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DOI:
10.1111/1471-0528.13546

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (Harvard):
Rowe, R, Li, Y, Knight, M, Brocklehurst, P & Hollowell, J 2016, 'Maternal and perinatal outcomes in women planning vaginal birth after caesarean (VBAC) at home in England: secondary analysis of the Birthplace national prospective cohort study', BJOG: An International Journal of Obstetrics & Gynaecology, vol. 123, no. 7, pp. 1123-32. https://doi.org/10.1111/1471-0528.13546

BJOG An International Journal of Obstetrics and Gynaecology

DOI: 10.1111/1471-0528.13546
www.bjog.org

Intrapartum care

Maternal and perinatal outcomes in women planning vaginal birth after caesarean (VBAC) at home in England: secondary analysis of the Birthplace national prospective cohort study

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Accepted 2 June 2015. Published Online 23 July 2015.

Objective To compare vaginal birth rates in women planning vaginal birth after caesarean (VBAC) at home versus in an obstetric unit (OU) and explore transfer rates in women planning home VBAC.

Design Prospective cohort study.

Setting OUs and planned home births in England.

Population 1436 women planning VBAC in the Birthplace cohort, including 209 planning home VBAC.

Methods We used Poisson regression to calculate relative risks adjusted for maternal characteristics.

Main outcome measures Main outcomes: (i) vaginal birth and (ii) transfer from planned home birth to OU during labour or immediately after birth. Secondary outcomes: (i) composite of maternal blood transfusion or admission to higher level care, (ii) stillbirth or Apgar score <7 at 5 minutes, (iii) neonatal unit admission.

Results Planned VBAC at home was associated with a statistically significant increase in the chances of having a vaginal birth compared with planned VBAC in an OU (adjusted relative risk 1.15, 95% confidence interval 1.06–1.24). The risk of an adverse maternal outcome was around 2–3% in both settings, with a similar risk of an adverse neonatal outcome. Transfer rates were high (37%) and varied markedly by parity (para 1, 56.7% versus para 2+, 24.6%).

Conclusion Women in the cohort who planned VBAC at home had an increased chance of a vaginal birth compared with those planning VBAC in an OU, but transfer rates were high, particularly for women with only one previous birth, and the risk of an adverse maternal or perinatal outcome was around 2–3%. No change in guidance can be recommended.

Keywords Caesarean, home birth, transfer, vaginal birth after caesarean (VBAC).

Tweetable abstract Higher vaginal birth rates in planned VBAC at home versus in OU but 2–3% adverse outcomes and high transfer rate.

Linked articles This article is commented on by J Scott, p. 1133 in this issue. To view this mini commentary visit http://dx.doi.org/10.1111/1471-0528.13565. This article is also commented on by BW Mol, p. 1134 in this issue. To view this mini commentary visit http://dx.doi.org/10.1111/1471-0528.13616.

Please cite this paper as: Rowe R, Li Y, Knight M, Brocklehurst P, Hollowell J. Maternal and perinatal outcomes in women planning vaginal birth after caesarean (VBAC) at home in England: secondary analysis of the Birthplace national prospective cohort study. BJOG 2016;123:1123–1132.

Introduction

The proportion of women who are offered or attempt a vaginal birth after caesarean (VBAC) is not known, although in the National Sentinel Caesarean Section Audit in 2001, only 44% of women who had a repeat caesarean section (CS) had been offered a trial of labour.[1] Because of concerns about the increased risk of uterine rupture, perinatal mortality, neonatal encephalopathy and other serious complications, current guidelines recommend that women with a previous CS plan birth in an obstetric unit (OU), where electronic fetal monitoring is available, and 'where there is immediate access to CS and on-site blood transfusion services' and advanced neonatal resuscitation.[2–4] Nevertheless, a small proportion of women in England opt for planned VBAC in midwifery-led settings, including at home and in freestanding midwifery units (FMUs), i.e. those located on a site separate from an OU, or in along-

side midwifery units (AMUs) located in the same building or on the same site as an OU.[5]

Currently, there is little evidence on outcomes for women planning VBAC in a midwifery-led setting. One small study in the USA reported on 57 women with a previous CS planning birth at home, of whom 93% had a spontaneous vaginal birth.[6] However, the authors acknowledge that this was a highly selected group, with more than half having had a previous VBAC and almost a third having had a previous home birth. In a recent German study of 1927 women planning their second birth in a birth centre or at home after a previous CS, 77.8% had a vaginal birth.[7] This study and others carried out in Germany and the USA on women planning VBAC in birth centres revealed significantly higher transfer rates compared with women who had a prior vaginal birth, but little evidence on adverse outcomes.[8,9] Given the different settings and health care systems these studies are unlikely to be generalisable to the UK context.

