Risk of complicated birth at term in nulliparous and multiparous women using routinely collected maternity data in England: cohort study

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ABSTRACT

OBJECTIVES

To determine the rate of complicated birth at term in women classified at low risk according to the National Institute for Health and Care Excellence guideline for intrapartum care (no pre-existing medical conditions, important obstetric history, or complications during pregnancy) and to assess if the risk classification can be improved by considering parity and the number of risk factors.

DESIGN

Cohort study using linked electronic maternity records.

PARTICIPANTS

276 766 women with a singleton birth at term after a trial of labour in 87 NHS hospital trusts in England between April 2015 and March 2016.

MAIN OUTCOME MEASURE

A composite outcome of complicated birth, defined as a birth with use of an instrument, caesarean delivery, anal sphincter injury, postpartum haemorrhage, or Apgar score of 7 or less at five minutes.

RESULTS

Multiparous women without a history of caesarean section had the lowest rates of complicated birth, varying from 8.8% (4879 of 55 426 women, 95% confidence interval 8.6% to 9.0%) in those without specific risk factors to 21.8% (613 of 2811 women, 20.2% to 23.4%) in those with three or more. The rate of complicated birth was higher in nulliparous women, with corresponding rates varying from 43.4% (25 805 of 59 413 women, 43.0% to 43.8%) to 64.3% (364 of 566 women, 60.3% to 68.3%); and highest in multiparous women with previous caesarean section, with corresponding rates varying from 42.9% (3426 of 7993 women, 41.8% to 44.0%) to 66.3% (554 of 836 women, 63.0% to 69.5%).

CONCLUSIONS

Nulliparous women without risk factors have substantially higher rates of complicated birth than multiparous women without a previous caesarean section even if the latter have multiple risk factors. Grouping women first according to parity and previous mode of birth, and then within these groups according to presence of specific risk factors would provide greater and more informed choice to women, better targeting of interventions, and fewer transfers during labour than according to the presence of risk factors alone.

WHAT IS ALREADY KNOWN ON THIS TOPIC

In many countries, women at low risk of complications at birth are advised that it is safe to give birth at home or in a midwife led unit

A National Institute for Health and Care Excellence guideline on intrapartum care used a consensus approach to identify women with specific risk factors for whom care in an obstetric unit is expected to reduce risk to mother or baby

The NICE guideline does not distinguish between women in their first pregnancy and those who have previously given birth

WHAT THIS STUDY ADDS

Parity and history of a caesarean section are considerably stronger determinants of the risk of a complicated birth than other risk factors identified by NICE

Giving more weight to parity and obstetric history would provide greater choice for many women, expand the proportion of women advised to consider giving birth in a midwife led unit, and reduce transfers to obstetric led care after the onset of labour

Introduction

Risk assessment is an essential part of antenatal and intrapartum care. In middle and high income settings, women are typically considered to be at low risk of complications in pregnancy or at birth if they do not have specific conditions or comorbidities.[1-12] In the United Kingdom, a national guideline for intrapartum care, developed by the National Institute for Health and Care Excellence, includes a set of risk factors that provide the basis of a risk classification system.[4] These risk factors, including a woman's age, body mass index (BMI), and the presence of specific clinical and obstetric conditions, are considered to identify women at increased risk of complications during labour and birth and to inform recommendations on place of birth.[4]

Women considered to be at low risk of complications are advised that a low risk setting such as their home or a midwife led unit is a suitable place for them to give birth,[4] whereas women considered to be at increased risk are advised to give birth in an obstetric unit. The NICE guideline recommends that women with characteristics that indicate they are at a higher risk of complications, but who according to its risk classification do not fall into the increased risk group (referred to as the intermediate risk group in this paper) should have an individual discussion about place of birth with their obstetric and midwifery team. The risk classification according to the NICE guideline does not distinguish between women with a single risk factor and those with multiple risk factors. Importantly, the listed factors that identify women as being at increased risk do not include a reference to parity (except for women who have had four or more pregnancies), even though the rate of complications and interventions

during labour are different between nulliparous and multiparous women.[4]

We evaluated the set of risk factors identified in the NICE guideline as a tool to identify women at increased risk of complications during labour and birth, using routinely collected maternity data. Firstly, we determined the numbers of women classified according to the NICE guideline as being at low, intermediate, and increased risk at the time of birth. Then we determined the rate of complications and interventions that are generally considered to require action by an obstetric or neonatal team, according to these risk groups. Finally, we assessed the extent to which the risk classification could be improved by considering the number of risk factors present in a woman and by distinguishing between nulliparous women and multiparous women with and without a previous caesarean section.

