NMPA

National Maternity & Perinatal Audit

Induction of Labour Snapshot report

Based on births in NHS maternity services in England, Scotland and Wales during 2023

Methods and Results

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LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE
RCPCH Royal College of Paediatrics and Child Health
Royal College of Midwives
Royal College of Obstetricians & Gynaecologists
HQIP Healthcare Quality Improvement Partnership

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Introduction

This document provides details of the data sources, methods and cohort construction used for the Induction of Labour (IOL) Snapshot Audit, and national-level results tables. The IOL Snapshot Audit report can be found online, along with a downloadable table of trust- and board-level results.

How to use this document

This document should be reviewed alongside the Methods and Measures Technical Specification documents for the NMPA 2023 annual clinical report. Both the annual clinical report and the IOL Snapshot Audit use the same datasets containing births in NHS maternity services in England, Scotland and Wales during 2023. Data quality criteria and parameters for case-mix adjustment used in the IOL Snapshot Audit closely follow those used for the annual clinical report.

The following supporting resources can be found on our website:

- The IOL Snapshot Audit report
- A Lay Summary
- A glossary explaining the terminology and abbreviations used in our reports
- A line-of-sight table describing the evidence base for the recommendations in the IOL report
- A video explaining funnel plot interpretation

Aims and objectives

The NMPA has identified persistent variation in IOL rates between maternity care providers upon a background of increasing IOL rates.

Considering induction as a process aimed at achieving an uncomplicated vaginal birth, this snapshot audit aims to examine the variation in outcomes after induction, namely the mode of birth and 5-minute Apgar score. This audit also aims to describe the characteristics of the women and birthing people undergoing IOL and how these characteristics relate to their mode of birth and their baby's 5-minute Apgar score.

The objectives of the IOL Snapshot Audit were:

1. To describe the background characteristics and pregnancy history (parity) of women and birthing people undergoing IOL, in comparison to the overall maternity population. (cohort 1)
2. To determine the rates of two outcomes following IOL (overall and according to background characteristics and pregnancy history (parity)), and to examine the trust/board-level variation for the following outcomes.
    a. Mode of birth (vaginal versus unplanned caesarean birth) (cohort 2a)
    b. Apgar score less than 7 at 5 minutes (cohort 2b)
3. To examine the relationship between background characteristics or pregnancy history (parity) and experiencing the following outcomes after IOL:
    a. Mode of birth (vaginal versus unplanned caesarean birth) (cohort 3a)
    b. Apgar score less than 7 at 5 minutes (cohort 3b)
4. To assess the quality and availability of data items that could enhance understanding of the variation in the use of IOL and its outcomes.

Data sources

The NMPA annual clinical report uses English, Scottish and Welsh data from the following sources:

England: Maternity data from the Maternity Services Data Set (MSDS v2.0), are linked to Hospital Episode Statistics Admitted Patient Care (HES APC) administrative data. These are linked to the ONS register of live births, stillbirths and mortality, as well as the PDS birth notification dataset which together form the ONS-PDS spine. All pseudonymised English datasets are controlled and supplied directly to the NMPA by NHS England.

Wales: Maternity data from the Maternity Indicators data set (MIds) (which includes the Initial Assessment (IA) dataset) are linked with selected variables from the National Community Child Health Database (NCCHD). These are then linked to administrative data from the Patient Episode Database for Wales (PEDW) Admitted Patient Care (APC). All pseudonymised Welsh datasets are controlled and supplied directly to the NMPA by Digital Health & Care Wales (DHCW).

Scotland: Maternity data from the Maternity Inpatients and Day Cases – Scottish Morbidity Record (SMR-02) and the Scottish Birth Record (SBR) are linked to data from the General Acute Inpatients and Day Cases – Scottish Morbidity Records (SMR-01). These are then linked to data from the National Records of Scotland (NRS) register for live births, still births and death. All pseudonymised Scottish datasets are controlled and supplied directly to the NMPA by Public Health Scotland (PHS).

Further information on data sources and dataset linkage can be found in the annual clinical report Methods and Measures Technical Specification documents and in the relevant NMPA Data Flow Diagram.

Data quality

For IOL Snapshot Audit, trust/board-level minimum data quality requirements closely mirror those used for the 2023 annual clinical report, with trust/board data excluded when missingness proportions for key variables exceed 30%, and when distributions of non-missing data for key variables are more extreme than a priori defined acceptable limits. When poor quality data from a trust or board was restricted to several months of data submissions, those specific months were excluded. Full details of the data quality criteria are available in the annual clinical report Measures Technical Specification document.

In addition to these minimum data quality requirements, further trust/board-level data quality criteria were developed relating to IOL rates by mode of birth to construct the cohort for the IOL snapshot audit (cohort 1). This was deemed necessary due to implausible distributions of IOL amongst planned and unplanned caesarean births identified in some trusts/boards. The cohorts for analysis of outcomes following IOL (mode of birth cohorts 2a, 3a and 5-minute Apgar score cohorts 2b, 3b) were further restricted to records that passed additional outcome or variable specific completeness and distribution criteria. Exclusions for data quality, including trust/board- and record-level criteria, for each stage of the analysis are outlined in the audit data flowchart (Figure 1).

