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CLINICAL ARTICLE

Obstetrics

Twin birth rates and obstetric interventions in Iceland: A nationwide study from 1997 to 2018.

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Abstract

Objective: Twin pregnancies are associated with increased antepartum and intrapartum risks. Limited multiple embryo transfers are associated with decreased twin birth rates. We aimed to study the effect of 2009 Icelandic regulations on twin birth rates and examine obstetric intervention rates for twin births during the study period.

Methods: The study included all births ($N = 94\,028$) in Iceland during 1997–2018. Twin birth rates and obstetric intervention rates were compared over birth year periods using modified Poisson regression adjusted for confounders.

Results: An observed decrease in the twin birth rate trend was most notable from 2006 until 2009. Twin birth decreased in 2009–2013 (prevalence ratio [PR] 0.74, 95% confidence interval [CI] 0.64–0.86) and in 2014–2018 (PR 0.74, 95% CI 0.64–0.86) compared with 1997–2002. This decrease was only evident for women aged 30+ years in stratified analysis. Induction of labor rates increased from 26% in 1997–2002 to 44% in 2014–2018 (adjusted rate ratio [ARR] 2.10, 95% CI 1.72–2.57) whereas elective cesarean section (ARR 0.80, 95% CI 0.59–1.07) and urgent cesarean section (ARR 0.79, 95% CI 0.63–1.00) rates appeared to decline.

Conclusion: Twin births decreased during the study period. International guidelines published before the Icelandic regulations may have affected twin birth rates in Iceland. Induction of labor rates for twins increased while cesarean section rates decreased.

KEYWORDS
assisted reproduction, delivery, induction of labor, cesarean, twin pregnancy

1 | INTRODUCTION

Twin birth rates have been increasing globally since the 1980s, especially among wealthier nations within Europe, North America, and Asia.[1] Delayed childbearing, higher birth orders, and advancements to medically assisted reproduction are widely accepted as reasons for the increasing rates.[1] Twin births are more likely to have complications during birth, to be born prematurely[1–3] and to be born by cesarean section (CS).[3,4] Additionally, twin births pose a significantly higher risk for maternal complications, including preeclampsia[5] and postpartum hemorrhage.[1–3,6]

In response to rising twin birth rates and the increased antepartum and intrapartum risks associated with twin pregnancies, many countries introduced changes to guidelines that shifted the approach

toward lower-risk singleton births.[1] In 2009, regulations were passed in Iceland that prohibited multiple embryo transfers during in vitro fertilization (IVF) treatments for women under 36 years of age and limited multiple embryo transfers for women aged 36 or over.[7] An analysis of twin birth rates in Iceland and an estimate of the effect of the regulatory change on twin birth rates in Iceland is yet to be conducted.

Twin births are associated with increased risk for obstetric intervention.[8] Induction of labor (IOL) is often indicated in twin pregnancies and an overall increase in rates of elective CS for twins has been seen worldwide.[2] It is unknown whether Iceland follows these same trends for twins. In Iceland, overall CS rates over the past two decades have remained relatively low and stable while induction of labor rates have significantly increased[9,10] and preterm birth rates for twin births have been increasing.[11] To date, studies that examine the overall obstetric intervention rates for twin births in Iceland are missing in the literature.

Our study aimed to examine twin birth rates in Iceland during 1997–2018, overall and according to maternal age, with special interest in capturing changes to trends occurring since embryo transfer regulations were passed in Iceland in 2009 that are specific to maternal age. We also aimed to examine obstetric interventions for twin births in Iceland during the same period.

2 | MATERIALS AND METHODS

This population-based, retrospective cohort study was based on data collected from the Icelandic Medical Birth Register. This nationwide, centralized registry contains complete coverage of all births in Iceland as well as maternal sociodemographic characteristics. The database includes live births and stillbirths for infants weighing >500 g or of gestational age > 22 weeks.

