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Mode of First Delivery and Women's Intentions for Subsequent Childbearing: Findings from the First Baby Study

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Abstract

Background: More than a dozen studies have reported a reduced rate of childbearing after caesarean delivery (CD). It has been hypothesised that this is because women who deliver by CD are less likely to intend to have subsequent children than women who deliver vaginally – either before childbirth or as a consequence of CD. Little research has addressed either of these hypotheses.

Methods: As part of an ongoing prospective study, we interviewed 3006 women in their third trimester and 1 month after first childbirth to assess subsequent childbearing intentions.

Results: Women who delivered by CD were similar to those who delivered vaginally in intent to have at least one additional child, both before childbirth (90.1% vaginal, 89.9% CD; $P = 0.97$) and after (87.8% vaginal, 87.1% CD; $P = 0.87$); however, women who had CD were less likely to intend two or more additional children, both before childbirth (34.7% vaginal, 29.2% CD; $P = 0.03$) and after (32.2% vaginal, 26.1% CD; $P = 0.01$). Among women who intended to have at least one additional child before childbirth, 5.0% reported intending to have no additional children 1 month after delivery (5.1% vaginal, 4.6% CD; $P = 0.52$).

Conclusions: Women whose first delivery is by CD are less likely to intend a relatively large family of three or more children than those who deliver vaginally, but delivery by CD does not decrease women's intentions to have at least one more child any more than does vaginal delivery, at least in the short term.

Keywords: *caesarean delivery, secondary infertility, first delivery, childbearing, prospective cohort study.*

Previous studies, conducted in both the US and other countries, have found that women who deliver by caesarean (CD) are less likely to bear subsequent children and bear fewer subsequent children than women who deliver vaginally.[1–14] However, nearly all of these studies were analyses of existing data sets,[1,3,4,6,9,10,13,14] such as birth registry data, or retrospective surveys,[2,7,8,11,12] often many years after the index delivery. Consequently, it is not clear if women who deliver by CD are different from women who deliver vaginally prior to the delivery, or if there is something about the CD itself that affects their desire or ability to conceive or bear subsequent children.

It has been suggested that the deficit in childbearing subsequent to CD found in previous studies is voluntary, that is, due to differences in subsequent childbearing intentions by mode of delivery.[11,13,15,16] If this deficit in childbearing subsequent to CD were voluntary one would hypothesise that either: (i) women who deliver by CD are less likely to intend to have subsequent children prior to delivery than those who deliver vaginally, or (ii) women who deliver by CD are more likely than those who deliver vaginally to decide that they intend to have no further children after childbirth, for reasons associated with the mode of delivery. The First Baby Study (FBS) is an ongoing, prospective interview study, which was designed to investigate the association between mode of delivery

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and subsequent fertility over the course of a 3-year follow-up period after first childbirth. FBS participants were asked about their childbearing intentions both before and after first childbirth.

While most prior studies of childbearing subsequent to CD have compared CD to vaginal delivery,[1,2,4,5,12,14,17] some have included instrumental vaginal delivery as a third mode – with conflicting results as to the effect of instrumental vaginal delivery on subsequent childbearing.[6,7,9–11,13] To better understand these findings, we investigated subsequent childbearing intentions in relation to two modes of delivery (CD vs. vaginal) as well as three modes – spontaneous vaginal, instrumental vaginal and CD. Previous studies have generally measured subsequent childbearing as a dichotomous variable (no subsequent children vs. one or more),[1–7,9–11,17] but several have measured number of children born subsequent to the index delivery and reported fewer children born subsequent to CD.[1–3,7,10] Several studies have also investigated time from the index delivery to a subsequent childbirth,[1,2,9,17,18] with some reporting longer time to a subsequent childbirth after CD, in comparison with vaginal delivery.[2,9,17] Therefore, in this study we assessed women's childbearing intentions in terms of whether or not they intended to have one or more children, the number of subsequent children intended, as well as the time frame for subsequent childbearing intentions.

