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**Exclusive caesarean section delivery and subsequent urinary and faecal incontinence; a twelve year longitudinal study**

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**Running title:** Exclusive caesarean section, urinary and faecal incontinence

## **Abstract**

**Objectives:** To investigate the association between delivery mode history and urinary and faecal incontinence, specifically a history of exclusive caesarean section deliveries.

**Design:** Twelve year longitudinal study.

**Setting:** Maternity units in Aberdeen, Birmingham and Dunedin.

**Population:** Women who returned postal questionnaires three months and twelve years after index birth.

**Methods:** Data on all births over a 12 month period were obtained from units and women were followed 3 months, 6 and 12 years postbirth.

**Main outcome measures:** Urinary incontinence (UI) and faecal incontinence (FI) 12 years after index birth.

**Results:** 3763 of 7883 women recruited at 3 months were followed at 12 years: non-responders were similar in obstetric factors. After adjustment for parity, body mass index and age at first birth, women who delivered exclusively by caesarean section were less likely to have UI than those who only had spontaneous vaginal births (OR 0.46, 95% CI 0.37 to 0.58), but not if they had a combination of caesarean and spontaneous vaginal births (1.14, 95% CI 0.89 to 1.47). There was no difference in FI among women who had exclusive caesarean births (OR 0.94, 95% CI 0.66 to 1.33) or mixed caesarean and spontaneous vaginal births (OR 1.06, 95% CI 0.73 to 1.54).

**Conclusions:** Unless women are resolved to have all their deliveries by the abdominal route (and their medical advisors agree), caesarean section does not

protect from subsequent UI. Even among those who do deliver exclusively by caesarean section, 40% still report UI; and this strategy confers no benefit for subsequent FI.

**Keywords:** Urinary incontinence; faecal incontinence; exclusive caesarean delivery

## **Introduction**

In the debate on women's choice to deliver by Caesarean Section (CS), supporters argue that CS will protect women from subsequent incontinence.<sup>1</sup> Three systematic reviews have considered whether protection does occur. One, titled 'Does Caesarean section reduce postpartum urinary incontinence' (UI), concluded that UI was significantly reduced after Caesarean relative to a vaginal birth but not for severe UI, although numbers with severe UI (severity according to study authors definition) were very small.<sup>2</sup> A review of Caesarean delivery for the prevention of anal incontinence found that the likelihood of faecal incontinence (FI) following an index birth by CS was no different than following a vaginal delivery.<sup>3</sup> A review of studies of faecal incontinence (FI) in the year after birth compared CS with spontaneous and instrumental vaginal births, showed a very small reduction in FI among women who had a Caesarean relative to a spontaneous vaginal birth; and more FI following forceps relative to Caesarean or to spontaneous vaginal births.<sup>4</sup> A crucial drawback of these reviews however, is that almost all available studies are based on symptoms following only one delivery, follow-up is limited and many women have other modes of delivery which are likely to modify their risk.

This longitudinal study of women first contacted at three months postpartum was followed up at six years to study delivery mode history.<sup>5,6</sup> At this time, among women who delivered exclusively by CS, there was significantly less urinary but no less faecal incontinence than among the group who had any other delivery mode history excluding forceps. An important aim of the 12 year follow up was to investigate whether incontinence at this time was less common in women who only ever delivered by CS relative to those who had only ever had spontaneous vaginal births; and what happened among those who had both Caesarean and spontaneous deliveries.

## **Methods**

The sample was all women who delivered over a 12 month period (1993/1994) in three maternity units, in Aberdeen (Scotland), Birmingham (England) and Dunedin (New Zealand), and were followed up 12 years later. These deliveries are referred to as the index births. Baseline data on maternal and obstetric characteristics were obtained for all deliveries to allow comparison of responders and non-responders. A postal questionnaire was sent at three months postpartum to assess prevalence of faecal and urinary incontinence. Women with UI at this time were eligible to take part in a randomised controlled trial (RCT) of the effects of an intensive pelvic floor muscle exercise (PFME) programme (described elsewhere<sup>7</sup>). At six years postpartum women who had responded were sent another questionnaire and at 12 years all women who had replied at three months were contacted a third time (including non-responders at six years), except known subsequent deaths or those who requested no further contact in their six year questionnaire.