Methods

Data sources
We used a national maternity dataset that was collated from extracts of the routinely collected electronic Maternity Information Systems (MIS) of English National Health Service hospitals by the National Maternity and Perinatal Audit.[13 14] In England, more than 99% of births occur within the NHS.[15] MIS extracts were provided by 124 of the 134 NHS hospital trusts that provide maternity services in England. After cleaning, the dataset contains information on mothers and babies for 573 336 babies born in England between 1 April 2015 and 31 March 2016 (85.9% of all babies born that year) to 564 000 women (fig 1).[14]

MIS data were linked at patient level to records from Hospital Episode Statistics (HES), an administrative database containing records of all admissions to English NHS hospitals. NHS Digital carried out the linkage using a deterministic algorithm based on the woman and baby's NHS numbers, dates of birth, and postcode. Of the 573 336 MIS records, 536 924 (93.6%) could be linked. When information was available in both datasets, we used the MIS data. If a woman had given birth twice during the study period, we only considered the first birth.

Study population
We first restricted the study population to 411 690 women aged 15-45 who gave birth in the 87 hospital trusts with high levels of completeness of key data items (>70% of records complete on all of maternal BMI, maternal age, and gestational age) and within these hospitals to the 356 251 women with a record of a singleton pregnancy linked to HES with available data on these key data items (fig 1). We identified 322 949 women who gave birth at term (37+0 to 41+6 weeks gestation), and the 276 766 women who gave birth at term after a trial of labour (elective caesarean births excluded) were included in the analyses (fig 1). We compared the characteristics of included and non-included hospital trusts and the complete and incomplete records within those trusts.

Definition of risk group
From the NICE guideline, we derived a list of characteristics and diagnosis and procedure codes that can be used to identify women at an increased risk of birth complications.[4] Diagnoses in HES records are coded using ICD-10 (international statistical classification of diseases and related health problems, 10th revision)[16] and procedure codes using the operating procedure codes (OPCS) classification of interventions and procedures used by NHS hospitals in the UK (see supplementary table S1).[17] When no precise match was possible for the condition defined, we included all diagnosis codes that could be used as a proxy for the condition. To assess concurrent validity, we also checked coded frequencies against known rates of particular conditions in the UK population (table 1, see full details in supplementary table S1).

As it is not possible to define exactly when a diagnosis code was assigned in the HES records, we made assumptions about the time of onset of conditions. We assumed that illnesses of pregnancy such as gestational diabetes or pre-eclampsia occurred after booking but before birth.

For some types of medical conditions, most notably asthma, hypothyroidism, and cardiac disease, HES does not give enough information about severity. For these three conditions, the most common level of severity was assumed for all women. Therefore, we assumed women with asthma or hypothyroidism to be stable and at low risk and women with cardiac conditions to be at increased risk. We carried out a sensitivity analysis in which we classified women with asthma and hypothyroidism in the increased risk group.

We distinguished five types of risk factors: previous caesarean section, BMI of 35 or more, pre-existing medical conditions, important obstetric history, and complications in the current pregnancy (table 1).

Definition of outcomes
When possible we defined outcomes using previously published coding frameworks.[18 19] A composite outcome of complicated birth was defined as a birth with any of the following events: use of an instrument (forceps or vacuum device), emergency caesarean delivery, obstetric anal sphincter injury, postpartum haemorrhage, or neonate born with an Apgar score of 7 or less at five minutes. We chose this composite outcome as it represents a birth that typically requires the attention of an obstetric or neonatal team. It also closely matches a definition of complicated birth used in a recent Danish study.[20]

As about 90% of stillbirths occur before the onset of labour and as information was not available on the timing of stillbirths in this dataset, we considered all stillbirths to be antepartum and therefore they were excluded.[21] We carried out a sensitivity analysis in which we considered all stillbirths as intrapartum and included stillbirth as a component of the complicated birth outcome.