Methods

Recruitment

This study was approved by the Penn State College of Medicine Institutional Review Board as well as the Institutional Review Boards of participating hospitals located throughout the State of Pennsylvania. Recruitment methods included the placement of study brochures, flyers and posters in strategic locations at a variety of venues including hospitals, obstetricians' offices, ultrasound centres, low-income clinics, community health and pregnancy support centres; press releases were sent to newspapers across the state and advertisements were placed in community newspapers and weekly publications; and the internet was used for hospital intranet postings and webpage announcements. Study recruiters described the study and distributed brochures to potential participants attending childbirth education classes and hospital tours associated with participating hospitals. Study brochures were mailed to potentially eligible women by a Medicaid insurer that served women across the State. Recruitment materials were also mailed to women reported to be nulliparous, pregnant, aged 18–35 and living in Pennsylvania, whose names and addresses were provided by a marketing company and compiled from information obtained from credit card companies, magazines, charities, organisations, manufacturers and retailers.

We began recruitment of study participants in January 2009 and completed in April 2011. There were 74 women who completed the baseline interview but did not complete the 1-month interview, some because of fetal demise, but most because they decided not to participate. Those who did not complete the 1-month interview were replaced until we had obtained our targeted enrolment number of 3000 women. We over-enrolled slightly to obtain a final sample size of 3006 study participants. Therefore, a total of 3080 women were recruited, consented and completed the baseline interview, and 3006 completed both the baseline and 1-month postpartum interviews. We used this method, to maximise participant retention. The 74 women who dropped out of the study after the first interview were different from those who completed the 1-month interview in that they were younger, less likely to be covered by private insurance and more likely to live in an urban area. They were not significantly different in race/ethnicity.

We obtained the birth certificate and hospital discharge data for the 3006 study participants, with a match rate of 99.4% for the birth certificate data, 99.5% for the mothers' hospital discharge data and 98.4% for the babies' hospital discharge data.

Inclusion and exclusion criteria

The primary outcome of the FBS is childbirth subsequent to the first delivery. To maximise the likelihood of the occurrence of this outcome, we included only women having a first, singleton birth as was done in previous studies of fertility subsequent to CD.[3,6,7,9,11,13,14,18] To be included in this study, women needed to be aged 18–35 at the time of study recruitment, primiparous, currently pregnant with a singleton pregnancy, speak English or Spanish and planning to deliver in a Pennsylvania hospital. Women who were planning to deliver at home or in a birthing centre not associated with a hospital were not

included. However, women under the care of a midwife were included in the study. Women were excluded if they planned for the infant to be adopted or planned to have a tubal ligation while hospitalised for delivery.

Interviews

The baseline interviews occurred prior to the beginning of labour, when participants were between 30 and 42 weeks of gestation, at a median gestational age of 35 weeks. The baseline interview assessed reproductive and health history; pregnancy complications and health care utilisation; mode of delivery preference; relationship factors; psychosocial factors; future birth desires and intentions; and sociodemographic factors. The 1-month postpartum telephone interview focused on the delivery experience and assessed factors related to labour and delivery; postpartum feelings about childbirth; in-hospital and post-discharge complications; and the health of the baby and the mother. The subsequent interviews (at 6, 12, 18, 24, 30 and 36 months postpartum) measure sexual relations and use of birth control; subsequent pregnancies; relationship factors; future birth desires and intentions; the health of the mother, the index child and all subsequent children; and sociodemographic factors. We completed the 12-month postpartum interviews in May 2012 and will complete the 36-month postpartum interviews in May 2014.

Future childbearing intentions were measured using questions adapted from the 2003 National Survey of Family Growth.[19] In the baseline survey participants were asked 'Not counting your current pregnancy, how many more babies do you intend to have?' and in the 1-month postpartum survey women were asked 'Not counting your new baby, how many more babies do you intend to have?' At both data collection stages participants were asked 'Do you have plans as to when you would like to have another baby?' and 'If so, when do you plan on having another baby?'

We used the 2009 Institute of Medicine (IOM) guidelines for weight gain during pregnancy to classify the study participants into three categories of weight gain: less than recommended, recommended and more than recommended.[20] These categories were based on the participant's pre-pregnancy body mass index (BMI). The pre-pregnancy height, weight and gestational weight gain were obtained primarily by self-report. However, in the case of missing or unlikely self-report data we used the birth certificate data to calculate pre-pregnancy BMI and gestational weight gain. Mode of delivery was based on self-report, and verified by the birth certificate data. Instrumental vaginal delivery included delivery by forceps or vacuum extraction. Maternal height was categorised in quartiles.

We compared the participants in the FBS with women aged 18–36 delivering their first, livebirth, singleton child, gestation of 35 weeks or later, in Pennsylvania as a whole in 2008, using birth certificate data paired with hospital discharge data, excluding those with a code indicating prior CD, or sterilisation at the time of delivery. The population characteristics were compared with the sample characteristics for the variables of age, race/ethnicity, education, insurance coverage, marital status, and mode of delivery (CD, spontaneous vaginal and instrumental vaginal).