### **Data collection and outcome measures**

The outcome measures were urinary and faecal incontinence 12 years after the index birth. To assess UI women were asked, “do you ever lose urine when you don’t mean to” and if yes, “in the last month how often has this happened, on average”, with optional responses from less than twice a month to three or more times a day. More severe UI was defined as that occurring at least weekly. To assess FI women were asked, “do you ever lose control of bowel motions (stool/faeces) from your back passage in between visits to the toilet?” Optional responses were ‘never’, ‘occasionally’, ‘sometimes’, ‘most of the time’ and ‘all of the time’. More severe FI was defined as that occurring more often than occasionally. The questions were designed by the study team, since at the time of recruitment there were no suitable validated questionnaires on incontinence. UI and FI were

defined as occurring with any level of frequency. Women who did not answer the primary incontinence question and had no subsidiary answers that indicated symptoms were recorded as not symptomatic. Women who answered 'no' to the primary question but gave subsidiary answers that indicated symptoms were recorded as being symptomatic (n=22 for FI and 50 for UI).

Obstetric and maternal data relating to the index delivery was obtained from routine hospital case-notes. Follow-up questionnaires at six and 12 years obtained date and mode of every delivery, which enabled delivery mode history to be determined. Height and weight were also obtained to determine Body Mass Index (BMI). Self-reported height and weight is known to be difficult to obtain, so all cases with missing or implausible values were categorised as 'not available' and included in the analysis.

### **Research question**

The main research question was whether delivery mode history was predictive of incontinence at 12 years after index birth. Pre-defined questions within this were what was the effect relative to having only spontaneous vaginal births: of delivering exclusively by CS; of having both Caesarean and spontaneous vaginal births; and of ever having a forceps delivery.

### **Analysis**

Logistic regression was used to assess the independent effects of delivery mode history on symptom outcome and to adjust for and report on other independent predictors. The variable *delivery mode history*, created from the reported birth histories, categorised all a woman's deliveries into: SVD only (reference); CS only; combination of only SVD and CS; one or more forceps; and one or more vacuum extraction but no forceps. (The last two categories include women who also had SVD and/or CS if they ever also had a forceps or vacuum delivery.) Subsidiary

regression models to explore type of CS and more severe symptoms were also undertaken. In all models adjustment was made for age at first birth (<25/25-29/30-34/35+), total number of births (one/two/three/four or more), ethnic origin (non-Asian/Asian) and BMI (<18.5/18.5-24.9/25-29.9/30+/not available). Cases with other missing values in the other variables included in the models were omitted from the analysis.

## Results

10989 women had been sent a questionnaire at three months postpartum and 7879 had replied. At six years, 117 women requested no further contact and there were 41 subsequent known deaths. Further checking of records identified four additional cases that were eligible to receive a questionnaire at 12 years. Excluding the 158 cases who requested no further contact or had died, 7725 follow-up questionnaires were sent at 12 years. 798 were returned as 'moved away' by the post office and 3763 were returned completed by the women, a response rate of 48.7% (3763/7725). Among these 3763 women, 2944 (78.2%) replied at all three contact points and 819 (21.8%) replied at three months and 12 years, but not six years. The 2944 responses represent 69.9% (2944/4214) of women who had replied at six years. Mean duration of follow up was 12.9 years (SD 0.67; range 10.6-14.3). There were 1280 women who had responded at six years but did not respond at 12 years. The mean age of the women at 12 years was 42.4 (SD 4.9).

Comparison of baseline characteristics of women who did and did not respond at 12 years showed some differences (Table 1). Fewer respondents had been under 25 years at index birth, fewer were Asian, slightly fewer were multiparous and more had an intact perineum. Parity, delivery mode, onset of labour and length of second stage of index birth were similar. The prevalence of FI at three months was a little

lower among respondents, which is likely to underestimate the prevalence of symptoms at 12 years but the prevalence of UI was the same.