Definitions of outcomes

Records for induction of labour, caesarean birth and 5-minute Apgar score were identified using the same methods as the 2023 annual clinical report, details of which can be found in the Measures Technical Specifications document.

The IOL snapshot audit also considered whether the IOL definition could be expanded to include unsuccessful IOL. An unsuccessful induction of labour is understood by maternity healthcare professionals to occur when the method or methods administered with the aim of starting labour do not progress sufficiently to the point of 'established labour', defined as regular contractions and progressive dilation of the cervix from 4cm. In this circumstance, a caesarean birth may be offered to many women and birthing people. However, a caesarean birth following IOL is not always the result of an unsuccessful IOL as a caesarean may be requested or advised for other reasons after the induction process has successfully started labour.

For the snapshot audit, an unsuccessful IOL was identified through the presence of the ICD-10 code 'O61' ("Failed induction of labour") in HES APC (England), SMR-02 (Scotland) and PEDW APC (Wales) for the maternity records that were successfully linked to these administrative hospital datasets. The ICD-10 manual provides no further details for 'O61' beyond the above definition and there is currently no widely accepted or used definition for an unsuccessful IOL, adding to the challenge of understanding this data. Records identified through the O61 code were used to overwrite labour onset, where labour onset was not missing but not indicative of an induction.

Inclusion/exclusion criteria

The snapshot audit included all women and birthing people with a singleton pregnancy undergoing IOL from 24^{+0} weeks gestation, where the labour is expected to result in the birth of a live baby. This differs from the NMPA annual clinical reports, which include IOL performed at term (37^{+0}–42^{+6} weeks gestation). This difference was deemed necessary to provide an in-depth analysis of IOL practices, including the preterm births that make up a small proportion (<3%) of the total number of IOL performed. This along with the exclusion criteria described below, explains the differences in numbers and rates of IOL between the snapshot audit and the annual clinical report.

For a very small number of pregnancies, IOL may be recommended after confirmation that an unborn baby's heartbeat has stopped (antenatal stillbirth). Due to differences in the rationale for IOL for antenatal stillbirths and for those undergoing a medical termination of pregnancy after 24 weeks, both of these were excluded from all analysis cohorts. While women and birthing people who experienced an intrapartum stillbirth (identified during labour) were included for the mode of birth after IOL analyses (cohorts 2a, 3a); they are excluded for the 5-minute Apgar score after IOL analyses (cohorts 2b, 3b) as only liveborn babies should be assigned an Apgar score. Information on timing of stillbirth in relation to labour was available in NMPA data although with varying quality. Where it was not possible to determine the timing due to missing or conflicting information, ICD-10 diagnostic codes (Appendix Supplementary Table 1) based on work previously published by the NMPA team were used to ascertain timing.[1 2] Stillbirths of unknown timing were excluded from cohorts, based on the evidence that 90% of stillbirths in the UK occur in the antenatal period.[3]

Births that took place in trusts/boards reporting fewer than 100 IOL were excluded due to small group size considerations, in particular for provider-level variation analyses of outcomes following IOL. As 98% of trusts and boards with obstetric units in Great Britain performed more than 100 IOL in 2023, it was also thought that practice in these smaller units would not be reflective of practice in the majority of units, or overall national practice and may skew the results. Additionally births that took place in a freestanding midwifery unit were excluded as induction of labour is not expected to be managed in this setting.

Records from trusts/boards which did not pass data quality checks as described above and those that had a missing 'labour onset' were excluded from all analysis cohorts. Records that had a missing 'mode of birth' or '5-minute Apgar score' were excluded from their respective cohorts (cohorts 2a/2b and 3a/3b). For cohorts 3a and 3b, IOL before 34 completed weeks gestation were excluded from analysis plot to mitigate the impact of small group sizes on the regression model output.

The snapshot audit data flowchart (Figure 1) outlines all trust/board- and record-level exclusions related to cohort construction and data quality for each stage of the analysis. The proportion of records excluded to construct IOL cohorts differed according to country (Tables 1a and 1b). One quarter of births in Wales were excluded, in part because one of large the Welsh Health Boards did not pass data quality checks.