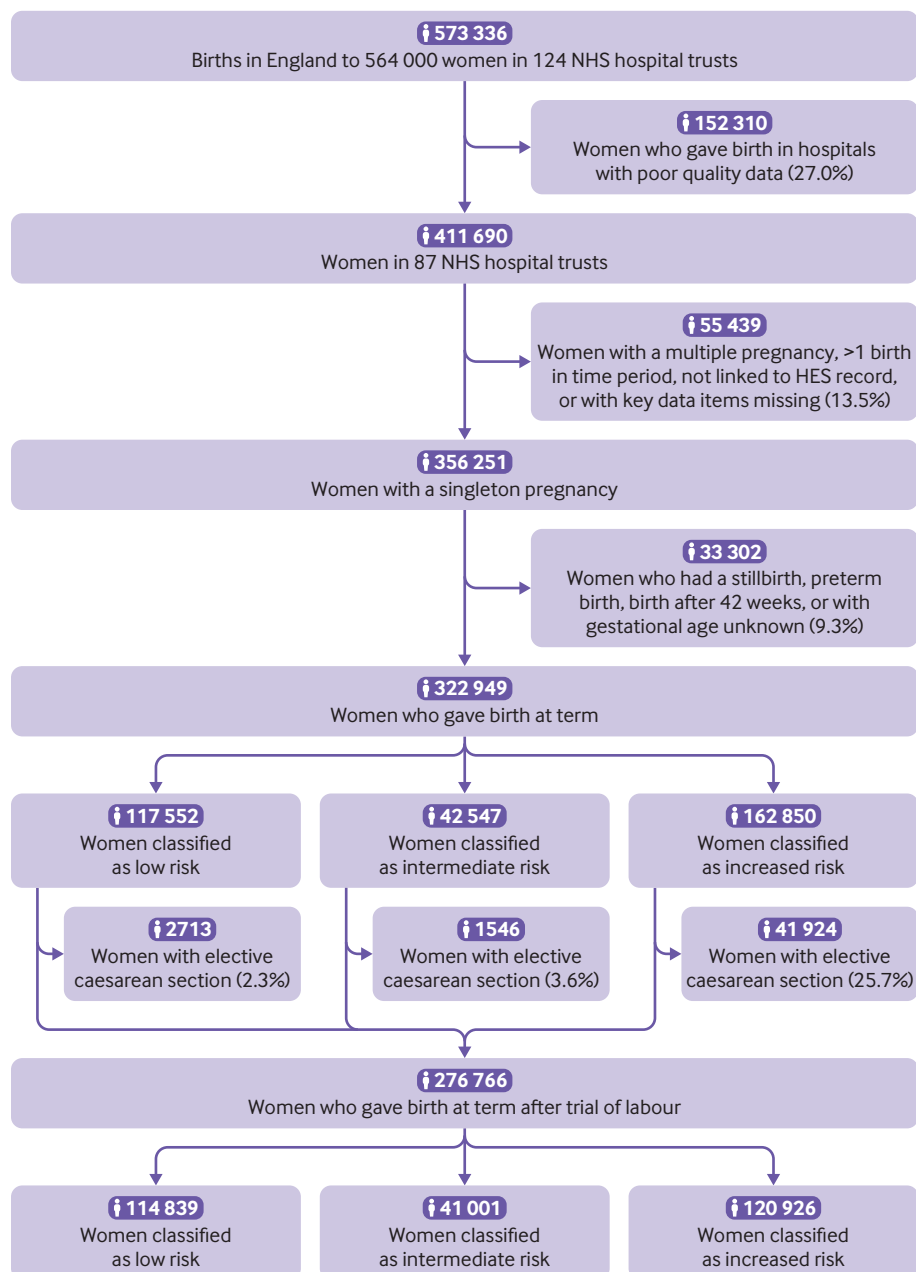To assess the sensitivity of the results to the dominance of instrumental birth among nulliparous

Fig 1 | Flowchart of cohort selection. NHS=national health service; HES=Hospital Episode Statistics

women, we conducted a sensitivity analysis with instrumental birth excluded from the outcome.

Statistical analysis

Firstly, we used proportions to describe the women's characteristics. Then we compared frequencies and the 95% confidence intervals of complicated births in women who gave birth at term after a trial of labour in three groups: nulliparous women, multiparous women with previous vaginal deliveries only, and multiparous women with a previous caesarean section. We used Poisson regression with robust standard errors to estimate risk ratios comparing the likelihood of complicated birth compared with a reference group of multiparous women with no additional risk

factors. Finally, for these three groups we compared frequencies of the individual components of the composite outcome between the risk groups separately.

Patient and public involvement

This study was motivated by discussions with the Women and Families Group of the National Maternity and Perinatal Audit, which represents women and their families accessing maternity care in the UK. This group helped to refine the research question.

Results

Risk classification groups at birth

Of the 322 949 women who gave birth at term, 117 552 (36.4%) were considered to be at low risk, 42 547

Table 1 | Summary of risk classification derived from National Institute for Health and Care Excellence guideline CG90: intrapartum care for healthy women and babies[4]

Risk factors	Risk group		
	Low	Intermediate	Increased
Age (years)	<35	≥35	–
Body mass index	<30	30-34.99	≥35
Pre-existing medical conditions	Stable mild medical conditions (asthma, hypothyroidism)	Mild medical conditions	Comorbidity (eg, hypertension), previous uterine surgery (eg, myomectomy)
Important obstetric history	No important history	Parity of ≥4, previous events that are unlikely to recur (eg, stillbirth of known cause), previous mild complications not known to occur in this pregnancy (eg, mild pre-eclampsia)	Previous caesarean section, previous events that might recur (eg, severe pre-eclampsia or stillbirth of unknown cause)
Complications in current pregnancy	None	–	Conditions or suspected conditions in mother, such as pre-eclampsia, fetal complications such as anomaly, multiple pregnancy, or suspected macrosomia

(13.2%) at intermediate risk, and 162 850 (50.4%) at increased risk at the time of birth according to the risk factors derived from the NICE guideline (table 2). Women in the low risk group were more often younger than 25 years (22.4%) and nulliparous (51.9%) than the women in the intermediate risk group (18.4% and 38.8%, respectively) and the increased risk group (16.3% and 31.8%, respectively). Women in the intermediate risk and increased risk groups were more often of black ethnicity and from more socioeconomically deprived backgrounds.