Statistical power

Using a retrospective cohort of all women aged 18–35 having their first, singleton delivery in Pennsylvania in 2000 and followed to the end of 2004, we found that women whose first delivery was vaginal were more likely to have a subsequent delivery within 3 years than those who delivered by CD [age-adjusted odds ratio (OR) 1.29 [95% confidence interval (CI) 1.28, 1.31]]. With a significance level of 0.05 power of 0.80, detectable/alternative OR of 1.29, the probability of exposure (CD) of 0.29 (among women aged 18–35, having a first, singleton birth of 34 weeks of gestation or later) and the probability of having a second delivery within 3 years if the first delivery is vaginal = 0.39, the required sample size was 2402.[21] Estimating that there would be a sample attrition rate of 20% over the course of the 3-year follow-up period, we calculated that we would need to enrol 3000 participants in order to have the required sample size of 2402 by the end of the 3-year follow-up period.

Statistical analysis

Chi-square tests were used to investigate the associations between covariates and mode of delivery and childbearing intention before and after first childbirth. *Z*-tests for proportions were used to compare the study sample to the population of women aged 18–36

Table 1. Study sample in comparison to population of first, singleton births among women aged 18–36 in Pennsylvania in 2008

Characteristics	Study sample (%) (n = 3006)	Population (%) (n = 43 430)	P-value
Mode of delivery			0.100
Normal vaginal	62.6	61.1	
Instrumental vaginal	8.7	8.9	
Caesarean	28.7	30.0	
Maternal age (years)			<0.001
18–24	27.0	46.2	
25–29	39.7	31.0	
30–36	33.3	22.9	
Race/ethnicity			<0.001
White	83.2	76.0	
Black	7.4	13.2	
Hispanic	5.5	5.8	
Other	3.9	5.0	
Education			<0.001
High school degree or less	16.7	36.2	
Some college or technical	26.7	28.9	
College grad or higher	56.6	34.8	
Insurance			<0.001
Private	76.7	64.8	
Public	22.9	29.8	
Self-pay	0.4	5.5	
Marital status			<0.001
Married	70.4	52.5	
Not married	29.6	47.5	

who had a first, singleton birth in Pennsylvania in 2008. Multivariable logistic regression models were used to estimate OR and 95% CI for the association between mode of delivery (in three categories) and intentions for subsequent childbearing (pre-delivery and post-delivery), with intentions in two categories (no more vs. one or more subsequent births), adjusting for maternal age.

Results

In general the participants in the FBS were different from the comparable population of women in Pennsylvania – they were older, more likely to be White, more educated, more likely to have private insurance and more likely to be married than the general population of women having their first, singleton birth, aged 18–36 (Table 1). They were not different in mode of delivery.

As seen in Table 2, the older a woman was at first childbirth the more likely she was to deliver by CD. There was a strong association between pre-pregnancy BMI category and delivery by CD: women who were obese prior to conception were the most likely to have CD and those who were underweight were the least likely. Gestational weight gain was also associated with mode of delivery – women who had gained more than recommended were more likely to have a CD than those who had gained as recommended or less than recommended.

Our first hypothesis that 'Women who deliver by CD are less likely to be intending to have subsequent children prior to delivery than those who deliver vaginally' was not supported (Table 3). Although we found that women who delivered vaginally were more likely to be intending to have a relatively large family – two or more additional children beyond the first child – than those who delivered by CD (vaginal = 34.7%, CD = 29.2%; P = 0.034), women who delivered by CD were equally likely as those who delivered vaginally to be intending to have one or more subsequent children prior to first childbirth.

