deliveries, and these data are reported separately[22].

Acknowledgements
The survey was funded by a project grant from BirthRight (now WellBeing). We are grateful to Anne-Marie Rennie, Alison McDonald, Jane Harvey and Jane Cook who carried out the survey administration.

The Health Services Research Unit is funded by the Chief Scientist Office of the Scottish Executive Health Department, but the views expressed in this article are those of the author, not the funding bodies.

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Table 1 **Comparison of responders and non responders to questionnaire survey among 4555 primiparous women**

Characteristic	Responder	Non-responder	Significance DiM [95% CI for DiM]
Number of women	3489	1066	
Twin pregnancies	84	18	
Centre [1]			
Dunedin	391 (79%)	103 (21%)	
Birmingham	1635 (70%)	689 (30%)	
Aberdeen	1379 (84%)	256 (16%)	
Age (years) [1]	26.7 (SD 5.25) n=3398	24.2 (SD 5.61) n=1048	-2.48 [-2.9 to –2.1]
Gestation (weeks) [1]	39.4 (SD 2.26) n=3357	39.1 (SD 2.54) n=1014	-0.32 [-0.48 to -.02]
Spontaneous onset of labour [1, 2]	2506 (78%)	797 (81%)	
Method of delivery [1]	3402	1046	
SVD	1971 (58%)	658 (63%)	
Forceps	583 (17%)	157 (15%)	
Vacuum	274 (8%)	53 (5%)	
CS	574 (17%)	178 (17%)	
Birthweight (grams) [1]	3296 (SD 592) n=3402	3148 (SD 667) n=1037	-148 [-193 to –102]

[1] Excluding women with twin pregnancies
[2] Excluding women having elective caesarean sections
DiM Difference in Means
SVD = spontaneous vaginal delivery
Forceps = assisted vaginal delivery (forceps and vaginal breech)
Vacuum = vacuum extraction
CS = caesarean section (elective and emergency deliveries)

Table 2 **Prevalence, type and frequency of incontinence and other urinary symptoms at three months postpartum for 3405 primiparous women with singleton deliveries**

Symptom	Number (3405)	Percent of all women
Urinary incontinence at any time	989	29
onset before index pregnancy	101	3
onset during index pregnancy	362	11
onset after index pregnancy	503	15
Continent	2416	71
Voiding "difficulty"	121/3370	4
having to strain	26	1
hurts, burns on voiding	38	1
poor flow	40	1
feeling of incomplete emptying	88	3
Urinary frequency (> 7 voids per day)	719	22
Nocturia (> 1 per night)	514	15
Faecal incontinence to motions (rarely or more often)	288	9
Any PFMT performed during pregnancy	2469/3340	74
Any PFMT performed soon after delivery	2859/3331	86
Any PFMT performed 3 months after delivery	1746/3380	52
INCONTINENT WOMEN	**Number (989)**	**Per cent of incontinent women**
Frequency of incontinence		
< once per week	485	50
< daily and > once per week	402	41
> daily leakage	88	9
Pad usage		
None	664	68
Sometimes	221	23
Daily	98	10
Effect on quality of life		
Hygiene	462	51
Home, work, social life	342	47
Sex life	140	17

Symptom	Number (3405)	Percent of all women
Type of incontinence		
Stress	459	48
Urge	221	23
Mixed / other	285	30
Co-existing faecal incontinence	136	15

Table 3 **Univariate associations with urinary incontinence in primiparous women with singleton births according to incontinence status and to timing of onset of incontinence at 3 months after delivery**

	Total	Continent [1]	Time of onset of urinary incontinence present at 3 months after index delivery		
			Before	During	After
	N	N (%)	N (%)	N (%)	N (%)
All women [2]	3377	2411 (71)	101 (3)	362 (11)	503 (15)
Vaginal deliveries	2805	1932 (69)	76 (3)	328 (12)	469 (17)
Mother's age					
<25 years	1140	834 (73)	37 (3)	134 (12)	135 (12)
25 to 29	1213	862 (71)	28 (2)	123 (10)	200 (17)
30 to 34	753	544 (72)	20 (3)	73 (10)	116 (15)
>=35	231	148 (64)	15 (7)	27 (12)	41 (18)
Gestation at delivery					
< 37 weeks	247	198 (80)	5 (2)	16 (6)	28 (11)
>= 37	3082	2184 (71)	94 (3)	339 (11)	465 (15)
Mode of delivery					
SVD	1954	1358 (70)	54 (3)	235 (12)	307 (16)
Forceps/breech	579	393 (68)	16 (3)	58 (10)	112 (19)
Vacuum	272	181 (67)	6 (2)	35 (13)	50 (18)
CS	569	477 (84)	24 (4)	34 (6)	34 (6)
Duration of Labour (vaginal deliveries only) - second stage					
< 30 minutes	756	534 (71)	21 (3)	88 (12)	113 (15)
30 to 59	513	357 (70)	14 (3)	59 (12)	83 (16)
>=60	1507	1021 (68)	40 (3)	176 (12)	270 (18)
Perineum (vaginal deliveries only)					
Intact	533	374 (70)	18 (3)	69 (13)	72 (14)
Laceration	1045	728 (70)	30 (3)	116 (11)	171 (16)
Episiotomy	1130	769 (68)	23 (2)	135 (12)	203 (18)
Birthweight (quartiles)					
< 3 kg	835	633 (76)	23 (3)	69 (8)	110 (13)
3 to 3.35	887	627 (71)	26 (3)	97 (11)	137 (15)
3.36 to 3.69	869	604 (70)	22 (3)	102 (12)	141 (16)
>=3.7	783	544 (70)	30 (4)	94 (12)	115 (15)
Head circumference (quartiles)					
< 335 mm	671	491 (73)	16 (2)	63 (9)	101 (15)
335 to 344	772	537 (70)	27 (4)	86 (11)	122 (16)
345 to 354	885	635 (72)	27 (3)	93 (11)	130 (15)
>=355	987	704 (71)	25 (3)	116 (12)	142 (14)