Of the 162 850 women in the increased risk group, 25 705 (15.8%) had a BMI of 35 or higher, 100 759 (61.9%) had at least one pre-existing medical condition, and 95 300 (58.5%) had complications in the current pregnancy (table 2). In total, 64 410 women at increased risk (39.6%) had more than one of the five types of risk factors: previous caesarean section, BMI of ≥35, pre-existing medical conditions, important obstetric history, and complications in the current pregnancy.

Of the 322 949 women who gave birth at term, 46 183 (14.3%) had an elective caesarean section and 276 766 (86.7%) had a trial of labour (fig 1). The elective caesarean section rate was lowest in multiparous women in the low risk group (1.9%) and highest in multiparous women with a previous caesarean section (59.0%) (table 3). Induction rates increased according to risk group, both in nulliparous women (from 24.8% in the low risk group to 40.2% in the increased risk group) and in multiparous women without a previous caesarean section (from 18.3% in the low risk group to 37.8% in the increased risk group).

Outcomes in women who had a trial of labour, by risk group

Among the 276 766 women who gave birth at term after a trial of labour, multiparous women without a previous caesarean section had the lowest rates of complicated birth (table 4, fig 2), with rates varying from 8.8% (95% confidence interval 8.6% to 9.0%) in those at low risk to 21.8% (20.2% to 23.4%) in those at increased risk with three or more types of risk factor. The rate of complicated birth was higher in nulliparous women across all risk groups, with rates varying from 43.4% (43.0% to 43.8%) in those at low risk to 64.3% (60.3% to 68.3%) in those at increased risk with three

or more types of risk factor. This is confirmed by risk ratios presented in supplementary table S3.

Multiparous women with a previous caesarean section had the highest rates of complicated birth, with rates varying from 42.9% (41.8% to 44.0%) in those who had a previous caesarean section but no additional risk factors to 66.3% (63.0% to 69.5%) in those with three or more additional risk factors.

Figure 2 shows that parity and a previous caesarean section are the dominant risk factors for a complicated birth in women experiencing a trial of labour at term, with substantially higher rates of complicated birth in nulliparous women and multiparous women with a previous caesarean section compared with multiparous women without a previous caesarean section. In contrast, not taking into account parity and history of a caesarean section, women classified as low, intermediate, and increased risk using the risk factors identified in the NICE guideline had rates of complicated birth of 26.7% (26.5% to 27.0%), 24.1% (23.7% to 24.5%), and 38.0% (37.7% to 38.2%), respectively (table 4).

Components of the composite outcome

Table 5 presents the components of the composite outcome according to risk group. The most common components of the composite outcome were instrumental birth and emergency caesarean section, especially in nulliparous women and in multiparous women with a previous caesarean section. For example, the increase in the rate of complicated birth in nulliparous women from 43.4% in the low risk group to 57.5% in the increased risk group is mainly driven by emergency caesarean section. Also, more than 90% of the complicated births in multiparous women with a previous caesarean resulted from instrumental birth or emergency caesarean section (table 5). For multiparous women with no previous caesarean section, the risks were low for all components of the composite outcome.

Sensitivity analyses

A sensitivity analysis was conducted to examine the impact of not having information about the severity of asthma and hypothyroidism. In this sensitivity analysis, 9672 women were classified as having unspecified asthma or hypothyroidism in the increased risk group rather than in the low risk group, as was done for the

Table 2 | Characteristics of 322 949 women who gave birth at term, according to risk classification. Values are numbers (percentages) unless stated otherwise