Twin birth rates were calculated including all births, both live and stillborn ($n = 94\,028$), during the study period. Twin and triplet births were counted as sets, twin births ($n = 1605$) and triplet births ($n = 38$). There were no higher-order births identified during the study period. Stillbirths ($n = 328$) were not excluded to avoid further limiting the sample size, of which 41 were from a twin pregnancy.

Twin birth rates were calculated as the number of twin births per 1000 births for each birth year from 1997 to 2018 and the overall trend in twin birth rates during the study period was assessed. We then examined the incidence proportion of twin births by each maternal age group for each birth year period. To explore the association between twin births and birth year period, we used modified Poisson regression to estimate prevalence ratios and 95% confidence interval (CI) for twin births, adjusted for demographic variables. This was done overall and for each maternal age group.

Birth year periods were categorized into four groups (1997–2002, 2003–2008, 2009–2013, 2014–2018) to account for year-to-year variation within a smaller population, with 1997–2002 as reference. Maternal age was categorized into three groups (<30, 30–35, 36+ years) with consideration of the age-based regulations. Obstetric interventions were categorized into four groups – IOL, instrumental birth (IB), elective CS and urgent CS – and were extracted from the database using *International Classification of Diseases and Health Related Problems* 10th revision (ICD-10) codes and NOMESCO Classification of Surgical Procedures (NCSP) codes. Obstetric intervention rates were calculated as the number of events per 100 twin births, with singleton and triplet data excluded. To account for differing mode of delivery in twin births and for consistency in evaluating twin births as a set, IB and urgent CS were counted as one event if at least one twin was delivered using the intervention. Parity was further stratified into subgroups for this analysis to include whether the woman had a previous history of at least one CS (primipara, multipara without previous CS, multipara with previous CS). To compare obstetric intervention rates between birth year periods, rate ratios with 95% CIs for each of the four categories of obstetric intervention were examined using modified Poisson regression models adjusted for confounders.

Categorical data were compared using Pearson's χ^2 test. ANOVA was applied to coefficients in regression models. Statistical significance was defined as *P*-value less than 0.05. Statistical analysis was performed using RStudio version 1.4.1717 in Iceland. Informed consent was not required for this study as we used existing, available registry data that are not traceable to individuals, individuals cannot be identified, and no interventions were applied. The study was approved by the National Bioethics Committee in Iceland on February 26, 2019 (approval number VSNb2019020007/03.01).

3 | RESULTS

Demographic characteristics of twin births are shown in Table 1. Twin births decreased during the study period, with the largest decrease in trend observed between the years 2006 and 2009, after which the rate leveled off. Figure 1 shows the twin birth rates per 1000 births and indicates a downward trend after 2006.

Women aged 36+ had the highest incidence proportion of twin births for every birth year period (Figure 2). The incidence proportion for age group 36+ decreased throughout each birth year period during the study and age group 30–35 followed a similar trend. Twin birth rates in the <30 age group remained stable throughout the study period and were consistently the lowest throughout all birth year periods (Figure 2).

Overall, twin births decreased in 2009–2013 (prevalence ratio [PR] 0.74, 95% CI 0.64–0.86) and in 2014–2018 (PR 0.74, 95% CI 0.64–0.86) compared with 1997–2002 (Table 2). When the results were stratified according to maternal age group, the decrease was only evident for women aged 30+ years (Table 2).

We examined the rates of obstetric interventions for twin births in Iceland during the study period (Table 3; Figure 3). The overall rate ratio for IOL increased for every birth year period when compared with 1997–2002, and most notably in birth year period

TABLE 1 Characteristics of twin births in Iceland during 1997–2018 ($N = 1605$), according to birth year period.