The primary aim of this study was to compare vaginal birth rates in women planning VBAC at home with women planning VBAC in an OU, and to estimate transfer rates in women planning VBAC at home. We also aimed to explore and describe maternal characteristics, mode of birth and maternal and perinatal outcomes in women planning VBAC at home and in an OU.

Methods

Setting and participants

We used data from the Birthplace in England national prospective cohort study.[10,11] The Birthplace study collected data on 79 774 'low risk' and 'higher risk' births between April 2008 and April 2010 from 142 National Health Service (NHS) trusts (97% of all trusts providing home birth services across England), 53 FMUs (95%), 43 AMUs (84%) and a random sample of 36 OUs, stratified by geographical area (north/south) and size (<2600/2600–4850/>4850 births per year). Women were eligible for inclusion in the Birthplace cohort if they planned a vaginal birth and received care from an NHS midwife during established labour[10] in their planned birth settings, for any amount of time. Women who had an elective CS or CS before the onset of labour, presented in preterm labour (<37 weeks' gestation), had a multiple pregnancy, an unplanned home birth, or who were 'unbooked' (received no antenatal care) were excluded. Stillbirths occurring before the start of care in labour were also excluded. The study had a high response rate, with 74% of units/NHS trusts providing data on at least 85% of eligible women, and low levels of missing data (2–4%).[10,11]

In the Birthplace study, women were defined as having planned to give birth in a particular setting if, at the start of care in labour, they intended to give birth there and they received care from a midwife during established labour in that setting. Attending midwives used a study-specific data collection form which included the medical or obstetric/fetal risk factors listed in national intrapartum care guidelines as 'indicating increased risk suggesting planned birth in an obstetric unit'.[12] For each woman, midwives recorded up to five risk factors, known prior to the onset of labour, including 'previous CS'. For the analyses reported here the main study population consisted of women planning birth at home or in an OU in the Birthplace cohort for whom 'previous CS' was recorded as a pre-existing risk factor. We excluded women with planned induction of labour because at the time of the Birthplace study this was almost exclusively carried out in OUs, so there were no comparable women in the home birth group (Figure S1). Records were excluded from the analyses reported here if parity was unknown (Figure S1).

Because previous analyses of the Birthplace cohort have shown that the number and distribution of risk factors in 'higher risk' women is different in women planning birth in an OU compared with those planning birth at home,[5] we additionally carried out the main analyses in the restricted population of women with a previous CS but no additional risk factors.

Study data

As described above and elsewhere,[5,10,11] maternal characteristics and risk factors known prior to the onset of labour were extracted from the woman's medical records by the midwife attending the birth. 'Complicating conditions' noted by the midwife at the start of care in labour (for example prolonged rupture of membranes and meconium-stained liquor); whether the woman was transferred from a planned home birth during labour or immediately after birth and the primary reason for transfer; and mode of birth were recorded during labour by the attending midwife. Data on maternal and perinatal outcomes were recorded by the midwife on or after the fifth postnatal day. Additional data on babies admitted to a neonatal unit and women admitted to higher level care or receiving a blood transfusion were collected in a follow-up survey by Birthplace local co-ordinating midwives, using maternal and neonatal notes, often with the help of neonatal staff.

Outcome measures

Our main outcome was vaginal birth, defined as any non-caesarean birth, i.e. including spontaneous vertex birth, vaginal breech birth, and vaginal birth assisted by ventouse or forceps. For planned home births we also considered transfer to an OU during labour or immediately after birth an outcome. We considered three secondary outcomes: (i) a composite of maternal blood transfusion or admission to higher level care, (ii) stillbirth or Apgar score <7 at 5 min-

utes, and (iii) admission to a neonatal unit within 48 hours of birth.

We also manually reviewed all available data, including free text where available, where stillbirth, early neonatal death, meconium aspiration syndrome or neonatal encephalopathy occurred in both settings and described the circumstances surrounding these uncommon serious adverse outcomes.

Statistical analysis

For all outcomes we calculated the weighted event rate with 95% confidence intervals (CI) and used modified log Poisson regression with robust standard errors[13] to calculate relative risks (RR) and CI. For our main outcome we adjusted for maternal characteristics [maternal age, ethnicity, marital status, body mass index (BMI), index of multiple deprivation, gestational age, and parity where appropriate]. Additionally, because previous analyses of the Birthplace cohort have found differences in the prevalence of 'complicating conditions' at the start of care in labour in women planning birth in different settings[5,11] we also adjusted for the presence of these 'complicating conditions' in the main analyses. For secondary outcomes, where the number of events was expected to be small, we calculated only descriptive statistics [weighted incidence and unadjusted RR with 95% CI] and did not adjust for maternal characteristics.