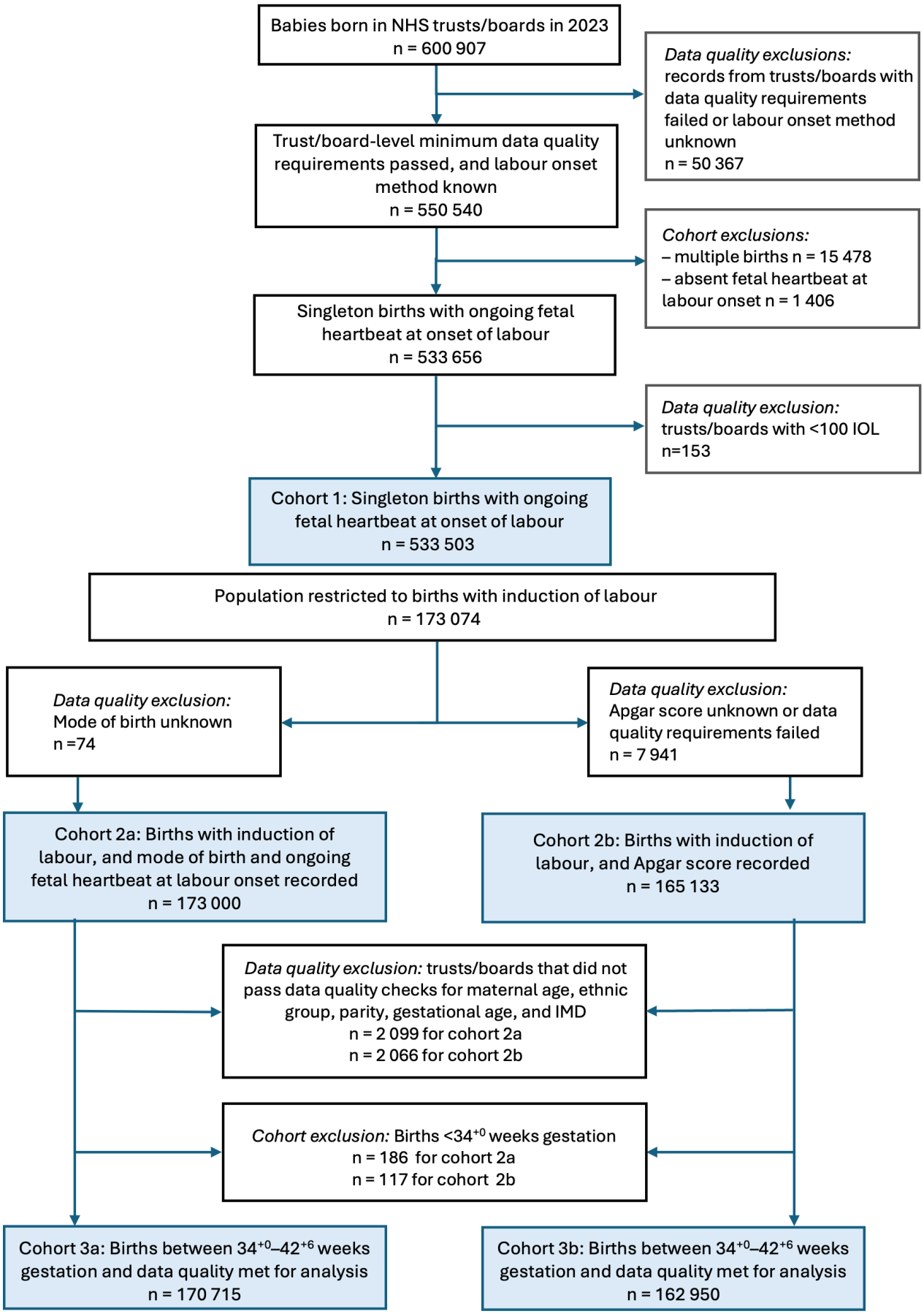

Figure 2: Induction of labour snapshot audit data flowchart

Analysis and reporting

For objective 1 (cohort 1), the background characteristics and pregnancy history, including maternal age, parity, ethnic group and socioeconomic deprivation (using the Index of Multiple Deprivation (IMD)) for the 173 074 women and birthing people undergoing IOL were described using proportions and compared with the characteristics of the overall maternity population of 533 503 births in 2023. A summary of key differences at a national-level are presented in the IOL snapshot audit report, with full data of national- and country-level comparisons are included in this document (Table 2).

For objective 2, the rates of two outcomes following IOL – caesarean birth (cohort 2a: 173 000 births) and Apgar score less than 7 at 5 minutes (cohort 2b: 165 133 births) – are reported at national-, country- and provider-level, and are described according to characteristics of women and birthing people experiencing these outcomes. The distributions of background characteristics and pregnancy history (parity) for women and birthing people for mode of birth (vaginal birth versus caesarean birth) and 5-minute Apgar score outcomes after IOL at country- and national-level are presented in this document (Tables 3 and 4).

The crude rates of these outcomes are reported at a national- and country-level and are summarised in Tables 2 and 3 of the IOL Snapshot Audit report. Logistic regression models were used to calculate case-mix adjusted rates at country- and trust/board-level. Case-mix adjustment controlled for maternal age, parity, previous caesarean birth, gestational age. Birthweight was not included in the model for the IOL snapshot audit as this information is unknown at the time of induction; Body Mass Index (BMI) and pre-pregnancy conditions such as diabetes and hypertension were not included in the model due to insufficient data completeness. Trust/board-level adjusted rates are presented in the IOL Snapshot Audit report using funnel plots (Figures 1 and 3) and both crude and adjusted rates for trusts/boards are reported in a downloadable table.