	Total	Continent [1]	Time of onset of urinary incontinence present at 3 months after index delivery		
			Before	During	After
	N	N (%)	N (%)	N (%)	N (%)
BMI pre-pregnancy [3] (quartiles)					
< 20.7	718	533 (74)	18 (3)	59 (8)	108 (15)
20.7 to 22.3	710	505 (71)	19 (3)	82 (12)	104 (15)
22.4 to 25	694	493 (71)	23 (3)	78 (11)	100 (14)
>25	629	425 (68)	27 (4)	73 (12)	104 (17)
Missing	627	455 (73)	14 (2)	70 (11)	88 (14)
Performing any PFMT during pregnancy					
Any PFMT	2469	1749 (73)	76 (77)	262 (73)	382 (77)
No PFMT	871	635 (17)	24 (13)	97 (27)	115 (13)

Missing values are excluded for all variables except BMI.

1 Women continent to urine at 3 months after index delivery

2 N=3377 due to 28 missing responses to onset of incontinence question

3 BMI = weight (kg)/height (metres)^2

Table 4a **Multivariate logistic regression: primiparae who are first incontinent after their index delivery compared with continent primiparae**

	n	UI n (%)	OR	95% CI	P
Age of mother at index birth					
<=25 years	939	128 (14)	1		
25 to 29	1040	197 (19)	1.52	(1.18 to 1.94)	0.001
30 to 34	634	110 (17)	1.46	(1.10 to 1.94)	0.010
>= 35	180	41 (23)	2.21	(1.47 to 3.33)	<0.001
Delivery type					
SVD	1606	293 (18)	1		
Forceps	483	104 (22)	1.12	(0.87 to 1.46)	0.376
Vacuum	224	48 (21)	1.14	(0.81 to 1.63)	0.447
CS	480	31 (7)	0.29	(0.19 to 0.42)	<0.001
Gestational age					
>=37 weeks	2589	451 (17)	1		
<37	204	25 (12)	0.85	(0.52 to 1.38)	0.509
Birthweight (quartiles)					
<3 kg	704	101 (14)	1		
3.00 to 3.35	737	132 (18)	1.26	(0.91 to 1.75)	0.166
3.36 to 3.69	718	136 (19)	1.42	(1.00 to 2.02)	0.050
>=3.70	634	107 (17)	1.33	(0.90 to 1.96)	0.157
Head circumference (quartiles)					
<335 mm	571	92 (16)	1		
335 to 344	643	120 (19)	0.93	(0.67 to 1.30)	0.678
345 to 354	752	127 (17)	0.77	(0.54 to 1.09)	0.144
>=355	827	137 (17)	0.76	(0.52 to 1.12)	0.163
BMI before pregnancy (quartiles)					
<20.7	609	102 (17)	1		
20.7 to 22.3	586	101(17)	1.02	(0.75 to 1.38)	0.918
22.4 to 25	570	94 (17)	0.95	(0.70 to 1.30)	0.751
>25	501	97 (19)	1.30	(0.95 to 1.79)	0.101
Missing	527	82 (16)	0.98	(0.71 to 1.35)	0.900

n = 2793; percentages rounded up for clarity
symptomatic women = 476

Table 4b **Final Model: primiparae who are first incontinent after their index delivery compared with continent primiparae**

	N	UI n (%)	OR	95% CI	P
Age of mother at index birth					
<=25 years	969	135 (14)	1		
25 to 29	1061	200 (19)	1.46	(1.15 to 1.86)	0.002
30 to 34	660	116 (18)	1.43	(1.08 to 1.88)	0.012
>= 35	188	41 (22)	2.02	(1.35 to 3.02)	0.001
Delivery type					
SVD	1645	300 (18)	1		
Forceps	501	110 (22)	1.18	(0.92 to 1.51)	0.191
Vacuum	230	50 (22)	1.16	(0.83 to 1.63)	0.393
CS	502	32 (6)	0.28	(0.19 to 0.41)	<0.001

n = 2878; percentages rounded up for clarity
symptomatic women = 492

Table 5a **Multivariate logistic regression: primiparae who are first incontinent during their index delivery compared with continent primiparae**