In the absence of data which would have enabled us to control for the number of previous CS or for whether the woman had previously given birth vaginally, both of which have been shown to impact on the success of VBAC,[14] we stratified all analyses by parity (para 1 versus para 2+). Stratified in this way, the group of women of para 1 planning VBAC provided a homogeneous group of women who all had had one previous CS and no previous vaginal birth, whereas the group of women of para 2+ was more heterogeneous. For analysis of the main outcome we tested for an interaction between planned place of birth and parity using the Wald test.

For the analyses of transfers there was no obvious comparator group for women planning VBAC at home since women already receiving care in an OU do not generally require transfer, so we did not conduct any statistical comparisons. We calculated the weighted percentage of women transferred with 95% CI in the planned home VBAC group and, for descriptive purposes, we additionally calculated the weighted percentage of women transferred in the overall cohort of 'higher risk' women planning home birth (including women with a previous CS) and in the subgroup of 'higher risk' women planning home birth who had risk factors other than previous CS.

Robust variance estimation was used to take account of the mis-specification of the Poisson model and allow for the clustered nature of the data, i.e. that women were grouped in hospitals or NHS trusts.[13] As described elsewhere,[10,11] probability weights were incorporated to account for differences in the probability of a woman being selected for inclusion in the study arising from differences in each unit/NHS trust's period of participation and the stratum-specific probabilities of selection of OUs. Unweighted frequencies and weighted percentages are used in descriptive tables. Weighting can result in percentages differing slightly for events occurring with equal frequencies, particularly when the number of events is small.

All analyses were carried out using STATA version 13[15] and we assessed statistical significance at the 5% level.

Results

The study population consisted of 1436 eligible women planning VBAC: 1227 planned OU births and 209 planned home births (see Figure S1 for study inclusion flow chart).

Maternal socio-demographic and clinical characteristics

Maternal characteristics are presented in Table 1 and Table S1. Compared with women planning VBAC in an OU, those planning VBAC at home were more likely to be older, particularly in the sub-group of women with two or more previous pregnancies. They were also more likely to be of White ethnic background, have a fluent understanding of English, be married or living with a partner, and be living in less deprived areas. Women in the planned VBAC at home group were also less likely to be obese (10.1% versus 20.6% in the planned OU VBAC group had a BMI >30 kg/m^2). In the sub-group of women of para 1, i.e. those with one previous CS and no previous vaginal birth, none of those planning VBAC at home had a BMI >35 kg/m^2 compared with 7.4% in the planned OU VBAC group.

Those planning VBAC at home were less likely to have had only one previous pregnancy (38.9% versus 62.8% in the planned OU VBAC group) and were more likely to have a prolonged pregnancy (≥40 weeks' gestation) (65.5% versus 57.1%).

Additional risk factors and 'complicating conditions'

Compared with women planning VBAC in an OU, those planning VBAC at home were less likely to have additional pre-existing risk factors (Table S2), particularly in women of para 2+.

Nine women in the home VBAC group (3.9%) had had a previous postpartum haemorrhage with treatment or blood transfusion, six (2.7%) had a BMI >35 kg/m^2 and five (2.5%) were known carriers of group B streptococcus (Table S3). In the planned OU VBAC group, BMI >35 kg/

Table 1. Maternal characteristics of women planning VBAC at home or in an obstetric unit