Birth year period	1997–2002 ($n = 476$)	2003–2008 ($n = 470$)	2009–2013 ($n = 343$)	2014–2018 ($n = 316$)	Overall ($N = 1605$)	*P*-value[a]
Maternal age (years)						
<30	140 (29.4%)	153 (32.6%)	120 (35.0%)	95 (30.1%)	508 (31.7%)	0.573
30–35	209 (43.9%)	207 (44.0%)	135 (39.4%)	138 (43.7%)	689 (42.9%)	
36+	127 (26.7%)	110 (23.4%)	88 (25.7%)	83 (26.3%)	408 (25.4%)	
Parity						
Primiparous women	177 (37.2%)	203 (43.2%)	138 (40.2%)	129 (40.8%)	647 (40.3%)	0.679
Multiparous women without previous CS	253 (53.2%)	227 (48.3%)	175 (51.0%)	162 (51.3%)	817 (50.9%)	
Multiparous women with previous CS	46 (9.7%)	40 (8.5%)	30 (8.7%)	25 (7.9%)	141 (8.8%)	
Nationality						
Icelandic	458 (96.2%)	433 (92.1%)	319 (93.0%)	276 (87.3%)	1486 (92.6%)	<0.001
Non-Icelandic	18 (3.8%)	37 (7.9%)	24 (7.0%)	40 (12.7%)	119 (7.4%)	
Residential area						
Capital area	273 (57.4%)	280 (59.6%)	230 (67.1%)	217 (68.7%)	1000 (62.3%)	<0.001
Outside of capital area	180 (37.8%)	180 (38.3%)	111 (32.4%)	98 (31.0%)	569 (35.5%)	
Missing	23 (4.8%)	10 (2.1%)	2 (0.6%)	1 (0.3%)	36 (2.2%)	
Marital status						
Married/cohabiting	438 (92.0%)	426 (90.6%)	290 (84.5%)	259 (82.0%)	1413 (88.0%)	<0.001
Single/divorced/widowed	31 (6.5%)	40 (8.5%)	45 (13.1%)	39 (12.3%)	155 (9.7%)	
Missing	7 (1.5%)	4 (0.9%)	8 (2.3%)	18 (5.7%)	37 (2.3%)	
Employment status						
Employed	368 (77.3%)	373 (79.4%)	257 (74.9%)	255 (80.7%)	1253 (78.1%)	<0.001
Homemaker	60 (12.6%)	28 (6.0%)	15 (4.4%)	7 (2.2%)	110 (6.9%)	
Pension/disability/other	17 (3.6%)	15 (3.2%)	7 (2.0%)	5 (1.6%)	44 (2.7%)	
Student	31 (6.5%)	51 (10.9%)	50 (14.6%)	34 (10.8%)	166 (10.3%)	
No income	0 (0%)	1 (0.2%)	9 (2.6%)	9 (2.8%)	19 (1.2%)	
Missing	0 (0%)	2 (0.4%)	5 (1.5%)	6 (1.9%)	13 (0.8%)	
Gestational age at delivery (completed weeks)						
<37	187 (39.3%)	217 (46.2%)	171 (49.9%)	175 (55.4%)	750 (46.7%)	<0.001
37–38	194 (40.8%)	196 (41.7%)	145 (42.3%)	137 (43.4%)	672 (41.9%)	
39+	94 (19.7%)	57 (12.1%)	27 (7.9%)	4 (1.3%)	182 (11.3%)	
Missing	1 (0.2%)	0 (0%)	0 (0%)	0 (0%)	1 (0.1%)	
Onset of labor						
Cesarean	128 (26.9%)	116 (24.7%)	75 (21.9%)	74 (23.4%)	393 (24.5%)	<0.001
Induction of labor	124 (26.1%)	157 (33.4%)	133 (38.8%)	140 (44.3%)	554 (34.5%)	
Spontaneous	224 (47.1%)	197 (41.9%)	135 (39.4%)	102 (32.3%)	658 (41.0%)	
Birth location						
National University Hospital – Landspitali	406 (85.3%)	411 (87.4%)	305 (88.9%)	292 (92.4%)	1414 (88.1%)	0.023
Other	70 (14.7%)	59 (12.6%)	38 (11.1%)	24 (7.6%)	191 (11.9%)	

Abbreviations: CS, cesarean section.

[a]Pearson's χ^2 test.