The second hypothesis that 'Women who deliver by CD are more likely to decide that they intend to have no further children after childbirth, for reasons associated with the mode of delivery' also was not sup-

Table 2. Distribution of maternal factors by mode of delivery

	Overall *n* (%)	Normal vaginal (%)	Instrumental vaginal (%)	Caesarean delivery (%)	*P*-value
Maternal age (years)					<0.001
18–24	811 (27.0)	71.1	6.5	22.3	
25–29	1193 (39.7)	61.9	9.6	28.5	
30–36	1002 (33.3)	56.5	9.4	34.1	
Race/ethnicity					0.556
White	2502 (83.2)	62.8	8.9	28.3	
Black	221 (7.4)	62.9	5.4	31.7	
Hispanic	166 (5.5)	61.4	8.4	30.1	
Other	117 (3.9)	59.0	11.1	30.2	
Education					0.158
High school degree or less	501 (16.7)	64.9	8.2	26.9	
Some college or technical	804 (26.7)	65.2	7.5	27.4	
College grad or higher	1701 (56.6)	60.7	9.4	29.9	
Insurance					0.116
Private	2307 (76.7)	61.4	8.9	29.6	
Public	687 (22.9)	66.5	7.7	25.8	
Self-pay	12 (0.4)	66.7	16.7	16.7	
Marital status					0.357
Married	2117 (70.4)	61.8	8.9	29.3	
Living with partner	544 (18.1)	63.1	9.7	27.2	
Not living with partner	187 (6.2)	65.8	7.0	27.3	
Unattached	157 (5.2)	67.5	4.5	28.0	
Pre-pregnancy body mass index					<0.001
Underweight (<18.5)	106 (3.5)	77.4	8.5	14.2	
Normal (18.5–24.9)	1609 (53.7)	66.1	10.3	23.7	
Overweight (25.0–29.9)	665 (22.2)	60.2	8.9	31.0	
Obese (≥30.0)	618 (20.6)	53.7	4.4	41.9	
Pregnancy weight gain[a]					<0.001
Less than recommended	334 (11.2)	69.5	8.7	21.9	
Recommended	1039 (34.7)	68.0	9.4	22.5	
More than recommended	1618 (54.1)	57.7	8.2	34.1	
Maternal height (inches)					<0.001
53–62	625 (20.8)	53.3	9.0	37.8	
63–65	1175 (39.1)	61.6	9.6	28.8	
66–67	726 (24.2)	67.4	8.1	24.5	
68–74	478 (15.9)	69.9	6.9	23.2	
Prior miscarriages					0.211
Yes	481 (16.0)	59.0	9.6	31.4	
No	2525 (84.0)	63.3	8.5	28.2	
Prior induced abortions					0.096
Yes	151 (5.0)	70.9	7.3	21.9	
No	2855 (95.0)	62.2	8.8	29.0	
Pregnancy was intended					0.298
Yes	1899 (63.4)	61.6	9.0	29.5	
No	1098 (36.6)	64.4	8.1	27.5	
Fertility treatment					0.002
Yes	335 (11.1)	54.3	9.0	36.7	
No	2671 (88.9)	63.6	8.6	27.7	
Time to conception					0.029
≤6 months[b]	2495 (83.0)	63.1	9.1	27.8	
>6 months	507 (16.9)	60.0	6.9	33.1	

[a]Based on 2009 IOM guidelines.[22]
[b]Including unintended pregnancies.