For objective 3, the association between background characteristics and the likelihood of experiencing a caesarean birth (cohort 3a: 170 715 births) or an Apgar score of less than 7 at 5 minutes (cohort 3b: 162 950 births) following IOL were estimated using logistic regression models accounting for trust/board-level clustering. The model included maternal age, parity, previous caesarean birth, gestational age as in previous analyses and also accounted for ethnic group, IMD and country where the birth took place. The estimated likelihood of experiencing the outcomes as derived from predicted values according to background characteristics and pregnancy history (parity) are visualised using margins plots in the IOL Snapshot Audit report (Figures 2 and 4). These models which account for potential trust/board-level clustering were developed in a stepwise fashion, with likelihood ratio tests used to identify the model best associated with the data. Model output tables expressing the adjusted estimated likelihoods for these plots, 95% confidence intervals and *p*-values are presented within this document (Tables 5 and 6).

Throughout the data analysis, the availability and quality of key data items were noted, to address objective 4. This led to the identification of several areas where reporting was not possible due to insufficient data quality. One of these areas focused on coding of unsuccessful induction of labour, where inconsistent coding between trusts and boards limited the useability of this data.

Results

Table 1a: Number of records excluded from the mode of birth analysis (cohort 2a), by country

	England	Scotland	Wales	Total
Overall births	527 933	45 973	27 001	600 907
Included births	470 288	42 712	20 286	533 286
Excluded	57 645	3 261	6 715	67 621
Percentage excluded	11%	7%	25%	11%
Number of women and birthing people undergoing IOL				
Cohort 2a	151 277	14 789	6 934	173 000
Cohort 3a	151 117	13 630	5 968	170 715

Table 1b: Number of records excluded from 5-minutes Apgar score analysis (cohort 2b), by country

	England	Scotland	Wales	Total
Overall births	527 933	45 973	27 001	600 907
Included births	438 787	42 075	20 256	501 118
Excluded	89 146	3 898	6 745	99 789
Percentage excluded	17%	8%	25%	17%
Number of women and birthing people undergoing IOL				
Cohort 2b	143 521	14 676	6 936	165 133
Cohort 3b	143 429	13 551	5 970	162 950

Table 2: Characteristics of women and birthing people

	England				Scotland				Wales				Great Britain			
	IOL cohort		Population		IOL cohort		Population		IOL cohort		Population		IOL cohort		Population	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total number	151 345		470 484		14 792		42 724		6 937		20 295		173 074		533 503	
Maternal age (years)																
<20	4 912	3.2	11 267	2.4	512	3.5	1 093	2.6	272	3.9	705	3.5	5 696	3.3	13 065	2.4
20–24	21 961	14.5	55 361	11.8	2 196	14.8	5 002	11.7	1 198	17.3	3 005	14.8	25 355	14.7	63 368	11.9
25–29	43 162	28.5	123 015	26.1	4 137	28.0	11 060	25.9	2 180	31.4	6 002	29.6	49 479	28.6	140 077	26.3
30–34	48 804	32.2	163 229	34.7	4 751	32.1	15 004	35.1	2 081	30.0	6 692	33.0	55 636	32.1	184 925	34.7
35–39	25 501	16.8	94 697	20.1	2 531	17.1	8 594	20.1	956	13.8	3 232	15.9	28 988	16.7	106 523	20.0
40–44	6 595	4.4	21 120	4.5	634	4.3	1 822	4.3	234	3.4	623	3.1	7 463	4.3	23 565	4.4
45+	410	0.3	1 795	0.4	31	0.2	116	0.3	13	0.2	30	0.1	454	0.3	1 941	0.4
Missing (% of total)	0		0		0		33	(0.1)	3	(<0.1)	6	(<0.1)	3	(<0.1)	39	(<0.1)
Gestation at birth (completed weeks)																
24–33	161	0.1	7 377	1.6	7	0.0	699	1.6	20	0.3	282	1.4	188	0.1	8 358	1.6
34–36	3 493	2.3	21 428	4.6	339	2.3	2 180	5.1	234	3.4	900	4.4	4 066	2.3	24 508	4.6
37	16 214	10.7	41 105	8.7	1 582	10.7	3 694	8.7	861	12.4	1 793	8.8	18 657	10.8	46 592	8.7
38	27 769	18.3	80 102	17.0	3 015	20.4	7 280	17.1	1 215	17.5	3 151	15.5	31 999	18.5	90 533	17.0
39	44 606	29.5	155 881	33.1	3 919	26.5	13 598	31.9	1 710	24.7	5 753	28.4	50 235	29.0	175 232	32.9
40	33 092	21.9	105 966	22.5	3 004	20.3	9 239	21.7	1 586	22.9	5 028	24.8	37 682	21.8	120 233	22.5
41+	25 996	17.2	58 471	12.4	2 920	19.7	5 938	13.9	1 305	18.8	3 372	16.6	30 221	17.5	67 781	12.7
Missing (% of total)	14	(<0.1)	154	(<0.1)	6	(<0.1)	96	(0.2)	6	(0.1)	16	(0.1)	26	(<0.1)	266	(<0.1)
Index of Multiple Deprivation																
Q1 (Least deprived)	22 475	14.9	75 432	16.1	2 064	14.0	7 133	16.8	818	12.0	2 763	13.8	25 357	14.7	85 328	16.1
Q2	25 829	17.2	82 507	17.6	2 711	18.4	8 554	20.1	1 167	17.1	3 497	17.5	29 707	17.3	94 558	17.8
Q3	28 356	18.8	88 309	18.9	2 725	18.5	7 624	17.9	1 484	21.7	4 460	22.3	32 565	18.9	100 393	18.9
Q4	33 561	22.3	102 670	21.9	3 179	21.6	8 741	20.5	1 609	23.6	4 466	22.3	38 349	22.3	115 877	21.8
Q5 (Most deprived)	40 353	26.8	118 976	25.4	4 057	27.5	10 504	24.7	1 746	25.6	4 808	24.0	46 156	26.8	134 288	25.3
Missing (% of total)	771	(0.5)	2 590	(0.6)	56	(0.4)	168	(0.4)	113	(1.6)	301	(1.5)	940	(0.5)	3 059	(0.6)
Ethnic group																
White	107 597	73.1	326 096	71.3	11 615	88.4	32 986	87.5	5 646	92.5	16 182	91.9	124 858	75.0	375 264	73.2
Black	8 904	6.0	29 416	6.4	353	2.7	1 106	2.9	73	1.2	211	1.2	9 330	5.6	30 733	6.0
Asian	21 186	14.4	69 447	15.2	684	5.2	2 061	5.5	162	2.7	485	2.8	22 032	13.2	71 993	14.0
Mixed	4 232	2.9	13 877	3.0	193	1.5	591	1.6	176	2.9	582	3.3	4 601	2.8	15 050	2.9
Other	5 312	3.6	18 379	4.0	289	2.2	943	2.5	46	0.8	141	0.8	5 647	3.4	19 463	3.8
Missing (% of total)	4 114	(2.7)	13 269	(2.8)	1 658	(11.2)	5 037	(11.8)	834	(12.0)	2 694	(13.3)	6 606	(3.8)	21 000	(3.9)