2014–2018 (adjusted rate ratio [ARR] 2.10, 95% CI 1.72–2.57) (Table 3). Proportionate IOL rates increased overall from 26.1% in 1997–2002 to 44.3% in 2014–2018 (Figure 3).

Overall IB rates remained low, but they increased from 8.6% in birth year period 1997–2002 to 13.6% in birth year period 2014–2018 (Figure 3). The rate ratios for IB increased for every

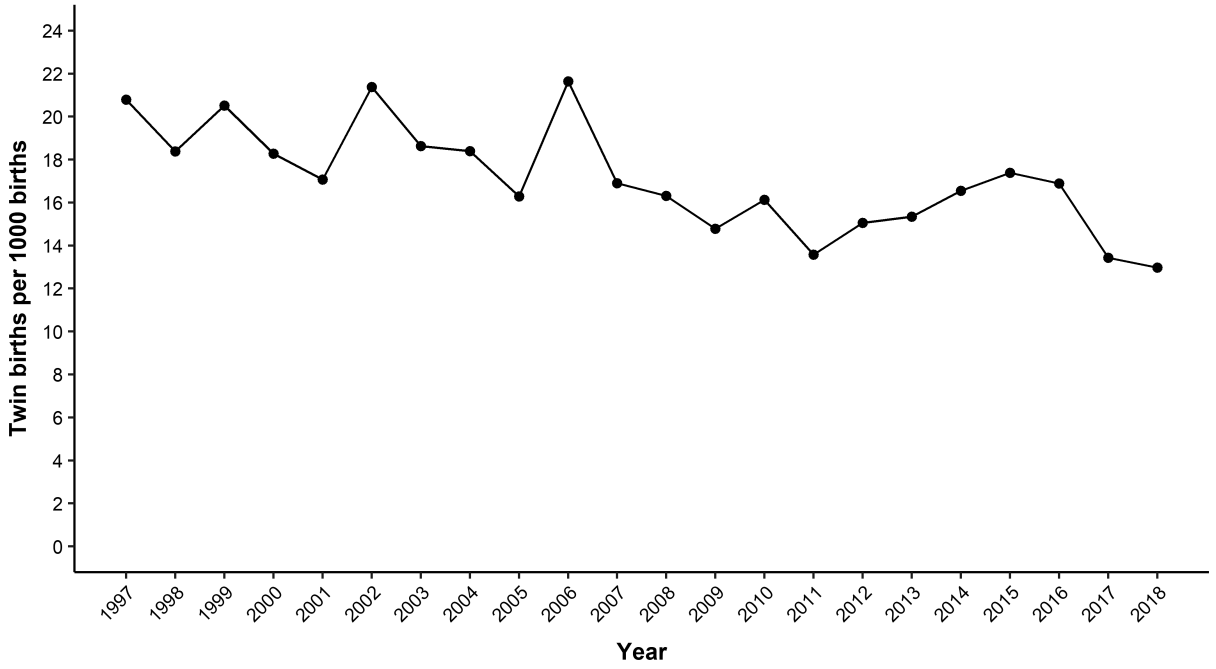

FIGURE 1 Twin birth rates in Iceland during 1997–2018.