Table 3. Mode of delivery and intentions for subsequent childbearing

	Overall ($n = 3006$)	Mode of delivery: Normal vaginal (%) ($n = 1882$)	Mode of delivery: Instrumental vaginal (%) ($n = 261$)	Mode of delivery: Caesarean delivery (%) ($n = 863$)	*P*-value	Modes overall: Vaginal (%) ($n = 2143$)	Modes overall: Caesarean delivery (%) ($n = 863$)	*P*-value
Pre-delivery intentions					0.005			0.034
No more children	6.2	5.8	8.4	6.4		6.1	6.4	
1 more child	57.0	55.8	52.9	60.7		55.4	60.7	
2 or more children	33.1	35.1	32.2	29.2		34.7	29.2	
Don't know	3.7	3.4	6.5	3.7		3.7	3.7	
Post-delivery intentions					0.006			0.011
No more children	9.3	8.9	11.5	9.6		9.2	9.6	
1 more child	57.2	55.7	55.0	61.1		55.6	61.1	
2 or more children	30.4	32.7	28.5	26.1		32.2	26.1	
Don't know	3.1	2.7	5.0	3.2		3.0	3.2	
Pre-delivery vs. postpartum intentions					0.710			0.954
Fewer (post < pre)	15.5	15.1	17.9	15.7		15.4	15.7	
Same number	75.3	75.5	74.9	74.9		75.5	74.9	
More (post > pre)	9.2	9.3	7.2	9.4		9.1	9.4	
Intend additional children postpartum but not prior to first birth[a]	26.3	28.4	18.2	25.5	0.737	26.7	25.5	0.958
No longer intend additional children[b]	5.0	5.0	5.4	4.6	0.377	5.1	4.6	0.520
Pre-delivery time frame for subsequent child[c]					0.285			0.293
Within 1 year	5.6	5.2	8.0	5.6		5.6	5.6	
In about 2 years	38.2	38.2	38.2	38.1		38.2	38.1	
In about 3 years	16.0	16.1	16.3	15.7		16.1	15.7	
In about 4 years	4.9	5.1	2.8	4.9		4.8	4.9	
In about 5 or more years	7.5	8.3	7.2	5.8		8.2	5.8	
No plans or Don't know	27.9	27.1	27.5	29.9		27.1	29.9	
Postpartum time frame for subsequent child[c]					0.012			0.022
Within 1 year	5.6	5.9	6.0	4.7		5.9	4.7	
In about 2 years	39.3	38.8	32.2	42.5		38.0	42.5	
In about 3 years	16.1	16.7	18.5	14.2		16.9	14.2	
In about 4 years	5.0	4.9	6.0	4.7		5.1	4.7	
In about 5 or more years	7.2	8.3	5.2	5.4		7.9	5.4	
No plans or Don't know	26.8	25.3	32.2	28.5		26.1	28.5	
Pre-delivery vs. postpartum time frame					0.101			0.134
Post sooner than pre	16.2	14.9	16.8	18.9		15.1	18.9	
Same	66.3	67.6	59.9	65.2		66.7	65.2	
Post later than pre	17.5	17.5	23.4	15.9		18.2	15.9	

[a]Among women who did not intend additional children prior to delivery.
[b]Among women who intended additional children prior to delivery.
[c]Among women who report that they intend one or more subsequent children postpartum.

ported (Table 3). Women who delivered by CD were equally likely as those who delivered vaginally to be intending to have one or more subsequent children after first childbirth, although they were less likely to be intending to have two or more subsequent children (vaginal = 32.2%, CD = 26.1%; $P = 0.011$).

After adjustment for maternal age, women who had an instrumental delivery were less likely to intend to have a subsequent child ($P = 0.040$) in comparison with those who delivered vaginally, prior to delivery (Table 4), as well as after delivery, although after delivery this was of borderline significance ($P = 0.071$). Mode of delivery (CD vs. vaginal) was not associated with pre-delivery intentions for subsequent childbearing (OR 0.9 [95% CI 0.8, 1.1]), or with post-delivery intentions (OR 1.0 [95% CI 0.9, 1.2]).

Comment

In this interview study of more than 3000 women at first childbirth we found little support for the hypothesis that women who deliver by CD are less likely to want subsequent children prior to or after childbirth than women who deliver vaginally. However, we did find that the women who delivered by CD were less likely to be intending to have a relatively large family, that is, two or more children subsequent to their first. It could be that women who intend to have only one more child are more likely to change their mind and not have a second child than women who intend to have two or more subsequent children.

Consistent with prior studies, we found that women who have difficulty conceiving and/or undergo fertility treatment were more likely to deliver by CD.[17,22] Difficulty conceiving one's first child is a factor that could quite clearly increase a woman's risk of being unable to conceive subsequent children. It has been hypothesised that for women who are borderline fertile, the 'added stress of a CD (peritubal adhesions or intrauterine injury) may push these women over the threshold and result in infertility'.[5] However, the women with difficulty conceiving were no less likely to be intending to have a subsequent child than those without difficulty conceiving.

Although the younger a woman was at first childbirth the less likely she was to deliver by CD, the women in the youngest age group in this study (age 18–24) were less likely to intend to have subsequent children prior to first birth, in comparison with women aged 25–29, and not significantly different from the women in the oldest age group (30–36). These are relevant findings because studies on the association of CD with a decrement in subsequent childbearing have considered maternal age to be an important confounder because the risk for CD increases with age while the likelihood of a subsequent childbirth decreases with age (regardless of mode of delivery), even among women under the age of 35.[6] The results of this study suggest that a decrement in childbearing subsequent to first birth for women of older age at first birth may not be because older women are less likely to be intending to have a subsequent child, but due to other factors, such as age-related sub-fecundity.