	n	UI n (%)	OR	95% CI	P
Age of mother at index birth					
<=25 years	940	129 (14)	1		
25 to 29	962	119 (12)	0.90	(0.68 to 1.18)	0.443
30 to 34	595	71 (12)	0.90	(0.66 to 1.24)	0.530
>= 35	166	27 (16)	1.47	(0.92 to 2.35)	0.106
Delivery type					
SVD	1538	225 (15)	1		
Forceps	435	56 (13)	0.81	(0.58 to 1.11)	0.190
Vacuum	209	33 (16)	1.05	(0.70 to 1.59)	0.800
CS	481	32 (7)	0.39	(0.27 to 0.59)	<0.001
Gestational age					
>=37 weeks	2469	331 (13)	1		
<37	194	15 (8)	0.73	(0.40 to 1.34)	0.313
Birthweight (quartiles)					
<3 kg	666	63 (10)	1		
3.00 to 3.35	696	91 (13)	1.42	(0.96 to 2.10)	0.076
3.36 to 3.69	683	101 (15)	1.72	(1.14 to 2.60)	0.010
>=3.70	618	91 (15)	1.82	(1.16 to 2.86)	0.009
Head circumference (quartiles)					
<335 mm	542	63 (12)	1		
335 to 344	603	80 (13)	0.88	(0.60 to 1.30)	0.513
345 to 354	715	90 (13)	0.73	(0.48 to 1.09)	0.124
>=355	803	113 (14)	0.80	(0.52 to 1.25)	0.328
BMI before pregnancy (quartiles)					
<20.7	564	57 (10)	1		
20.7 to 22.3	564	79 (14)	1.49	(1.03 to 2.15)	0.035
22.4 to 25	550	74 (14)	1.35	(0.93 to 1.96)	0.115
>25	471	67 (14)	1.60	(1.09 to 2.35)	0.016
Missing	514	69 (13)	1.44	(0.98 to 2.09)	0.061

n = 2663; percentages rounded up for clarity
symptomatic women = 346

Table 5b **Final Model: primiparae who are first incontinent during their index delivery compared with continent primiparae**

	n	UI n (%)	OR	95% CI	P
Delivery type					
SVD	1592	235 (15)	1		
Forceps	451	58 (13)	0.80	(0.59 to 1.10)	0.164
Vacuum	216	35 (16)	1.06	(0.72 to 1.57)	0.771
CS	510	34 (7)	0.39	(0.27 to 0.58)	<0.001
Birthweight (quartiles)					
<3 kg	701	69 (10)	1		
3.00 to 3.35	724	97 (13)	1.33	(0.95 to 1.85)	0.095
3.36 to 3.69	706	102 (14)	1.45	(1.05 to 2.02)	0.026
>=3.70	638	94 (15)	1.56	(1.12 to 2.19)	0.009
BMI before pregnancy (quartiles)					
<20.7	591	59 (10)	1		
20.7 to 22.3	587	82 (14)	1.48	(1.04 to 2.12)	0.032
22.4 to 25	569	78 (14)	1.38	(0.96 to 1.99)	0.080
>25	497	73 (15)	1.68	(1.16 to 2.43)	0.006
Missing	525	70 (13)	1.39	(0.96 to 2.02)	0.081

n = 2769; percentages rounded up for clarity
symptomatic women = 362

Appendix: Questionnaire wording

Questions related to urinary incontinence:

1. At present, do you ever lose any urine when you don't mean to? *(Yes/No)*
2. In the last month how often has this happened on average? *(less than twice per month to three or more times a day)*
3. Do you wear a pad for this? *(No, sometimes, all day, all night, all day and all night)*

A positive response to one or more of these questions was taken to indicate that the woman was incontinent.

4. Overall, how much of a problem to you is losing control of your urine? (visual analogue scale marked with a cross on a 10 cm line from '*no problem at all*' to '*can't think of anything worse*'.

Questions related to type of incontinence:

5. Do you lose urine when you (*Yes/No*):
   - a) cough, laugh or sneeze
   - b) run, jump or play sport
   - c) feel an urgent desire to pass water and are unable to reach the toilet in time
   - d) at some other time (please specify)

a) or b) alone = stress urinary incontinence (SUI)
c) alone = urge urinary incontinence (UUI)
d) or both SUI and UUI = mixed urinary incontinence (MUI)

Questions related to quality of life:

6. How much has the problem with wetting yourself affected the following areas of your life? (*Severely affected, moderately affected, not affected, not applicable*)
   - a) Hygiene
   - b) Home life
   - c) Work life
   - d) Social life (includes hobbies and sports)
   - e) Sex life

b), c) and d) aggregated as a measure of quality of life, a) and e) reported separately.

Questions related to faecal incontinence

7. Do you ever lose control of wind or bowel motions from your back passage in between visits to the toilet? (*No, rarely, sometimes, often, always*)
   - a) Lose control of wind?
   - b) Lose control of motions?

Questions related to pelvic floor muscle training

8. Thinking about your recent pregnancy and delivery, how often did you do pelvic floor exercises: *(Never, a few times a month, once a week, a few times a week, every day)*
   - a) During your pregnancy?
   - b) After delivery on discharge from hospital?
   - c) During the last month?