Characteristics	Risk group		
	Low (n=117 552)	Intermediate (n=42 547)	Increased (n=162 850)
Age (years):			
15-24	26 284 (22.4)	7836 (18.4)	26 573 (16.3)
25-34	91 268 (77.6)	14 089 (33.1)	105 838 (65.0)
35-44	–	20 622 (48.5)	30 439 (18.7)
Parity:			
0 (nulliparous)	61 039 (51.9)	16 491 (38.8)	51 850 (31.8)
1-3	56 513 (48.1)	22 072 (51.9)	103 523 (63.6)
≥4	–	3984 (9.4)	7477 (4.6)
IMD (national fifth)*:			
1st (least deprived)	20 308 (18.5)	7607 (19.0)	25 181 (16.5)
2nd	16 497 (15.0)	5821 (14.5)	20 782 (13.7)
3rd	21 761 (19.8)	7454 (18.6)	28 476 (18.7)
4th	24 382 (22.2)	8782 (21.9)	33 909 (22.3)
5th (most deprived)	26 746 (24.5)	10 409 (26.0)	43 843 (28.8)
Missing	7858	2474	10 659
Ethnicity:			
White	85 553 (79.2)	31 674 (80.0)	116 010 (75.9)
Black	5005 (4.6)	2410 (6.1)	11 006 (7.2)
Asian	12 960 (12.0)	3826 (9.7)	19 857 (13.0)
Other	4463 (4.1)	1648 (4.2)	5999 (3.9)
Unknown	9571	2989	9978
Body mass index:			
‹18	–	–	9361 (5.7)
18-24.9	77 821 (66.2)	15 039 (35.3)	61 513 (37.8)
25-29.9	39 731 (33.8)	8385 (19.7)	43 594 (26.8)
30-34.9	–	19 123 (44.9)	22 677 (13.9)
≥35	–	–	25 705 (15.8)
Pre-existing medical conditions:			
Cardiac	–	–	2514 (1.5)
Endocrine/renal	–	–	3245 (2.0)
Neurological	–	–	9262 (5.7)
Psychiatric	–	–	12 682 (7.8)
Haematological	–	–	7473 (4.6)
Other	–	–	65 583 (40.3)
None	117 552 (100)	42 547 (100)	62 091 (38.1)
Important obstetric history:			
Caesarean birth	–	–	48 331 (29.7)
Uterine surgery	–	–	6827 (4.2)
Previous tear	–	–	5267 (3.2)
Other	–	–	21 029 (12.9)
None	117 552 (100)	42 547 (100)	91 018 (55.9)
Complications in current pregnancy:			
Hypertension	–	–	16 880 (10.4)
Fetal complication	–	–	30 956 (19.0)
Diabetes	–	–	15 690 (9.6)
Other	–	–	45 471 (27.9)
None	117 552 (100)	42 547 (100)	67 550 (41.5)

IMD=index of multiple deprivation.
Comparisons between risk groups were made using two sided x^2 tests. All comparisons were statistically significant, at P‹0.001.
*Combines socioeconomic information about a postcode area.

main analysis. This had little impact on the rate of a complicated birth according to the risk classification. The biggest changes were seen in nulliparous women with increased risk whose risk of a complicated birth decreased from 57.5% to 55.3% and in multiparous women at increased risk with no previous caesarean section whose risk decreased from 17.0% to 16.0%.

A further sensitivity analysis examined the impact of not having information about the timing of stillbirth in the dataset. In this sensitivity analysis, all 1271 stillbirths were considered to have occurred intrapartum rather than antepartum, and these stillbirths were therefore included in the analysis as a complicated birth. The rate of stillbirth was low among all women with a singleton pregnancy (0.36%). The stillbirth rate was highest in nulliparous women and thus the largest difference in results was seen in nulliparous women, with an associated increase in the rate of complicated birth from 43.4% to 43.6% in women at low risk, from 45.8% to 45.9% in those at intermediate risk, and from 57.5% to 57.7% in those at increased risk.

Table 3 | Mode of onset of labour according to risk group in 322 949 women who gave birth at term

	Risk group		
Onset of labour by parity	Low (n=117 552)	Intermediate (n=42 547)	Increased (n=162 850)
Nulliparous women			
No in group:	n=61 039	n=16 491	n=51 850
Spontaneous	44 260 (72.5)	10 372 (62.9)	23 048 (44.5)
Induced	15 153 (24.8)	5 244 (31.8)	20 854 (40.2)
Elective caesarean section	1626 (2.7)	875 (5.3)	7948 (15.3)
Multiparous women			
No previous caesarean section:	n=56 513	n=26 056	n=63 003
Spontaneous	45 075 (79.8)	19 221 (73.8)	33 506 (53.2)
Induced	10 351 (18.3)	6164 (23.7)	23 824 (37.8)
Elective caesarean section	1087 (1.9)	671 (2.6)	5673 (9.0)
Previous caesarean section:			47 997
Spontaneous	–	–	13 979 (29.1)
Induced	–	–	5715 (11.9)
Elective caesarean section	–	–	28 303 (59.0)

A final sensitivity analysis evaluated whether the dominance of instrumental delivery in the composite outcome influenced the pattern of associations for nulliparous women. If instrumental delivery was not included in the composite outcome, a similar pattern of results was, however, observed (supplementary table S4).