This study has several limitations. Unlike some of the previous large-scale studies using birth certificate or other types of administrative data, this is not a population-based study. The participants in this study are of higher socio-economic status than women delivering their first, singleton child in the State of Pennsylvania as a whole. It was not feasible to conduct probability sampling, such as via random-digit dialling or random sampling of households, as is done with national surveys. To use probability sampling to identify and enrol more than 3000 pregnant women prior to first childbirth would have been prohibitively expensive because we would have had to contact thousands of individuals to identify each woman aged 18–35, pregnant with her first, singleton child and otherwise eligible and willing to participate. Participation studies tend to include more educated and affluent individuals than in the general population, as seen in our study.[23,24] One bias, which could arise from the higher socio-economic status of our sample, could be a greater ability to seek fertility treatment in case of difficulty conceiving subsequent to first childbirth than women in the state overall. Another source of selection bias, inherent to observational treatment outcome studies, is differences between those who receive one treatment vs. another (treatment-selection bias). As this study illustrates, women who have CD at first childbirth are different from those who deliver vaginally. When we assess the primary outcome of interest in this study (childbearing over the course of the follow-up period) we will investigate the usefulness of weighting methods commonly used to adjust for participant-selection bias,[25,26] as well as propensity scoring and other types of methods used to adjust for treatment-selection bias.[27,28]

Table 4. Mode of delivery and maternal factors by subsequent childbearing intentions

	Pre-delivery intentions for subsequent childbearing			Postpartum intentions for subsequent childbearing		
	No more (%) (n = 186)	One or more (%) (n = 2706)	Adjusted OR[a] [95% CI]	No more (%) (n = 280)	One or more (%) (n = 2633)	Adjusted OR[a] [95% CI]
Mode of delivery						
Normal vaginal	6.0	94.0	Reference	9.1	90.9	Reference
Instrumental vaginal	9.0	91.0	0.6 [0.4, 1.0]	12.1	87.9	0.7 [0.5, 1.0]
Caesarean delivery	6.6	93.4	0.9 [0.6, 1.2]	9.9	90.1	0.9 [0.7, 1.2]
Maternal age (years)						
18–24	9.0	91.0	Reference	13.7	86.3	Reference
25–29	4.2	95.8	2.2 [1.5, 3.3]	6.0	94.0	2.5 [1.8, 3.4]
30–36	7.0	93.0	1.3 [0.9, 1.9]	10.6	89.4	1.3 [1.0, 1.8]
Race/ethnicity						
White	5.3	94.7	Reference	7.9	92.1	Reference
Black	14.8	85.2	0.4 [0.2, 0.6]	20.5	79.5	0.4 [0.3, 0.6]
Hispanic	10.8	89.2	0.5 [0.3, 0.9]	17.3	82.7	0.5 [0.4, 0.7]
Other	10.0	90.0	0.5 [0.3, 1.0]	16.4	83.6	0.5 [0.3, 0.8]
Education						
High school degree or less	11.1	88.9	Reference	17.2	82.8	Reference
Some college or technical school	7.8	92.2	1.5 [1.0, 2.2]	11.0	89.0	1.7 [1.2, 2.4]
College grad or higher	4.4	95.6	3.1 [1.9, 4.9]	6.7	93.3	3.2 [2.2, 4.8]
Insurance						
Private	4.5	95.5	Reference	7.2	92.8	Reference
Public	12.8	87.2	0.3 [0.2, 0.4]	17.8	82.3	0.3 [0.2, 0.4]
Self-pay	14.3	85.7	0.4 [0.1, 3.4]	14.3	85.7	0.7 [0.1, 5.7]
Marital status						
Married	4.2	95.8	Reference	7.1	92.9	Reference
Living with partner	9.6	90.4	0.3 [0.2, 0.4]	12.4	87.6	0.4 [0.3, 0.6]
Not living with partner	13.6	86.4	0.2 [0.1, 0.3]	20.6	79.4	0.2 [0.1, 0.3]
Unattached	17.2	82.8	0.1 [0.1, 0.2]	20.9	79.1	0.2 [0.1, 0.3]
Pre-pregnancy body mass index category (kg/m^2)						
Underweight (<18.5)	6.9	93.1	1.0 [0.5, 2.3]	9.6	90.4	1.2 [0.6, 2.3]
Normal (18.5–24.9)	6.6	93.4	Reference	10.0	90.0	Reference
Overweight (25.0–29.9)	5.5	94.5	1.2 [0.8, 1.8]	8.3	91.7	1.2 [0.9, 1.7]
Obese (≥30.0)	6.9	93.1	1.0 [0.7, 1.4]	9.8	90.2	1.1 [0.8, 1.4]
Pregnancy weight gain[b]						
Less than recommended	6.2	93.8	1.0 [0.6, 1.7]	11.2	88.8	0.8 [0.5, 1.2]
Recommended	6.1	93.9	Reference	8.9	91.1	Reference
More than recommended	6.5	93.5	0.9 [0.7, 1.3]	9.6	90.4	0.9 [0.7, 1.2]
Maternal height (inches)						
53–62	9.1	90.9	Reference	12.0	88.0	Reference
63–65	6.6	93.4	1.4 [1.0, 2.0]	10.9	89.1	1.1 [0.8, 1.5]
66–67	3.7	96.3	2.5 [1.6, 4.1]	6.7	93.3	1.9 [1.3, 2.7]
68–74	6.5	93.5	1.4 [0.9, 2.2]	7.6	92.4	1.6 [1.1, 2.5]
Prior miscarriages						
Yes	5.4	94.6	1.2 [0.8, 1.9]	11.2	88.8	0.8 [0.6, 1.1]
No	6.6	93.4	Reference	9.3	90.7	Reference
Prior induced abortions						
Yes	9.1	90.9	0.7 [0.4, 1.3]	13.3	86.7	0.7 [0.4, 1.2]
No	6.3	93.7	Reference	9.4	90.6	Reference
Pregnancy was intended						
Yes	4.0	96.0	Reference	7.1	92.9	Reference
No	10.7	89.3	0.3 [0.2, 0.4]	14.1	85.9	0.5 [0.4, 0.6]
Fertility treatment						
Yes	5.3	94.7	1.2 [0.7, 2.1]	9.2	90.8	1.0 [0.7, 1.5]
No	6.6	93.4	Reference	9.7	90.3	Reference
Time to conception						
6 months or less (including unplanned)	6.7	93.3	Reference	9.9	90.1	Reference
More than 6 months	4.7	95.3	1.4 [0.9, 2.2]	8.1	91.9	1.2 [0.8, 1.7]