### **Prevalence of incontinence at 12 years**

The prevalence of any UI at 12 years was 52.7% (1983/3763): 23.6% (891/3763) reported it at least weekly with 5.4% (244/3763) one or more times daily. The prevalence of any faecal incontinence at 12 years was 12.9% (487/3763). Most women reported this as occurring occasionally, with 2.8% (106/3763) reporting it as more frequent.

### **Urinary Incontinence at 12 years and delivery mode history**

Relative to women who had only ever had SVDs, delivering exclusively by CS was independently associated with a reduction in UI at 12 years, but having an SVD in addition to a CS birth was not (see Table 2). There was slightly less UI among women who had ever had a forceps delivery and no difference in women who had ever had a vacuum delivery but no forceps. Older maternal age at first birth was associated with more UI, but this was only statistically significant for age groups 30 or more. Having four or more births relative to one, was significantly associated with more UI but two or three births were not. Increasing BMI was associated with more UI and there was a marginal association for BMI not available. Asian ethnic group was not associated with UI.

A subsidiary model to examine different types of CS within the delivery history showed a similar reduction whether the CS was pre or post labour or a mixture of both with other associations unaltered (see Table 3). More severe UI at 12 years relative to less severe or no UI showed a similar delivery history pattern as for any UI (see Table 4).

### **Faecal incontinence at 12 years and delivery mode history**

The association between FI at 12 years and delivery mode history after adjustment is shown in Table 5. Among those who had only ever delivered by CS the likelihood of FI was no different from those who only ever had spontaneous vaginal births. The same was found for women who had a combination of spontaneous vaginal and Caesarean deliveries. FI was significantly more common among women who ever had a forceps delivery, but there was no association with having ever delivered by vacuum extraction in the absence of forceps. FI was also independently associated with increasing parity, older age at first birth, and greater BMI. FI did not differ significantly by Asian ethnic origin.

A subsidiary model to examine different types of CS within the delivery history, although based on smaller numbers, did not alter the lack of effect of delivering only by CS with the other associations unaltered (see Table 3). More severe FI at 12 years compared with less severe or no FI, again based on smaller numbers, showed a similar pattern for delivery mode history as for any FI compared with no FI (see Table 4). The association with age of first birth and parity also showed the same pattern as for any FI and an increase in severe FI was found among Asian women (OR 2.71, 95% CI 1.48 to 5.0).

## **Discussion**

This large 12 year cohort study has clearly documented that CS was not protective of UI unless all the women's deliveries were exclusively by CS. If women had spontaneous vaginal as well as Caesarean births, the prevalence of UI was similar to those who only ever delivered spontaneously. And even after exclusive Caesarean births the prevalence of long term UI was high, at 40%. For FI, there was no

symptom reduction with exclusive CS births. Whether or not the Caesarean sections took place before or after labour had started did not modify these findings.

A delivery history that included just one forceps birth, irrespective of additional modes of delivery that a woman had, increased the prevalence of FI; but there was no increase in UI after forceps birth. In fact, there was less UI with forceps (of borderline statistical significance) which was not present at 6 years and was not found for more severe UI. These inconsistencies, as well as the literature, makes it likely to be a chance finding.

The main strengths of this study are its large size and long duration: it is by far the largest postpartum cohort study in the literature with this duration of follow-up, only small studies having had longer follow up.<sup>2,3,4</sup> Unless a study is large there are insufficient numbers of women delivering exclusively by CS or having a combination of Caesarean and spontaneous vaginal births to be able to make comparisons with adequate precision.<sup>8</sup> In the systematic review of UI,<sup>2</sup> all 12 cohort studies in total comprised only 8727 women and none examined delivery mode history. Our six year follow-up was not included, being published just after the search exclusion date. Delivery history data was complete for all but 11 of the 3763 women. It was obtained directly from the women but validation studies have shown that women's recall of delivery mode is high,<sup>9</sup> and it was possible in this study to check the accuracy of reports for mode of the index birth since we also had obstetric case-note data. For 98% of CS, 98% of SVD, 87% of forceps and 88% of vacuum deliveries data from both sources were consistent.