	Para 1				Para 2+				All			
	OU *n* = 787		Home *n* = 87		OU *n* = 440		Home *n* = 122		OU *n* = 1227		Home *n* = 209	
	n	%*	*n*	%*	*n*	%*	*n*	%*	*n*	%*	*n*	%*
Maternal age (years)												
Under 20	9	1.1	0	0.0	1	0.2	0	0.0	10	0.8	0	0.0
20–24	103	13.3	4	4.1	37	7.4	8	6.2	140	11.1	12	5.4
25–29	234	29.2	5	7.2	106	23.3	22	17.7	340	27.0	27	13.6
30–34	245	31.7	40	49.2	137	30.1	32	27.6	382	31.1	72	36.0
35–39	169	21.3	33	33.6	127	30.9	41	34.2	296	24.9	74	34.0
40+	26	3.4	5	5.9	32	8.1	19	14.3	58	5.1	24	11.0
Missing	1		0		0		0		1		0	
Ethnic group												
White	585	71.9	78	90.9	292	63.2	113	93.3	877	68.6	191	92.4
Non-white	201	28.2	9	9.1	146	36.8	9	6.7	347	31.4	18	7.6
Missing	1		0		2		0		3		0	
Understanding of English												
Fluent	694	89.0	87	100.0	375	85.4	121	99.3	1069	87.7	208	99.5
Not fluent	77	11.0	0	0.0	54	14.6	1	0.8	131	12.3	1	0.5
Missing	16		0		11		0		27		0	
Marital/Partner status												
Married/Living together	736	93.6	84	98.2	402	91.0	119	99.3	1138	92.6	203	98.9
Single/Unsupported by partner	43	6.4	2	1.8	33	9.0	1	0.7	76	7.4	3	1.1
Missing	8		1		5		2		13		3	
Body mass index (kg/m^2)**												
Not recorded	132	17.9	17	21.3	59	14.3	28	19.9	191	16.6	45	20.4
<18.5	12	1.6	1	1.3	12	2.6	3	1.9	24	2.0	4	1.7
18.5–24.9	278	34.6	37	41.8	153	34.0	44	42.3	431	34.3	81	42.1
25.0–29.9	199	25.0	28	31.5	127	29.2	28	22.1	326	26.6	56	25.7
30.0–34.9	105	13.6	4	4.1	60	13.5	13	9.5	165	13.6	17	7.4
35.0–39.9	35	4.2	0	0.0	19	4.3	1	0.8	54	4.3	1	0.5
40.0+	24	3.2	0	0.0	9	2.0	5	3.6	33	2.7	5	2.2
Missing	2		0		1		0		3		0	
IMD quintiles												
1st Least deprived	161	19.1	20	22.9	45	9.7	23	20.5	206	15.6	43	21.4
2nd	145	17.4	24	25.0	61	13.4	21	18.2	206	15.9	45	20.8
3rd	154	19.4	15	17.6	62	12.9	24	19.0	216	17.0	39	18.5
4th	126	16.5	18	22.2	96	21.9	20	17.0	222	18.5	38	19.0
5th Most deprived	193	27.6	10	12.4	172	42.0	34	25.3	365	33.0	44	20.3
Missing	8		0		4		0		12		0	
Previous pregnancies ≥24 completed weeks												
1 previous	787	100.0	87	100.0	0	0.0	0	0.0	787	62.8	87	38.9
2 previous	0	0.0	0	0.0	260	57.3	65	54.0	260	21.3	65	33.0
3+ previous	0	0.0	0	0.0	180	42.7	57	46.0	180	15.9	57	28.1
Missing	0		0		0		0		0		0	

*Weighted percentage. Note that weighting can result in percentages differing slightly for events occurring with equal frequencies, particularly when numbers are small (see Methods).
**WHO obesity classes. Note that women with a BMI of 35 kg/m^2 fall within WHO obesity class II (BMI 35.0–39.9) but only women with a BMI >35 kg/m^2 are defined as 'higher risk' under the NICE guideline criteria.

m^2 was the most commonly occurring additional risk factor (5.7%), followed by known carriage of group B streptococcus (4.8%) and gestational diabetes (2.3%).

The proportion of women with 'complicating conditions' identified at the start of care in labour was lower in the planned VBAC at home group (8.0%) than in the OU

VBAC group (21.7%) (Table S2). The 'complicating conditions' identified in the two groups of women are shown in Table S4.

Transfers in women planning VBAC at home

Overall, 37.2% of women planning VBAC at home were transferred to an OU during labour or immediately after the birth of their baby (Table S5). Transfer rates varied markedly with parity; 56.8% of the women of para 1 were transferred, compared with 24.6% of women of para 2+. Among 'higher risk' women with risk factors other than previous CS, transfer rates were 46.1% in nulliparous women and 25.0% and 14.5% in women of para 1 and para 2+, respectively (Table 2). Failure to progress in the first or second stage was the most common reason for transfer, particularly in women of para 1 (Table S5). Repair of perineal trauma was the most common reason for transfer after birth, accounting for over 40% of postnatal transfers overall, and 70% of postnatal transfers in women of para 1.

Mode of birth

The proportion of women planning VBAC at home who had a spontaneous vertex birth was higher overall (82.6% versus 53.7%), and in both groups defined by parity, compared with women planning VBAC in an OU (Table S6). The proportions having ventouse, forceps or caesarean births in the planned home VBAC group were lower than in the OU VBAC group. Two women in the planned home VBAC group and one woman in the OU VBAC group had vaginal breech births.

Proportions were similar when the analysis was restricted to women planning VBAC with no additional risk factors.