[a]Adjusted for maternal age, except for the association of maternal age with subsequent childbearing intentions.
[b]Based on 2009 IOM guidelines.[22]
OR, odds ratio; CI, confidence interval.

Another limitation of this study is that the postpartum assessment of childbearing intentions reported here occurred only 1 month after first childbirth. As the glow of new motherhood begins to fade over the course of time, women may change their minds about subsequent childbearing. In addition, women who delivered by CD may be more likely to decide that they do not want to go through childbirth again because of the lengthier recovery period, or the development of painful scar tissue, or some other factor that would not be evident at 1-month postpartum.

After more than a dozen studies have reported a deficit in childbearing subsequent to CD, it is important that prospective, longitudinal interview studies be conducted in order to investigate why this deficit occurs. The results reported here suggest that women's pre-first-delivery intentions for more children are not substantially different for women who deliver by CD in comparison with those who deliver vaginally. In addition, we found no evidence at 1-month postpartum that delivery by CD causes women to decide that they no longer want subsequent children any more than does vaginal delivery.

As we follow this cohort of more than 3000 women forward in time, with interviews every 6 months over the course of a 3-year period, we will be able to measure the extent to which such factors as pre-delivery and 1-month postpartum childbearing intentions play out in determining the occurrence of the primary outcome of interest – subsequent childbearing.