	England				Scotland				Wales				Great Britain			
	IOL cohort		Population		IOL cohort		Population		IOL cohort		Population		IOL cohort		Population	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Parity																
Primiparous	80 863	53.4	213 839	45.5	8 092	54.8	19 998	46.9	3 690	53.5	9 304	46.2	92 645	53.6	243 141	45.6
Multiparous no previous caesarean	62 563	41.4	176 062	37.5	6 143	41.6	15 557	36.5	2 851	41.3	7 828	38.9	71 557	41.4	199 447	37.4
Multiparous with previous caesarean	7 869	5.2	80 069	17.0	531	3.6	7 046	16.5	355	5.1	3 017	15.0	8 755	5.1	90 132	16.9
Missing (% of total)	50	(<0.1)	514	(0.1)	26	(0.2)	123	(0.3)	41	(0.6)	146	(0.7)	117	(0.1)	783	(0.1)

Please note: Proportions may not add up to 100% due to rounding.

Table 3: Mode of birth following IOL, stratified by maternal characteristics

	England				Scotland				Wales				Great Britain			
	Vaginal birth		Caesarean		Vaginal birth		Caesarean		Vaginal birth		Caesarean		Vaginal birth		Caesarean	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total number	106 494		44 783		10 228		4 561		4 910		2 024		121 632		51 368	
Maternal age (years)																
<20	3 853	3.6	1 058	2.4	376	3.7	135	3.0	218	4.4	54	2.7	4 447	3.7	1 247	2.4
20–24	15 977	15.0	5 976	13.3	1 605	15.7	591	13.0	905	18.4	292	14.4	18 487	15.2	6 859	13.4
25–29	29 957	28.1	13 181	29.4	2 875	28.1	1 261	27.6	1 504	30.6	676	33.4	34 336	28.2	15 118	29.4
30–34	34 048	32.0	14 732	32.9	3 193	31.2	1 557	34.1	1 457	29.7	624	30.8	38 698	31.8	16 913	32.9
35–39	17 878	16.8	7 617	17.0	1 752	17.1	779	17.1	659	13.4	295	14.6	20 289	16.7	8 691	16.9
40–44	4 528	4.3	2 062	4.6	413	4.0	221	4.8	159	3.2	75	3.7	5 100	4.2	2 358	4.6
45+	253	0.2	157	0.4	14	0.1	17	0.4	6	0.1	7	0.3	273	0.2	181	0.4
Missing (% of total)	0		0		0		0		2	(<0.1)	1	(<0.1)	2	(<0.1)	1	(<0.1)
Gestation at birth (completed weeks)																
24–33	110	0.1	50	0.1	5	0.0	113*	2.5*	161*	3.3*	16	0.8	119	0.1	68	0.1
34–36	2 469	2.3	1 022	2.3	228	2.2					77	3.8	2 854	2.3	1 210	2.4
37	12 243	11.5	3 961	8.8	1 181	11.6	400	8.8	664	13.5	197	9.7	14 088	11.6	4 558	8.9
38	20 430	19.2	7 331	16.4	2 212	21.6	803	17.6	906	18.5	309	15.3	23 548	19.4	8 443	16.4
39	32 531	30.6	12 057	26.9	2 808	27.5	1 111	24.4	1 255	25.6	453	22.4	36 594	30.1	13 621	26.5
40	22 537	21.2	10 537	23.5	2 013	19.7	990	21.7	1 070	21.8	516	25.5	25 620	21.1	12 043	23.4
41+	16 163	15.2	9 822	21.9	1 778	17.4	1 141	25.0	849	17.3	455	22.5	18 790	15.5	11 418	22.2
Missing (% of total)	11	(<0.1)	3	(<0.1)	3	(<0.1)	3	(0.1)	5	(0.1)	1	(<0.1)	19	(<0.1)	7	(<0.1)
Index of Multiple Derivation																
Q1 (Least deprived)	15 938	15.0	6 522	14.6	1 385	13.6	679	14.9	562	11.6	256	12.9	17 885	14.8	7 457	14.6
Q2	18 248	17.2	7 569	17.0	1 783	17.5	928	20.4	827	17.1	340	17.1	20 858	17.2	8 837	17.3
Q3	19 769	18.7	8 578	19.3	1 866	18.3	859	18.9	1 023	21.2	460	23.1	22 658	18.7	9 897	19.4
Q4	23 227	21.9	10 323	23.2	2 217	21.8	962	21.2	1 120	23.2	488	24.5	26 564	22.0	11 773	23.1
Q5 (Most deprived)	28 800	27.2	11 532	25.9	2 938	28.8	1 116	24.6	1 297	26.9	448	22.5	33 035	27.3	13 096	25.6
Missing (% of total)	512	(0.5)	259	(0.6)	39	(0.4)	17	(0.4)	81	(1.6)	32	(1.6)	632	(0.5)	308	(0.6)
Ethnic group																
White	78 501	75.7	29 040	66.9	8 192	89.7	3 420	85.6	4 056	93.2	1 588	90.7	90 749	77.4	34 048	69.3
Black	5 287	5.1	3 615	8.3	165	1.8	188	4.7	42	1.0	31	1.8	5 494	4.7	3 834	7.8
Asian	13 426	12.9	7 755	17.9	462	5.1	222	5.6	101	2.3	61	3.5	13 989	11.9	8 038	16.4
Mixed	2 904	2.8	1 327	3.1	141	1.5	52	1.3	119	2.7	56	3.2	3 164	2.7	1 435	2.9
Other	3 647	3.5	1 662	3.8	175	1.9	114	2.9	32	0.7	14	0.8	3 854	3.3	1 790	3.6
Missing (% of total)	2 729	(2.6)	1 384	(3.1)	1 093	(10.7)	565	(12.4)	560	(11.4)	274	(13.5)	4 382	(3.6)	2 223	(4.3)

	England				Scotland				Wales				Great Britain			
	Vaginal birth		Caesarean		Vaginal birth		Caesarean		Vaginal birth		Caesarean		Vaginal birth		Caesarean	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Parity																
Primiparous	47 582	44.7	33 236	74.2	4 530	44.3	3 559	78.3	2 252	46.1	1 436	71.5	54 364	44.7	38 231	74.5
Multiparous no previous caesarean	55 176	51.8	7 370	16.5	5 429	53.1	714	15.7	2 463	50.4	387	19.3	63 068	51.9	8 471	16.5
Multiparous with previous caesarean	3 701	3.5	4 167	9.3	258	2.5	273	6.0	169	3.5	186	9.3	4 128	3.4	4 626	9.0
Missing (% of total)	35	(<0.1)	10	(<0.1)	11	(0.1)	15	(0.3)	26	(0.5)	15	(0.7)	72	(0.1)	40	(0.1)

Please note: Proportions may not add up to 100% due to rounding.

* Counts and percentages for adjacent cells have been combined to retain anonymity due to small numbers.

Table 4: Apgar score at 5-minutes following IOL, stratified by maternal characteristics