Table 4 | Rates of complicated birth in 276 766 women who gave birth at term after a trial of labour (elective caesarean births excluded*)

Risk classification†	Nulliparous women		Multiparous women without a previous caesarean section		Multiparous women with a previous caesarean section		All women	
	No in group	Complicated births; % (95% CI)	No in group	Complicated birth; % (95% CI)	No in group	Complicated births; % (95% CI)	No in group	Complicated births; % (95% CI)
Low risk	59 413	25 805; 43.4 (43.0 to 43.8)	55 426	4879; 8.8 (8.6 to 9.0)	–	–	114 839	30 684; 26.7 (26.5 to 27.0)
Intermediate risk	15 616	7153; 45.8 (45.0 to 46.6)	25 385	2712; 10.7 (10.3 to 11.1)	–	–	41 001	9870; 24.1 (23.7 to 24.5)
BMI 30-34 alone	6671	2933; 44.0 (42.9 to 45.2)	8700	771; 8.9 (8.3 to 9.5)	–	–	–	–
Age ≥35 alone	8134	3799; 46.7 (45.6 to 47.8)	11 284	1449; 12.8 (12.2 to 13.5)	–	–	–	–
Parity ≥4 alone	0	0	2022	100; 4.9 (4.0 to 5.9)	–	–	–	–
No of risk factor types:								
1	14 805	6732; 45.5 (44.7 to 46.3)	22 006	2320; 10.5 (10.1 to 11.0)	–	–	–	–
2	811	421; 51.9 (48.4 to 55.4)	3032	364; 12.0 (10.9 to 13.2)	–	–	–	–
3	–	–	347	28; 8.1 (5.4 to 11.5)	–	–	–	–
Increased risk	43 902	25 230; 57.5 (57.0 to 57.9)	57 330	9767; 17.0 (16.7 to 17.4)	19 694	10 908; 55.4 (54.7 to 56.1)	120 926	45 905; 38.0 (37.7 to 38.2)
Previous caesarean section alone	–	–	–	–	7 993	3 426; 42.9 (41.8 to 44.0)	–	–
BMI ≥35 alone*	7063	3260; 46.2 (45.0 to 47.3)	8134	917; 11.3 (10.6 to 12.0)	790	317; 40.1 (36.6 to 43.6)	–	–
Pre-existing medical conditions alone*	9920	5098; 51.4 (50.4 to 52.4)	11 446	1445; 12.6 (12.0 to 13.2)	1217	571; 46.9 (44.1 to 49.8)	–	–
Important obstetric history alone*	–	–	8415	1511; 18.0 (17.1 to 18.8)	1110	505; 45.5 (42.5 to 48.5)	–	–
Complications in current pregnancy alone*	19 464	12 456; 64.0 (63.3 to 64.7)	13 230	2826; 21.4 (20.6 to 22.1)	4601	3480; 75.6 (74.4 to 76.9)	–	–
No of risk factor types*:								
1	36 447	20 814; 57.1 (56.6 to 57.6)	41 225	6709; 16.3 (15.9 to 16.6)	7718	4873; 63.1 (62.0 to 64.2)	–	–
2	6889	4052; 58.8 (57.6 to 60.0)	13 294	2445; 18.4 (17.7 to 19.1)	3147	2055; 65.3 (63.6 to 67.0)	–	–
≥3	566	364; 64.3 (60.3 to 68.3)	2811	613; 21.8 (20.2 to 23.4)	836	554; 66.3 (63.0 to 69.5)	–	–
All	118 931	58 188; 48.9 (48.6 to 49.2)	138 141	17 358; 12.6 (12.4 to 12.7)	19 694	10 908; 55.4 (54.7 to 56.1)	276 766	86 459; 31.2 (31.1 to 31.4)

*In addition to previous caesarean section for multiparous women with previous caesarean section.
†According to National Institute for Health and Care Excellence guidelines.

Discussion

In this study we found that parity and a history of caesarean section are considerably stronger determinants for risk of a complicated birth in women with a trial of labour at term than the other factors of the risk classification derived from the clinical guideline for intrapartum care developed by NICE in the UK. Low risk nulliparous women have substantially higher rates of complicated birth than increased risk multiparous women without a previous caesarean section even if the latter have multiple risk factors.

Methodological considerations

We used routinely collected data to determine the risk of complications during childbirth at the onset of term labour in the English NHS. About 60% of births in England could be included. Most exclusions were related to poor data completeness at hospital level rather than missing data at individual level. Comparison of included and excluded NHS hospital trusts showed similar maternal and hospital characteristics for number of deliveries each year and region. A comparison among women with a singleton term birth showed that women in the included hospital trusts were younger, more often of white ethnicity, and less often living in socioeconomically deprived areas (supplementary table S5). However, as these differences were small they will have had minimal impact on our findings.

We were not able to conduct any direct validation of the clinical information recorded in the MIS or HES data. It is possible that owing to under-recording of diagnostic and procedure data in routinely collected datasets, some women in the low risk group were misclassified. As a result, we might have overestimated the risk of a complicated birth in the low risk group, but it is unlikely that this will have had a major impact on our results given that the observed risk of complications in multiparous women classified as low risk is low (8.8%). Furthermore, the routinely collected maternity data included little information about severity of specific medical conditions. However, a sensitivity analysis assessing the impact of moving women with asthma and hypothyroidism from the low risk group to the increased risk group had little effect on our results.