Table 2. Transfer rates in 'higher risk' women planning home birth, by parity

	Transfers	Births	Weighted	
	n	*n*	%*	(95% CI)
All 'higher risk' women				
Overall	412	1489	27.1	(24.6–29.8)
Para 0	143	288	46.1	(40.4–51.9)
Para 1	164	562	29.9	(25.9–34.3)
Para 2+	105	639	16.6	(13.4–20.2)
All 'higher risk' women excluding women planning VBAC				
Overall	330	1280	25.4	(22.8–28.1)
Para 0	143	288	46.1	(40.4–51.9)
Para 1	114	475	25.0	(21.0–29.5)
Para 2+	73	517	14.5	(11.5–18.1)
All women planning VBAC				
Overall	82	209	37.1	(30.2–44.5)
Para 1	50	87	56.7	(47.0–65.9)
Para 2+	32	122	24.6	(16.4–35.2)
All women planning VBAC with no additional risk factors				
Overall	71	170	39.1	(30.5–48.4)
Para 1	44	73	58.9	(47.4–69.4)
Para 2+	27	97	26.0	(16.5–38.6)

*Weighted percentage.

Chances of vaginal birth

Overall, planned VBAC at home was associated with a statistically significant increase in the chances of having a vaginal birth compared with planned VBAC in an OU [adjusted relative risk (aRR) 1.15, 95% CI 1.06–1.24], after adjustment for maternal socio-demographic characteristics, parity and the presence of 'complicating conditions' at the start of labour care (Table 3). There were similar statistically significant increases in the chance of vaginal birth in the planned VBAC at home group when we stratified by parity.

Results were similar when we restricted analyses to women planning VBAC without additional risk factors.

The proportions of women having vaginal birth in each setting by parity, and stratified by the presence of additional risk factors and 'complicating conditions', are shown in Table S7.

Maternal and perinatal outcomes

The numbers of adverse maternal and perinatal outcomes were small in both groups. Absolute risks and unadjusted relative risks are shown in Table 4.

Adverse maternal outcomes

Seven women (2.99%) in the planned home VBAC group had a blood transfusion or were admitted to higher level care. Of these women, one had a uterine rupture and a transfusion of six units of blood, three were admitted to a higher dependency unit for observation or recovery following CS (one of whom had a transfusion of three units), two had a blood transfusion of 3–4 units following a spontaneous vertex birth (one following transfer after birth at home) and one woman had a planned postnatal admission for reasons unrelated to her VBAC, following birth at home.

In the planned OU VBAC group, 36 women (2.85%) had a blood transfusion or were admitted to higher level care. Three of these women had a uterine rupture. Thirty women had a blood transfusion, 17 of whom were admitted to higher level care; 13 women had a blood transfusion following CS. Data on the volume of blood transfused was available for 27 women; this ranged from 2 to 15 units with a median of three units.

Adverse perinatal outcomes

Seven women (1.87%) in the planned VBAC at home group and 20 women (1.57%) in the planned OU VBAC

Table 3. Chance of vaginal birth in women planning VBAC by planned place of birth

	Vaginal births	Births	Weighted		Unadjusted		Adjusted**		Adjusted***	
	n	*n*	%*	(95% CI)	RR	(95% CI)	RR	(95% CI)	RR	(95% CI)
All women planning VBAC										
Overall										
OU	853	1227	69.1	(65.3–72.6)	1	–	1	–	1	–
Home	182	209	87.6	(82.6–91.3)	1.27	(1.18–1.36)	1.19	(1.09–1.29)	1.15	(1.06–1.24)
Wald test for interaction								*P* = 0.68****		*P* = 0.69*****
Para 1										
OU	501	787	63.0	(58.7–67.1)	1	–	1	–	1	–
Home	67	87	76.8	(65.8–85.1)	1.22	(1.06–1.41)	1.21	(1.05–1.40)	1.17	(1.01–1.37)
Para 2+										
OU	352	440	79.3	(74.5–83.4)	1	–	1	–	1	–
Home	115	122	94.4	(87.7–97.6)	1.19	(1.11–1.28)	1.17	(1.08–1.28)	1.14	(1.04–1.24)
All women planning VBAC with no additional risk factors										
Overall										
OU	661	934	70.7	(66.6–74.5)	1	–	1	–	1	–
Home	149	170	88.2	(82.6–92.2)	1.25	(1.15–1.35)	1.16	(1.06–1.27)	1.12	(1.03–1.23)
Wald test for interaction								*P* = 0.31****		*P* = 0.40*****
Para 1										
OU	414	634	64.7	(60.4–68.8)	1	–	1	–	1	–
Home	58	73	79.6	(67.9–87.8)	1.23	(1.07–1.42)	1.22	(1.05–1.41)	1.17	(0.99–1.37)
Para 2+										
OU	247	300	82.7	(76.4–87.6)	1	–	1	–	1	–
Home	91	97	93.9	(85.8–97.6)	1.14	(1.04–1.24)	1.13	(1.02–1.26)	1.11	(0.99–1.23)