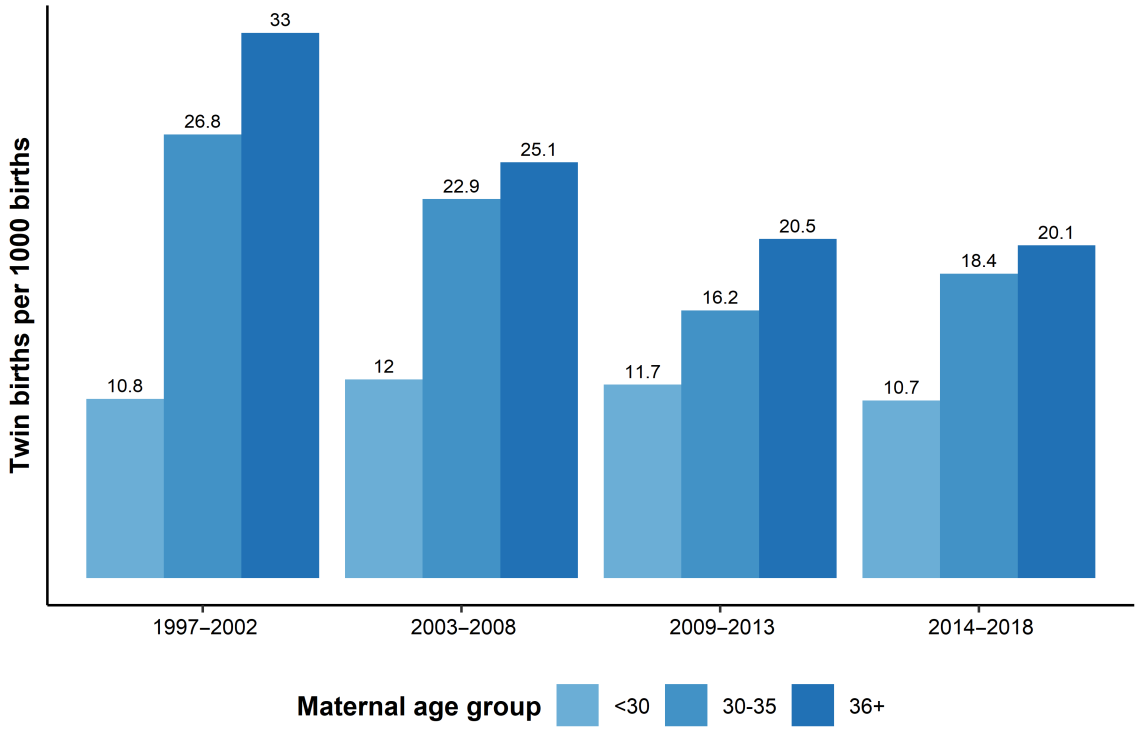

FIGURE 2 Incidence proportions of twin births in Iceland during 1997–2018 by maternal age group, according to birth year period.

birth year period when compared with 1997–2002 and was significant in 2014–2018 (ARR 1.50, 95% CI 1.01–2.23) (Table 3). This significant increase seems to apply only to the primiparous subgroup according to the subgroup analysis (Figure 3). The use of forceps in twin deliveries in Iceland was very low throughout the study period (<2%) and more frequently used in the delivery of twin B (Table S1). Vacuum delivery varied in predominance between twin A and B, and rates ranged from 3.8% to 8.2% (Table S1).

Overall elective CS and urgent CS rates declined throughout the study period, 22.3% to 16.8% and 29% to 24.4%, respectively, when compared with 1997–2002 (Figure 3). The rate ratios for elective CS decreased in all birth year periods when compared with 1997–2002, although the decrease in 2014–2018 (ARR 0.80,

TABLE 2 Prevalence ratios and 95% confidence intervals (CIs) for twin birth in Iceland during 1997–2018 ($N = 94028$), overall and by maternal age group, according to birth year period.

	2003–2008				2009–2013				2014–2018			
	PR	95% CI	PR[a]	95% CI	PR	95% CI	PR[a]	95% CI	PR	95% CI	PR[a]	95% CI
Overall	0.93	0.82–1.05	0.91	0.80–1.04	**0.77**	**0.67–0.89**	**0.74**	**0.64–0.86**	**0.80**	**0.69–0.92**	**0.74**	**0.64–0.86**
<30 years	1.11	0.88–1.39	1.14	0.90–1.43	1.08	0.85–1.38	1.11	0.86–1.44	0.99	0.76–1.28	0.99	0.76–1.30
30–35 years	0.85	0.71–1.03	0.86	0.71–1.04	**0.60**	**0.49–0.75**	**0.62**	**0.50–0.78**	**0.69**	**0.55–0.85**	**0.69**	**0.55–0.86**
36+ years	**0.76**	**0.59–0.98**	**0.74**	**0.57–0.95**	**0.62**	**0.48–0.81**	**0.59**	**0.45–0.77**	**0.61**	**0.46–0.80**	**0.57**	**0.43–0.75**

Note: Birth year period 1997–2002 as reference; statistically significant values are bold.