A further limitation is that our data reflect real world practice and as a result the risk factors included in the NICE guideline will have influenced the women's chosen place of birth. This will in turn have affected the rate of complicated birth that we report, given that the use of instrumental delivery or emergency caesarean section is higher in obstetric led care.[13] This limitation cannot, however, explain the substantially higher rates of complicated birth we found in nulliparous women compared with multiparous women without a previous caesarean section. Nulliparous women were more often classified as low risk according to the risk factors derived from the NICE guideline (50.0% of those who had a trial of labour at term) than multiparous women without a previous caesarean section (40.1%).

Lastly, we did not have information about the timing of stillbirth and assumed for the main analyses that all stillbirths had occurred before the onset of labour. A sensitivity analysis that included stillbirths as if all had occurred after the onset of labour did not change our results appreciably. Importantly, the stillbirth rate varied little according to the risk classification and it was highest in nulliparous women. The results of this sensitivity analysis are in line with the main analysis, adding to the evidence that parity and a history of caesarean birth are stronger determinants of the rates of complicated birth than other risk factors identified in the NICE guideline.

Comparison with other studies

Other studies have classified women as low risk using a similar risk classification as recommended by NICE.[1-3 5-12 22] A study of about 10 million births in the United States found that 38% of women were low risk according to the absence of risk factors at the time of birth and, similar to our results, 29% of these women had a complication requiring an obstetric or neonatal intervention.[8] A Dutch study, using a similar risk classification, estimated the proportion of women at low risk of complications as 42.5%.[10] This Dutch study did not, however, have access to information about BMI, which is a major reason why women in our study were classified in the intermediate risk or increased risk groups.

The Birthplace in England study, which included 45 000 births between April 2008 and April 2010, was designed to look at place of birth for women at low risk of complications, defined in a similar way as the risk classification recommended by NICE.[23] The primary outcome in this study was a composite of perinatal mortality and adverse neonatal outcomes. The neonatal component of our outcome, a low Apgar score (≤7) at five minutes, was chosen as it represents a baby requiring additional involvement from the neonatal team. It is also a proxy for adverse neonatal outcomes. Evidence suggests that a low Apgar score at five minutes is associated with perinatal mortality,[24] poorer cognitive development,[25 26] and cerebral palsy.[27]
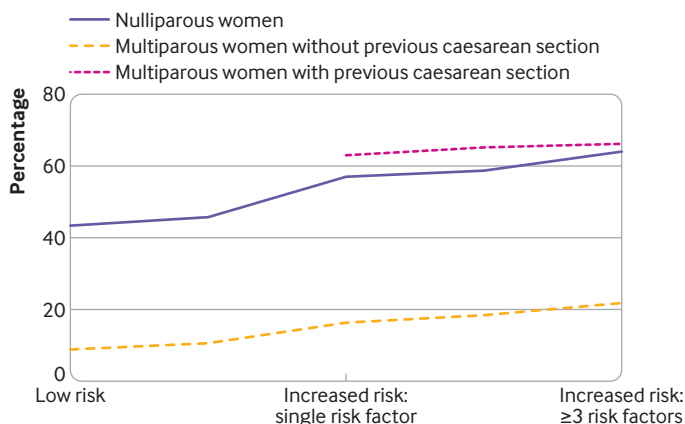

Fig 2 | Association between number of types of risk factors and rates of complicated birth among women who gave birth at term after a trial of labour in England, 2015-16

Table 5 | Components of composite outcome by risk group, parity and obstetric history in 276 766 women who gave birth at term after a trial of labour (elective caesarean births excluded*)