*Weighted percentage.
**Adjusted for maternal age, ethnic group, understanding of English, marital/partner status, BMI in pregnancy, index of multiple deprivation score quintile, gestation at delivery and parity where appropriate.
***Additionally adjusted for 'complicating conditions' identified at the start of care in labour.
****P-value for interaction, adjusted for maternal age, ethnic group, understanding of English, marital/partner status, BMI in pregnancy, index of multiple deprivation score quintile, gestation at delivery and parity (binary).
*****P-value for interaction, adjusted for maternal age, ethnic group, understanding of English, marital/partner status, BMI in pregnancy, index of multiple deprivation score quintile, gestation at delivery, parity (binary) and 'complicating conditions' identified at the start of care in labour.

group had a baby who was stillborn or had an Apgar score <7 at 5 minutes. Four babies were stillborn, two in each group. Two of these four stillbirths were associated with uterine rupture.

Eight women (3.71%) in the planned VBAC at home group and 40 women (3.04%) in the planned OU VBAC group had a baby who was admitted to a neonatal unit within 48 hours of birth. There were four cases of meconium aspiration syndrome (two in each group) and one baby had signs consistent with neonatal encephalopathy, following forceps delivery, in a planned VBAC in an OU. There were no neonatal deaths.

Discussion

Main findings

Compared with women planning VBAC in an OU, fewer women planning VBAC at home had additional pre-existing risk factors and they were less likely to have 'complicating conditions' noted by the midwife at the start of care in labour.

Compared with women planning VBAC in an OU, women planning VBAC at home were significantly more likely to have a vaginal birth.

The number of adverse outcomes was small but not negligible. Serious adverse maternal outcomes occurred in around 2–4% of births and similar proportions of babies were admitted to a neonatal unit. Stillbirth or Apgar score <7 at 5 minutes occurred in 1–3% of births.

Transfer rates were high (56.8%) in women planning VBAC at home in a second pregnancy. Transfer rates were lower in women of para 2+ planning VBAC at home (24.6%).

Strengths and limitations

A strength of the study is that we were able to evaluate outcomes in a nationally representative sample of women planning VBAC in an OU or at home using high quality

Table 4. Adverse maternal and perinatal outcomes in women planning VBAC by parity and planned place of birth

		Vaginal births	Births	Weighted		Unadjusted	
		n	*n*	%*	(95% CI)	RR	(95% CI)
Maternal blood transfusion or maternal admission for higher level care							
All women planning VBAC							
Overall	OU	36	1218	2.85	(2.03–3.99)	1	–
	Home	7	209	2.99	(1.50–5.90)	1.05	(0.49–2.26)
Para 1	OU	22	780	2.71	(1.82–4.01)	1	–
	Home	3	87	3.58	(1.14–10.65)	1.32	(0.40–4.36)
Para 2+	OU	14	438	3.09	(1.68–5.61)	1	–
	Home	4	122	2.62	(0.98–6.84)	0.85	(0.27–2.68)
All women planning VBAC with no additional risk factors							
Overall	OU	28	927	3.00	(2.09–4.29)	1	–
	Home	5	170	2.53	(1.04–6.02)	0.84	(0.33–2.19)
Para 1	OU	18	628	2.82	(1.81–4.38)	1	–
	Home	2	73	2.82	(0.72–10.46)	1.00	(0.24–4.15)
Para 2+	OU	10	299	3.35	(1.81–6.12)	1	–
	Home	3	97	2.34	(0.69–7.63)	0.70	(0.18–2.71)
Stillbirth or Apgar<7 at 5 minutes							
All women planning VBAC							
Overall	OU	20	1225	1.57	(0.97–2.52)	1	–
	Home	4	206	1.87	(0.72–4.75)	1.19	(0.41–3.44)
Para 1	OU	13	785	1.56	(0.88–2.75)	1	–
	Home	0	87	0	–	–	–
Para 2+	OU	7	440	1.59	(0.58–4.27)	1	–
	Home	4	119	3.08	(1.16–7.93)	1.94	(0.48–7.79)
All women planning VBAC with no additional risk factors							
Overall	OU	15	933	1.67	(0.98–2.83)	1	–
	Home	3	167	1.73	(0.54–5.43)	1.03	(0.29–3.70)
Para 1	OU	9	633	1.49	(0.79–2.79)	1	–
	Home	0	73	0	–	–	–
Para 2+	OU	6	300	2.04	(0.72–5.66)	1	–
	Home	3	94	2.90	(0.88–9.07)	1.42	(0.30–6.77)
Neonatal unit admission							
All women planning VBAC							
Overall	OU	40	1223	3.04	(2.05–4.49)	1	–
	Home	8	205	3.71	(1.94–6.99)	1.22	(0.57–2.59)
Para 1	OU	27	786	3.29	(2.21–4.86)	1	–
	Home	4	87	4.27	(1.68–10.38)	1.30	(0.48–3.51)
Para 2+	OU	13	437	2.62	(1.38–4.91)	1	–
	Home	4	118	3.34	(1.21–8.85)	1.27	(0.39–4.16)
All women planning VBAC with no additional risk factors							
Overall	OU	25	932	2.61	(1.59–4.25)	1	–
	Home	7	166	3.92	(1.90–7.90)	1.50	(0.63–3.57)
Para 1	OU	18	633	2.78	(1.57–4.89)	1	–
	Home	3	73	3.61	(1.26–9.94)	1.30	(0.40–4.26)
Para 2+	OU	7	299	2.27	(1.03–4.95)	1	–
	Home	4	93	4.13	(1.48–11.01)	1.82	(0.50–6.55)