	England				Scotland				Wales				Great Britain			
	Apgar <7		Apgar ≥7		Apgar <7		Apgar ≥7		Apgar <7		Apgar ≥7		Apgar <7		Apgar ≥7	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total number	2 126		141 395		371		14 305		132		6 804		2 629		162 504	
Maternal age (years)																
<20	70	3.3	4 614	3.3	16	4.3	492	3.4	5	3.8	267	3.9	91	3.5	5 373	3.3
20–24	324	15.2	20 566	14.5	68	18.3	2 110	14.8	23	17.4	1 174	17.3	415	15.8	23 850	14.7
25–29	605	28.5	40 357	28.5	115	31.0	3 988	27.9	37	28.0	2 143	31.5	757	28.8	46 488	28.6
30–34	668	31.4	45 588	32.2	91	24.5	4 635	32.4	40	30.3	2 041	30.0	799	30.4	52 264	32.2
35–39	350	16.5	23 762	16.8	62	16.7	2 444	17.1	21	15.9	935	13.7	433	16.5	27 141	16.7
40–44	101	4.8	6 135	4.3	19	5.1	605	4.2	6	4.5	228	3.4	126	4.8	6 968	4.3
45+	8	0.4	373	0.3	0	0.0	31	0.2	0	0.0	13	0.2	8	0.3	417	0.3
Missing (% of total)	0		0		0		0		0		3	(<0.1)	0		3	(<0.1)
Gestation at birth (completed weeks)																
24–33	14	0.7	78	0.1	19*	5.1*	323*	2.3*	13*	9.9*	19	0.3	17	0.6	101	0.1
34–36	97	4.6	3 095	2.2							222	3.3	126	4.8	3 636	2.2
37	274	12.9	15 126	10.7	56	15.1	1 516	10.6	23	17.4	838	12.3	353	13.4	17 480	10.8
38	363	17.1	26 068	18.4	101	27.2	2 897	20.3	24	18.2	1 191	17.5	488	18.6	30 156	18.6
39	618	29.1	41 767	29.5	68	18.3	3 815	26.7	28	21.2	1 682	24.7	714	27.2	47 264	29.1
40	436	20.5	30 987	21.9	73	19.7	2 909	20.3	22	16.7	1 563	23.0	531	20.2	35 459	21.8
41+	324	15.2	24 262	17.2	54	14.6	2 840	19.9	22	16.7	1 283	18.9	400	15.2	28 385	17.5
Missing (% of total)	0		12	(<0.1)	0		5	(<0.1)	0		6	(0.1)	0		23	(<0.1)
Index of Multiple Deprivation																
Q1 (Least deprived)	289	13.7	21 164	15.0	36	9.7	2 017	14.2	12	9.2	806	12.0	337	12.9	23 987	14.8
Q2	357	16.9	24 161	17.2	65	17.5	2 626	18.4	22	16.9	1 145	17.1	444	17.0	27 932	17.3
Q3	383	18.1	26 531	18.9	75	20.2	2 625	18.4	28	21.5	1 456	21.8	486	18.6	30 612	18.9
Q4	467	22.1	31 025	22.1	102	27.5	3 055	21.4	32	24.6	1 577	23.6	601	23.0	35 657	22.1
Q5 (Most deprived)	621	29.3	37 816	26.9	93	25.1	3 928	27.6	36	27.7	1 709	25.5	750	28.6	43 453	26.9
Missing (% of total)	9	(0.4)	698	(0.5)	0		54	(0.4)	2	(1.5)	111	(1.6)	11	(0.4)	863	(0.5)
Ethnic group																
White	1 558	75.3	101 131	73.5	282	86.0	11 242	88.5	113	95.8	5 532	92.4	1 953	77.7	117 905	75.4