Rate of follow-up at 12 years might be seen as the main limitation of the study at just under 50% of those initially contacted at three months. It is important therefore to consider the possible effects of this in terms of bias. The original intention of the

study had been for a single contact at three months so no alternative contact details in the event of a house move had been sought. At six years alternative contacts for subsequent follow-up were sought and loss between six and 12 years was much smaller, with 70% of the six year responders responding again. It is therefore likely that much non-response was not purposeful. Additional methods of tracing were available at 12 years in the UK centres and this meant that 819 women who had moved by six years thus not responded, did so when traced at a different address at 12 years. Geographical mobility is not known to be associated with incontinence or with delivery mode.

We could examine possible response bias as we had obstetric case-note data for the index birth for non-responders and comparisons were made showing that the greatest difference was that fewer younger women (under 25) responded as did ethnic minority groups, which has typically been a common response pattern among childbirth populations.<sup>10</sup> The age difference is likely to lead to an overestimate from the study of the overall prevalence of incontinence which was lower in younger women. The obstetric factors however, in particular for mode of delivery, were similar between responders and non-responders. The only difference was that an intact perineum at index birth was more common among non-respondents. In our first follow-up at six years we investigated the association between UI and FI and the detailed index birth obstetric variables and found no association with perineal trauma, either laceration (anal sphincter tears were not sub-categorised being too few) or episiotomy. So although the difference in this or in demographic variations of responders might affect our estimates of symptom prevalence, it is difficult to see how it could affect the delivery mode history associations. Another weakness is that a validated questionnaire was not used, but at the time of recruitment there were none available and we wanted to follow-up with consistent questioning.

The only other large study to examine UI after exclusive vaginal delivery or CS was a Norwegian population-based cross-sectional study of women under age 65 which compared three groups; no deliveries; delivered exclusively by CS and exclusively vaginal deliveries (spontaneous or instrumental).<sup>11</sup> This showed that the prevalence of urinary stress incontinence was lower among the exclusive CS group, although this was still significantly higher than among nulliparous women, indicating that there is something about pregnancy itself that predisposes toward this symptom. There was no separate group categorised who had mixed Caesarean and spontaneous vaginal deliveries so there are no findings on this. They also found within their older age group (50-64) that the symptom prevalence was similar among the vaginal only and the CS only groups, suggesting that any protection from CS might anyway be lost with advancing age. We could not examine this since we had few women in this older age group. Of other cohort studies, the three largest included 2386,<sup>12</sup> 1472<sup>13</sup> and 1189<sup>14</sup> women: and all had low CS rates (5.7%, 5.9%, 10.8% respectively), thus the numbers in these groups were small. And none of these studies examined delivery mode history. Studies examining delivery mode and FI<sup>3,4</sup> were all even smaller than those investigating UI.

## **Conclusions**

The findings of this large cohort study comprise an important new message to inform choice of delivery by CS. Unless women are resolved to have all their deliveries by the abdominal route (and their medical advisors agree), there is no protection from subsequent UI with CS. Even among women who do deliver exclusively by CS, 40% still report incontinence, and this strategy confers no benefit at all in terms of subsequent FI.

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**Contribution to authorship:** All authors contributed to the design, analysis and writing-up of the study. Other members of the ProLong study group are: Nicola Dean, Suzanne Hagan, Christine Bain, Philip Tooz-Hobson, Adrian Grant.