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References

1 Zdeb MS, Therriault GD, Logrillo VM. Frequency, spacing, and outcome of pregnancies subsequent to primary cesarean childbirth. *American Journal of Obstetrics and Gynecology* 1984; 150:205–212.
2 Hemminki E, Graubard BI, Hoffman HJ, Mosher WD, Fetterly K. Cesarean section and subsequent fertility: results from the 1982 National Survey of Family Growth. *Fertility and Sterility* 1985; 43:520–528.
3 Hemminki E. Effects of cesarean section on fertility and abortions. *Journal of Reproductive Medicine* 1986; 31:620–624.
4 Hemminki E, Merilainen J. Long-term effects of cesarean sections: ectopic pregnancies and placental problems. *American Journal of Obstetrics and Gynecology* 1996; 174:1569–1574.
5 LaSala AP, Berkeley AS. Primary cesarean section and subsequent fertility. *American Journal of Obstetrics and Gynecology* 1987; 157:379–383.
6 Hall MH, Campbell DM, Fraser C, Lemon J. Mode of delivery and future fertility. *British Journal of Obstetrics and Gynaecology* 1989; 96:1297–1303.
7 Jolly J, Walker J, Bhabra K. Subsequent obstetric performance related to primary mode of delivery. *British Journal of Obstetrics and Gynaecology* 1999; 106:227–232.
8 Bahl R, Strachan B, Murphy DJ. Outcome of subsequent pregnancy three years after previous operative delivery in the second stage of labour: cohort study. *BMJ (Clinical Research Ed)* 2004; 328:311.
9 Mollison J, Porter M, Campbell D, Bhattacharya S. Primary mode of delivery and subsequent pregnancy. *BJOG* 2005; 112:1061–1065.
10 Hemminki E, Shelley J, Gissler M. Mode of delivery and problems in subsequent births: a register-based study from Finland. *American Journal of Obstetrics and Gynecology* 2005; 193:169–177.
11 Bhattacharya S, Porter M, Harrild K, Naji A, Mollison J, van Teijlingen E, *et al*. Absence of conception after caesarean section: voluntary or involuntary? *BJOG* 2006; 113:268–275.
12 Collin SM, Marshall T, Filippi V. Caesarean section and subsequent fertility in sub-Saharan Africa. *BJOG* 2006; 113:276–283.
13 Smith GC, Wood AM, Pell JP, Dobbie R. First cesarean birth and subsequent fertility. *Fertility and Sterility* 2006; 85:90–95.
14 Tollanes MC, Melve KK, Irgens LM, Skjaerven R. Reduced fertility after cesarean delivery: a maternal choice. *Obstetrics and Gynecology* 2007; 110:1256–1263.
15 Porter M, Bhattacharya S, van Teijlingen E, Templeton A. Does Caesarean section cause infertility? *Human Reproduction* 2003; 18:1983–1986.
16 Oral E, Elter K. The impact of cesarean birth on subsequent fertility. *Current Opinion in Obstetrics and Gynecology* 2007; 19:238–243.
17 Murphy DJ, Stirrat GM, Heron J. The relationship between Caesarean section and subfertility in a population-based sample of 14 541 pregnancies. *Human Reproduction* 2002; 17:1914–1917.
18 Eijsink JJ, van der Leeuw-Harmsen L, van der Linden PJ. Pregnancy after Caesarean section: fewer or later? *Human Reproduction* 2008; 23:543–547.
19 National Survey of Family Growth (US). *National Survey of Family Growth Cycle III, 1982*. Editor: ASCII. Hyattsville, MD: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, 2003; pp. 48–50.
20 IOM (Institute of Medicine). *Weight gain during pregnancy: reexamining the guidelines*. Washington, DC: The National Academies Press; 2009.

21 Demidenko E. Sample size determination for logistic regression revisited. *Statistics in Medicine* 2007; 26:3385–3397.
22 Pandian Z, Bhattacharya S, Templeton A. Review of unexplained infertility and obstetric outcome: a 10 year review. *Human Reproduction* 2001; 16: 2593–2597.
23 Jacobsen TN, Nohr EA, Frydenberg M. Selection by socioeconomic factors into the Danish National Birth Cohort. *European Journal of Epidemiology* 2010; 25:349–355.
24 Strandhagen E, Berg C, Lissner L, Nunez L, Rosengren A, Toren K, *et al*. Selection bias in a population survey with registry linkage: potential effect on socioeconomic gradient in cardiovascular risk. *European Journal of Epidemiology* 2010; 25:163–172.
25 Cuddeback G, Wilson E, Orme JG, Combs-Orme T. Detecting and statistically correcting sample selection bias. *Journal of Social Service Research* 2004; 30:19–33.
26 Haneuse S, Chen J. A multiphase design strategy for dealing with participation bias. *Biometrics* 2011; 67:309–318.
27 Lalani T, Cabell CH, Benjamin DK, Lasca O, Naber C, Fowler VG, *et al*. Analysis of the impact of early surgery on in-hospital mortality of native valve endocarditis use of propensity score and instrumental variable methods to adjust for treatment-selection bias. *Circulation* 2010; 121:1005–1013.
28 Spreeuwenberg MD, Bartak A, Croon MA, Hagenaars JA, Busschbach JJV, Andrea H, *et al*. The multiple propensity score as control for bias in the comparison of more than two treatment arms an introduction from a case study in mental health. *Medical Care* 2010; 48:166–174.