*Weighted percentage. Note that weighting can result in percentages differing slightly for events occurring with equal frequencies, particularly when numbers are small (see Methods).

data from a cohort study with a low risk of bias due to non-response and controlling for potential confounders.[10] We were able to address possible biases arising from differences in the risk profile of the two groups by restricting analyses to women with no additional risk factors and adjusting for the presence of 'complicating conditions' at

the start of labour care. Nevertheless, it is possible that the study groups may have differed in other unmeasured ways that may have affected outcomes. Additionally, the home birth group was self-selected and the findings may not be generalisable to women planning VBAC in general, who tend to have more and possibly different additional risk factors and who may also differ from our study population in ways that we have not measured.

Our sample was large enough to detect important differences in rates of vaginal birth between the two groups, adjusted for differences in maternal characteristics. However, the numbers of adverse maternal outcomes (blood transfusion or maternal admission to higher level care) and adverse perinatal outcomes (stillbirth or Apgar score <7 at 5 minutes and neonatal unit admission) were small and we had limited statistical power to detect differences in these important uncommon adverse outcomes.

We had no data on whether the previous CS had been performed after the onset of labour, which would influence the likelihood of achieving a vaginal birth in a subsequent pregnancy. We also had no data on the number of previous CS or previous vaginal births in women with more than one previous birth, except where this was recorded in text by attending midwives. We therefore carried out all analyses stratified by parity, which enabled us to create a group known to have had one previous CS and no previous vaginal birth and a group with two or more previous pregnancies, including one or more CS.

Interpretation

Because of the risks associated with VBAC, national guidelines recommend planned birth in an OU.[2–4] Overall, the proportion of women planning birth at home who have had a previous CS is small at just over 1%,[5,10] but among 'higher risk' parous women planning home birth, previous CS is one of the more common risk factors (18%).[5]

We found that planning birth at home after a previous CS significantly increased the chances of having a vaginal birth by around 12–15% compared with planning birth in an OU. This is consistent with other analyses of the Birthplace cohort, which have shown higher rates of vaginal birth and lower rates of CS in planned home births in 'low risk' and 'higher risk' women compared with planned OU birth.[10] In our study, 76.8% of women planning home birth after one CS and no other pregnancies had a vaginal birth, very similar to rates found in two studies of out of hospital (i.e. birth centre and planned home) or birth centre VBAC in a second pregnancy in Germany.[7,8] Higher vaginal birth rates have been shown in US studies of VBAC at home or in birth centres, but in groups where large proportions of the population had a previous vaginal birth and/or a previous home birth.[6,16] In our group of women with para 2+ planning VBAC at home it seems likely that some will have had a previous vaginal birth, which may contribute to the higher vaginal birth rate in this group.

Transfer rates in women planning VBAC at home were high. In women with one previous birth planning VBAC at home, the transfer rate (56.7%) was around twice that observed in other 'higher risk' women of the same parity and about four times that observed in 'low risk' women of the same parity.[17] It has been suggested that nulliparous women may be a more appropriate comparison group for women with no prior vaginal birth planning VBAC.[18] In the Birthplace cohort, around 45% of 'low risk' nulliparous women planning home birth were transferred,[19] so compared with this group, transfer rates in women with one previous birth planning VBAC at home were still around ten percentage points higher (56.7%). Comparison with data on reasons for transfer in 'low risk' nulliparous women in the Birthplace cohort,[19] suggests a possible small excess of transfers for failure to progress in the second stage and possibly a small excess of transfers after birth in women with one previous birth planning VBAC at home. However, the number of transfers in our planned VBAC at home group was small and findings on reasons for transfer should be interpreted cautiously.