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**Table 1 Characteristics of respondents and non-respondents at 12 years**

	Respondent		Non-respondent*	
	No	%	No	%
<b>Age at index child</b>				
<25	651	(17.3)	1172	(28.5)
25-29	1327	(35.3)	1438	(34.9)
30-34	1285	(34.1)	1081	(26.3)
35+	500	(13.3)	428	(10.4)
Not known	0		1	
Total	3763		4120	
<b>Ethnic group</b>				
Non-Asian	3588	(96.0)	3680	(90.9)
Asian	149	(4.0)	368	(9.1)
Not known	26		72	
Total	3763		4120	
<b>Induced</b>				
Yes	646	(17.6)	695	(17.2)
No	3029	(82.4)	3353	(82.8)
Not known	88		72	
Total	3763		4120	
<b>Primiparous</b>				
Yes	1760	(46.8)	1782	(43.6)
No	2003	(53.2)	2304	(56.4)
Not known	0		34	
Total	3763		4120	
<b>Perineal Trauma<sup>†</sup></b>				
Intact	815	(27.0)	1205	(36.8)
Laceration	1386	(46.0)	1310	(40.0)
Episiotomy	814	(27.0)	763	(23.3)
Not known	148		197	
Total	3163		3475	
<b>2<sup>nd</sup> Stage &gt;=1 hr<sup>†</sup></b>				
Yes	1018	(37.4)	986	(35.0)
No	1706	(62.6)	1832	(65.0)
Not known	439		657	
Total	3163		3475	
<b>Mode of index birth</b>				
CS	600	(16.3)	645	(15.9)
Forceps or breech	392	(10.6)	382	(9.4)
Vacuum	190	(5.2)	166	(4.1)
SVD	2506	(68.0)	2867	(70.6)
Not known	75		60	
Total	3763		4120	
<b>Urinary incontinence at 3 months postpartum</b>				
Yes	1247	(33.1)	1386	(33.6)

No	2516	(66.9)	2734	(66.4)
Total	3763		4120	

**Faecal incontinence at  
3 months postpartum**

Yes	307	(8.2)	392	(9.5)
No	3456	(91.8)	3728	(90.5)
Total	3763		4120	

\* This includes as non-responders those who said at 6 years no further contact and the 41 cases that had died

<sup>†</sup> Excludes caesarean sections

*Percentages calculated after excluding cases classed as not known*

**Table 2 Logistic Regression of UI at 12 Years and Delivery Mode History**

Variable	Total	Symptoms no. (%)	OR	(95% CI)	p
<b>Delivery mode history (mean no. dels, mean yrs since last del)</b>					
Only SVD (2.5, 10.2)	1852	1013 (54.7)		Reference	
Only CS (2.0, 10.8)	403	162 (40.2)	0.46	(0.37 to 0.58)	<0.001
SVD and CS (2.9, 9.7)	293	174 (59.4)	1.14	(0.89 to 1.47)	0.308
Any forceps (2.6, 10.4)	956	491 (51.4)	0.81	(0.69 to 0.95)	0.010
Any vacuum, no forceps (2.3, 9.4)	248	139 (56.0)	0.97	(0.74 to 1.28)	0.851
<b>Age at 1<sup>st</sup> birth</b>					
< 25	1273	647 (50.8)		Reference	
25-29	1492	773 (51.8)	1.15	(0.99 to 1.35)	0.073
30-34	788	443 (56.2)	1.51	(1.24 to 1.82)	<0.001
35 +	199	116 (58.3)	1.88	(1.36 to 2.59)	<0.001
<b>Number of births</b>					
One	410	202 (49.3)		Reference	
Two	1834	972 (53.0)	1.18	(0.94 to 1.47)	0.158
Three	1014	525 (51.8)	1.16	(0.91 to 1.48)	0.241
Four or more	494	280 (56.7)	1.45	(1.09 to 1.93)	0.010
<b>Body Mass Index</b>					
< 18.5	61	29 (47.5)	0.98	(0.59 to 1.65)	0.945
18.5-24.9	1785	839 (47.0)		Reference	
25-29.9	1020	576 (56.5)	1.55	(1.33 to 1.82)	<0.001
30 or more	642	406 (63.2)	2.17	(1.80 to 2.63)	<0.001
Not known	244	129 (52.9)	1.34	(1.02 to 1.76)	0.035

Based on 3752 cases: 11 with delivery mode history missing

**Table 3 Logistic regression subsidiary models of UI and FI at 12 years and delivery mode history sub-dividing type of section**