Abbreviation: PR, prevalence ratio.

[a]Adjusted for parity, marital status, employment status, residential area, and nationality; in addition, overall was adjusted for maternal age group.

TABLE 3 Rate ratios and 95% confidence intervals (CIs) for obstetric interventions in twin births during 1997–2018 ($N = 1605$), overall, according to birth year period.

	2003–2008				2009–2013				2014–2018			
	RR	95% CI	ARR[a]	95% CI	RR	95% CI	ARR[a]	95% CI	RR	95% CI	ARR[a]	95% CI
Induction of labor	**1.28**	**1.05–1.56**	**1.42**	**1.17–1.71**	**1.49**	**1.22–1.82**	**1.77**	**1.45–2.16**	**1.70**	**1.40–2.07**	**2.10**	**1.72–2.57**
Instrumental birth[b]	1.41	0.96–2.06	1.34	0.92–1.96	1.08	0.70–1.68	1.07	0.69–1.66	**1.58**	**1.06–2.37**	**1.50**	**1.01–2.23**
Elective CS	**0.72**	**0.55–0.94**	**0.74**	**0.58–0.96**	**0.68**	**0.50–0.92**	**0.70**	**0.52–0.93**	0.75	0.56–1.01	0.80	0.59–1.07
Urgent CS[c]	1.03	0.84–1.25	0.99	0.81–1.20	0.93	0.74–1.16	0.89	0.71–1.10	0.84	0.66–1.07	0.79	0.63–1.00

Note: Birth year period 1997–2002 as reference; significant values are bold.

Abbreviations: ARR, adjusted rate ratio; CS, cesarean section; RR, rate ratio.

[a]Adjusted for gestational age at delivery, maternal age group, parity subgroup, and birth location.

[b]Forceps and/or vacuum, used in at least one delivery in twin birth.

[c]Urgent cesarean delivery of at least one twin in twin birth.