Black	177	8.6	8 064	5.9	15	4.6	335	2.6			71	1.2	194	7.7	8 470	5.4
Asian	230	11.1	19 583	14.2	12	3.7	668	5.3	5*	4.2*	162	2.7	242	9.6	20 413	13.1
Mixed	48	2.3	3 937	2.9	7	2.1	184	1.4			173	2.9	58	2.3	4 294	2.7
Other	55	2.7	4 907	3.6	12	3.7	276	2.2			46	0.8	67	2.7	5 229	3.3
Missing (% of total)	58	(2.7)	3 773	(2.7)	43	(11.6)	1 600	(11.2)	14	(10.6)	820	(12.1)	115	(4.4)	6 193	(3.8)

	England				Scotland				Wales				Great Britain			
	Apgar <7		Apgar ≥7		Apgar <7		Apgar ≥7		Apgar <7		Apgar ≥7		Apgar <7		Apgar ≥7	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Parity																
Primiparous	1 282	60.4	75 237	53.2	220	59.3	7 803	54.6	76	58.5	3 614	53.4	1 578	60.1	86 654	53.4
Multiparous no previous caesarean	714	33.6	58 803	41.6	133	35.8	5 967	41.8	41	31.5	2 809	41.5	888	33.8	67 579	41.6
Multiparous with previous caesarean	128	6.0	7 309	5.2	18	4.9	509	3.6	13	10.0	342	5.1	159	6.1	8 160	5.0
Missing (% of total)	2	(0.1)	46	(<0.1)	0		26	(0.2)	2	(1.5)	39	(0.6)	4	(0.2)	111	(0.1)

Please note: Proportions may not add up to 100% due to rounding.

*Counts and percentages for adjacent cells have been combined to retain anonymity due to small numbers.

Table 5: Estimated likelihood of a caesarean birth following IOL by maternal characteristics

Characteristic	Estimated likelihood of caesarean birth following IOL % (95% Confidence interval)	*p* value
Country		**0.24**
England	29.4 (28.5–30.3)	
Scotland	32.3 (29.0–35.6)	
Wales	30.1 (25.4–34.9)	
Gestational age (completed weeks)		**<0.001**
34–36	33.1 (31.4–34.7)	
37	27.7 (26.7–28.8)	
38	28.3 (27.4–29.2)	
39	27.9 (27.0–28.8)	
40	29.9 (28.9–30.8)	
41+	33.9 (32.8–34.9)	
Maternal age (years)		**<0.001**
<20	16.9 (15.9–17.9)	
20–24	24.0 (23.2–24.9)	
25–29	28.8 (27.9–29.7)	
30–34	31.3 (30.4–32.2)	
35–39	34.6 (33.5–35.6)	
40–44	39.5 (38.1–40.9)	
45+	48.4 (44.0–52.9)	
Index of Multiple Deprivation		**<0.001**
Q1 (Least deprived)	28.1 (27.1–29.1)	
Q2	28.8 (27.9–29.8)	
Q3	29.8 (28.8–30.7)	
Q4	30.3 (29.3–31.2)	
Q5 (Most deprived)	30.4 (29.4–31.3)	
Ethnic group		**<0.001**
White	28.1 (27.2–28.9)	
Black	39.4 (38.1–40.7)	
Asian	33.6 (32.5–34.7)	
Mixed	30.8 (29.3–32.3)	
Other	29.8 (28.4–31.2)	
Parity		**<0.001**
Primiparous	42.5 (41.4–43.7)	
Multiparous, no previous caesarean	11.4 (10.9–11.9)	
Multiparous, previous caesarean	49.6 (48.1–51.2)	