Variable	Total	UI			FI				
		Symptoms no.	Symptoms %	OR	(95% CI)	Symptoms no.	OR	(95% CI)	
<b>Delivery mode history</b>									
Only SVD	1852	1013	(54.7)		Reference	213	(11.5)	Reference	
Only pre-lab CS	124	48	(38.7)	0.43	(0.29 to 0.63)	13	(10.5)	0.82	(0.45 to 1.50)
Only post-lab CS	109	44	(40.4)	0.46	(0.30 to 0.69)	10	(9.2)	0.75	(0.38 to 1.50)
Only CS/ pre+post lab	170	70	(41.2)	0.49	(0.35 to 0.68)	24	(14.1)	1.13	(0.71 to 1.79)
SVD + CS	293	174	(59.4)	1.14	(0.89 to 1.48)	39	(13.3)	1.06	(0.74 to 1.54)
Any forceps	956	491	(51.4)	0.81	(0.69 to 0.95)	160	(16.7)	1.48	(1.18 to 1.85)
Any vacuum, no forceps	248	139	(56.0)	0.97	(0.74 to 1.28)	27	(10.9)	0.91	(0.59 to 1.40)

*Age at 1<sup>st</sup> birth, number of births and BMI not shown*

**Table 4 Logistic regression subsidiary models of more severe UI and more severe FI and delivery mode history**

Variable	Total	More severe UI Symptoms		OR	(95% CI)	More severe FI Symptoms		OR	(95% CI)
		no.	%			no.	%		
<b>Delivery mode history</b>									
Only SVD	1852	439 (23.7)			Reference	43 (2.3)		Reference	
Only CS	403	78 (19.4)	0.64	(0.48 to 0.84)		9 (2.2)	1.07	(0.51 to 2.27)	
SVD + CS	293	87 (29.7)	1.24	(0.94 to 1.65)		8 (2.7)	1.02	(0.47 to 2.21)	
Any forceps	956	219 (22.9)	0.87	(0.72 to 1.06)		40 (4.2)	1.79	(1.14 to 2.79)	
Any vacuum, no forceps	248	66 (26.6)	1.11	(0.82 to 1.51)		6 (2.4)	1.14	(0.48 to 2.74)	

*Age at 1<sup>st</sup> birth, number of births and BMI not shown*

**Table 5 Logistic Regression of FI at 12 Years and delivery mode history**

Variable	Total	Symptoms no. %	OR	(95% CI)	p
<b>Delivery mode history</b>					
Only SVD	1852	213 (11.5)		Reference	
Only CS	403	47 (11.7)	0.94	(0.66 to 1.33)	0.716
SVD + CS	293	39 (13.3)	1.06	(0.73 to 1.54)	0.758
Any forceps	956	160 (16.7)	1.48	(1.18 to 1.85)	0.001
Any vacuum, no forceps	248	27 (10.9)	0.91	(0.59 to 1.40)	0.667
<b>Age at 1<sup>st</sup> birth</b>					
< 25	1273	175 (13.7)		Reference	
25-29	1492	160 (10.7)	0.83	(0.65 to 1.05)	0.121
30-34	788	118 (15.0)	1.35	(1.03 to 1.77)	0.033
35 ≥	199	33 (16.6)	1.62	(1.05 to 2.50)	0.029
<b>Number of births</b>					
One	410	43 (10.5)		Reference	
Two	1834	228 (12.4)	1.35	(0.95 to 1.93)	0.095
Three	1014	130 (12.8)	1.47	(1.00 to 2.15)	0.051
Four or more	494	85 (17.2)	2.04	(1.33 to 3.13)	0.001
<b>Body Mass Index</b>					
< 18.5	61	9 (14.8)	1.49	(0.72 to 3.09)	0.284
18.5-24.9	1785	194 (10.9)		Reference	
25-29.9	1020	131 (12.8)	1.21	(0.96 to 1.54)	0.114
30 or more	642	119 (18.5)	1.90	(1.47 to 2.44)	<0.001
Not known	244	33 (13.5)	1.29	(0.87 to 1.93)	0.210

*Based on 3752 cases: 11 with delivery mode history missing*