Components of composite outcome	Low risk		Intermediate risk		Increased risk	
	No with outcome	% (95% CI)	No with outcome	% (95% CI)	No with outcome	% (95% CI)
Nulliparous with trial of labour	59 413		15 616		43 902	
Complicated birth:	25 805	43.4 (43.0 to 43.8)	7153	45.8 (45.0 to 46.6)	25 230	57.5 (57.0 to 57.9)
Instrumental birth	15 377	25.9 (25.5 to 26.3)	3830	24.5 (23.8 to 25.2)	11 935	27.2 (26.8 to 27.6)
Emergency caesarean birth	7445	12.5 (12.2 to 12.9)	2657	17.0 (16.4 to 17.6)	11 274	25.7 (25.3 to 26.1)
Obstetric anal sphincter injury	3565	6.0 (5.8 to 6.2)	755	4.8 (4.5 to 5.2)	2266	5.2 (5.0 to 5.4)
Postpartum haemorrhage	1561	2.6 (2.5 to 2.8)	468	3.0 (2.7 to 3.3)	1903	4.3 (4.1 to 4.5)
Apgar score ≤7 at 5 minutes	696	1.2 (1.0 to 1.3)	194	1.2 (1.1 to 1.4)	820	1.9 (1.7 to 2.0)
Multiple components (≥2)	2839	4.8 (4.6 to 5.0)	751	4.8 (4.5 to 5.2)	2968	11.7 (11.4 to 12.2)
Multiparous no previous caesarean with trial of labour	55 426		25 385		57 330	
Complicated birth:	4879	8.8 (8.6 to 9.0)	2712	10.7 (10.3 to 11.1)	9767	17.0 (16.9 to 17.2)
Instrumental birth	2140	3.9 (3.7 to 4.0)	1098	4.3 (4.1 to 4.6)	3317	5.8 (5.6 to 6.0)
Emergency caesarean birth	976	1.8 (1.6 to 1.9)	749	3.0 (2.7 to 3.2)	3589	6.3 (6.1 to 6.5)
Obstetric anal sphincter injury	1125	2.0 (1.9 to 2.1)	485	1.9 (1.7 to 2.1)	1541	2.7 (2.6 to 2.8)
Postpartum haemorrhage	689	1.2 (1.1 to 1.3)	414	1.6 (1.5 to 1.7)	1515	2.6 (2.5 to 2.8)
Apgar score ≤7 at 5 minutes	318	0.6 (0.5 to 0.6)	185	0.7 (0.6 to 0.8)	645	1.1 (1.0 to 1.2)
Multiple components (≥2)	369	0.7 (0.6 to 0.7)	219	0.9 (0.8 to 1.0)	840	1.5 (1.4 to 1.6)
Multiparous with previous caesarean with trial of labour					19 694	
Complicated birth:	–	–	–	–	10 908	55.4 (55.0 to 55.7)
Instrumental birth	–	–	–	–	3416	17.3 (16.8 to 17.9)
Emergency caesarean birth	–	–	–	–	6748	34.3 (33.6 to 34.9)
Obstetric anal sphincter injury	–	–	–	–	747	3.8 (3.5 to 4.1)
Postpartum haemorrhage	–	–	–	–	1322	6.7 (6.4 to 7.1)
Apgar score ≤7 at 5 minutes	–	–	–	–	575	2.9 (2.7 to 3.2)
Multiple components (≥2)	–	–	–	–	1900	9.6 (9.2 to 10.1)

In line with our findings, the Birthplace in England study found that the chances of a baby having serious medical problems were higher for low risk nulliparous women (about 5 per 1000 births) than for low risk multiparous women (about 3 per 1000 births), irrespective of planned place of birth. For nulliparous women planning a home birth, this risk was even higher (about 10 per 1000 births). The study also found that about one in three nulliparous women who had planned to give birth in a midwife led unit were transferred before delivery to an obstetric unit compared with fewer than one in 10 multiparous women.[23] These results support our findings that the risk of requiring the attention of an obstetric or neonatal team is much higher in nulliparous women than in multiparous women and highlight the importance of considering parity when planning place of birth.

Substantial literature evaluates the importance of previous mode of birth for multiparous women.[28-30] In agreement with these studies, we found that the risk of a complicated birth for multiparous women with a previous caesarean section is similar to the risk observed in nulliparous women.[29] The risk in women with a previous caesarean section who also had a vaginal delivery either before or after the caesarean section is, however, much lower, and offers opportunities for further refinement of a risk group based on parity and obstetric history.[19]

Implications
Our results indicate that it is appropriate to consider modifying the risk classification used to give advice to women who are planning where to give birth. For

multiparous women without a previous caesarean section, the chance of a complicated birth is low, irrespective of whether or not they have additional risk factors, and planning to give birth in a midwife led setting is appropriate, even for women with additional risk factors. However, nulliparous women, including those without additional risk factors, have considerably higher risks of a complicated birth, and they could consider giving birth in a setting that enables rapid access to care by an obstetric or neonatal team, including midwife led units. These considerations are especially relevant for those women considering a home birth. There are no obvious reasons why these findings in the English NHS are not applicable to other countries with similar models of care.

Giving more weight to parity when assessing the risk in women giving birth at term might lead to substantial shifts in where women choose to give birth, which in turn could have substantial implications for workforce and capacity planning. For example, 45% of women who labour at term are multiparous without a history of caesarean section. In contrast, the risk classification system recommended by NICE identifies only 36% of women who labour at term as low risk and therefore as candidates for a low risk birth setting. These shifts would not only expand the proportion of women who are advised to consider giving birth in midwife led settings but would also have an impact on the proportion of women actually giving birth in these settings, given that the transfer rate during labour to obstetric led care is far lower for multiparous women than for nulliparous women.[23]

Conclusion

Parity and obstetric history are key determinants of the risk of a complicated birth in women who labour at term. Grouping women first according to parity and previous mode of birth, and then within these groups according to the presence of specific risk factors would allow better planning of place of birth and targeting of interventions, with greater and more informed choice for many women and fewer undesired transfers to obstetric led care after the onset of labour.

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Supplementary information: additional tables, S1 to S5