Table 6: Estimated likelihood of an Apgar score less than 7 at 5 minutes following IOL by maternal characteristics

Characteristic	Estimated likelihood of an Apgar score less than 7 at 5 minutes following IOL % (95% Confidence interval)	*p* value
Country		**<0.001**
England	1.48 (1.36–1.61)	
Scotland	2.81 (2.07–3.56)	
Wales	1.70 (1.00–2.41)	
Gestational age (completed weeks)		**<0.001**
34–36	3.56 (2.89–4.24)	
37	2.14 (1.87–2.41)	
38	1.62 (1.44–1.81)	
39	1.52 (1.36–1.67)	
40	1.45 (1.29–1.61)	
41+	1.32 (1.16–1.48)	
Maternal age (years)		**0.064**
<20	1.36 (1.05–1.66)	
20–24	1.55 (1.36–1.74)	
25–29	1.55 (1.39–1.70)	
30–34	1.57 (1.42–1.73)	
35–39	1.72 (1.52–1.93)	
40–44	2.04 (1.65–2.42)	
45+	1.63 (0.33–2.92)	
Index of Multiple Deprivation		**0.016**
Q1 (Least deprived)	1.38 (1.19–1.56)	
Q2	1.53 (1.35–1.72)	
Q3	1.54 (1.37–1.72)	
Q4	1.69 (1.51–1.87)	
Q5 (Most deprived)	1.71 (1.54–1.89)	
Ethnic group		**<0.001**
White	1.61 (1.48–1.74)	
Black	2.47 (2.07–2.87)	
Asian	1.27 (1.08–1.46)	
Mixed	1.38 (1.00–1.75)	
Other	1.37 (1.02–1.72)	
Parity		**<0.001**
Primiparous	1.89 (1.72–2.05)	
Multiparous, no previous caesarean	1.22 (1.10–1.34)	
Multiparous, previous caesarean	1.91 (1.58–2.24)	

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Appendix

Supplementary Table S1: ICD-10 codes used to ascertain timing of stillbirth for records where timing was unknown

ICD-10 code	Definition
Stillbirth of unknown timing recoded as antepartum stillbirth	
O60.3	Preterm delivery without spontaneous labour
Z35.1	Supervision of pregnancy with history of abortive outcome
O35.1	Maternal care for (suspected) chromosomal abnormality in fetus, not applicable or unspecified
Z35.4	Supervision of pregnancy with grand multiparity
O41.8	Other specified disorders of amniotic fluid and membranes,
O32.2	Maternal care for transverse and oblique lie, not applicable or unspecified
O14.2	HELLP syndrome (HELLP), unspecified trimester
O44.1	Complete placenta previa with haemorrhage, unspecified trimester
O69.4	Labour and delivery complicated by vasa previa, not applicable or unspecified
O82.0	Delivery by elective caesarean section
O02.1	Missed abortion
O04.6	Delayed or excessive haemorrhage following (induced) termination of pregnancy
Stillbirth of unknown timing recoded as intrapartum stillbirth	
O68.0	Labour and delivery complicated by fetal heart rate anomaly
O45.9	Premature separation of placenta, unspecified, unspecified trimester
O35.8	Maternal care for other (suspected) fetal abnormality and damage, not applicable or unspecified
O68.2	Labour and delivery complicated by fetal heart rate anomaly with meconium in amniotic fluid
O75.8	Maternal exhaustion complicating labour and delivery
O42.1	Premature rupture of membranes, onset of labour more than 24 hours following rupture
O42.0	Premature rupture of membranes, onset of labour within 24 hours of rupture
O68.8	Labour and delivery complicated by other evidence of fetal stress
O69.0	Labour and delivery complicated by prolapse of cord, not applicable or unspecified
O60.1	Preterm labour with preterm delivery, unspecified trimester, not applicable or unspecified
O32.6	Maternal care for compound presentation, not applicable or unspecified
O32.3	Maternal care for face, brow and chin presentation, not applicable or unspecified
O62.4	Hypertonic, incoordinate, and prolonged uterine contractions
E87.2	Acidosis
O62.8	Other abnormalities of forces of labour
O68.3	Labour and delivery complicated by biochemical evidence of fetal stress
O64.1	Obstructed labour due to breech presentation, not applicable or unspecified

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