Rising CS rates are a concern in the developed world. Previous CS is the most common primary obstetric indication for having a repeat CS, and low VBAC rates are associated with a high overall CS rate.[1] The risk of some adverse outcomes, including uterine rupture, increases with increasing numbers of CS.[20] Strategies to increase the proportion of women having a VBAC are therefore important. We do not know how many women currently have the opportunity to consider or discuss planning a vaginal birth following a prior CS, nor do we know why women in our study opted for a home birth. Studies of women's decision-making about mode of birth in a subsequent pregnancy after CS show that this can be complex and conflicted,[21] particularly with regard to balancing safety with women's expressed 'need' to experience labour and 'normal birth'.[21–23] These studies also demonstrate the importance of information from health professionals in women's decision-making; in one study, women reflected that this information could be unclear and contradictory[21] and in another that they experienced 'latent communication' from health professionals who simultaneously presented 'official' messages of choice while revealing personal views which gave women the impression that their choices would be restricted.[24] In this context, it is possible that some women choose to plan birth at home after a prior CS because they consider that they will not be fully supported to achieve a vaginal birth in an OU. Our study suggests that the chances of having a vaginal birth are indeed increased by planning birth at home, but also confirms that the risk of a serious adverse maternal or perinatal outcome in planned

VBAC in any setting is not insubstantial. While we found no statistically significant differences between the two groups in the risk of serious adverse maternal or perinatal outcomes, the direction of effect for all perinatal outcomes was the same, with findings consistent with higher incidence in the planned VBAC at home group.

Trials of decision-support aids for women choosing mode of birth after a prior CS have shown that these may help women to feel more sure about their birth choice, but have demonstrated varied impacts on rates of VBAC.[25,26] Local small-scale evaluations of specialist consultant-led and midwife-led (V)BAC clinics to support women's decision-making have shown mixed results in terms of increasing the proportion of women who choose VBAC or have a successful VBAC.[27,28] More research is required to establish whether specialist VBAC clinics are effective in supporting women to achieve a vaginal birth following a prior CS in a setting where there is easy access to obstetric, anaesthetic and advanced neonatal support if needed.

Conclusion

Women in the Birthplace cohort who planned VBAC at home had a significantly increased chance of achieving a vaginal birth compared with women who planned VBAC in an OU, but their chances of transfer were high (37%) and the risk of an adverse maternal outcome was 2–3%, with a similar risk of an adverse neonatal outcome. Current guidelines recommend that women with a previous CS plan birth in an OU; no change in this guidance can be recommended on the basis of our findings. Further research is required to identify why some women with a previous CS opt for a home birth, and to establish how those women whose preference is for a vaginal birth can best be supported to achieve this.

Disclosure of interests

Full disclosure of interests available to view online as supporting information.

Contribution to authorship

JH conceived the study outline; RR developed the protocol and analysis plan with input from JH and YL; YL conducted the analysis; RR drafted the manuscript with input from JH, YL, MK and PB; all authors were involved in interpretation of data, review and revision of the draft manuscript and approval of the final version.

Details of ethics approval

Research ethics committee approval for the Birthplace study was obtained from the Berkshire Research Ethics Committee (MREC ref. 07/H0505/151).

Funding

This project reports on an independent study which is funded by the Policy Research Programme in the Department of Health. The views expressed are not necessarily those of the Department. Birthplace combined the Evaluation of Maternity Units in England study funded in 2006 by the National Institute for Health Research Service Delivery and Organisation (NIHR SDO) programme, and the Birth at Home in England study funded in 2007 by the Department of Health Policy Research Programme (DH PRP). From January 2012, the NIHR SDO programme merged with the NIHR Health Services Research programme to establish the new NIHR Health Services and Delivery Research (NIHR HS&DR) programme. The views and opinions expressed in this paper are those of the authors and do not necessarily reflect those of the HS&DR Programme, NIHR, NHS, DH PRP or the Department of Health.

Acknowledgements

See under 'Funding'.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Study inclusion flow chart.

Table S1. Gestational age and baby's birthweight in women planning VBAC at home or in an obstetric unit.

Table S2. Prevalence of additional pre-existing risk factors and 'complicating conditions' in women planning VBAC by parity and planned place of birth.

Table S3. Clinical risk factors in women planning VBAC by planned place of birth.

Table S4. 'Complicating conditions' in women planning VBAC by planned place of birth.

Table S5. Transfers in women planning VBAC at home.

Table S6. Mode of delivery in women planning VBAC by planned place of birth and parity.

Table S7. Chance of vaginal birth in women planning VBAC by planned place of birth, parity and risk status. ■

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