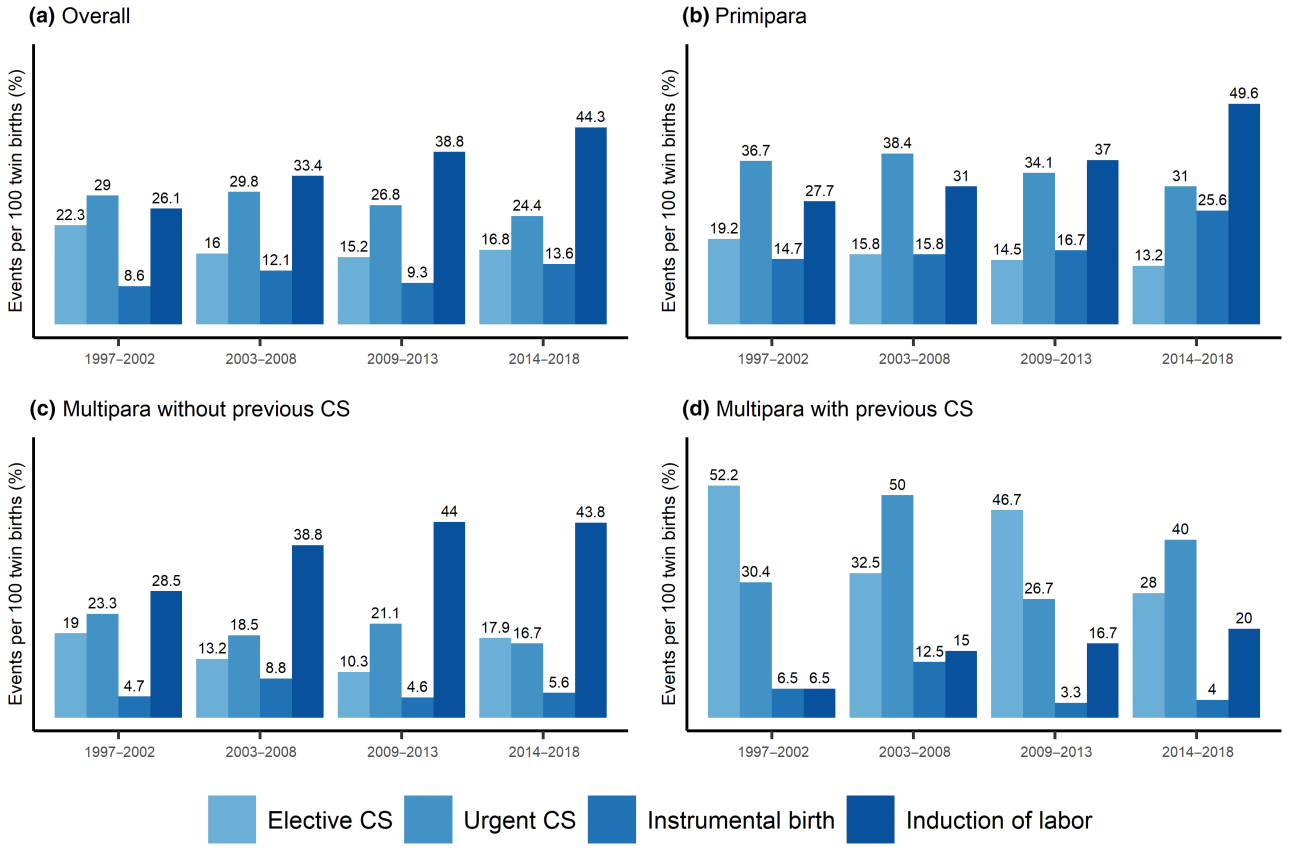

FIGURE 3 Obstetric intervention rates in twin births in Iceland during 1997–2018 overall and by parity subgroup, according to birth year period. CS, cesarean section.

95% 0.59–1.07) was not significant. Rate ratios for urgent CS decreased in all birth year periods and were not significant when compared with 1997–2002.

When we stratified obstetric intervention rates according to parity subgroups (Figure 3), the multipara with previous CS subgroup had lower rates of IOL and higher rates of elective and urgent CS that varied in predominance over the birth year periods. A lower combined rate of CS was noted in 2014–2018 when IOL rates are at their highest for this subgroup. Rate ratios were limited for this subgroup analysis by lower numbers of observations within the sample (Table S2).

4 | DISCUSSION

In this study we found that twin birth rates decreased, with the largest decrease in trend observed between the years 2006 and 2009, after which the rate leveled off. Twin births also decreased in all birth year periods compared with 1997–2002, with this decrease only being evident for women aged 30+ years. Obstetric intervention rates for elective CS and urgent CS declined, while IOL rates increased considerably during the same period.

Delayed childbearing is a well-known risk factor for spontaneous dizygotic twin pregnancies.[12] The risk of dizygotic twins increases with maternal age up to the age of 39, after which the risk begins to decrease.[13] The average age of primipara women in Organization for Economic Co-operation and Development (OECD) countries has increased by about 1 year for every decade since the 1970s.[14] On average, women in Iceland have shown the largest change in years of postponement of first childbirth among OECD countries, with the average maternal age at first childbirth increasing by over 5 years from 1970 to 2008, to 26.5 years, while the least amount of change was seen in the USA where the average age increased by only 1.5 years during the same period.[14]

Previous studies of twin birth rates have found considerable increases in twin birth rates in many European countries, North America, and East Asia when compared with the 1980s.[1] Although these countries had significant increases in twin birth rates, the rates leveled off in the early 2000s after strategies were implemented to limit multiple embryo transfer and shift the focus toward successful singleton live birth.[1] A previous study examining trends in twin birth rates in developed countries found that several countries, including Iceland, experienced a peak and subsequent decline in twin birth rates.[15] Iceland was found to have peaked between 1997 and 2006.[15]

A study published in 2016 examining variations in twin birth rates and the impact on perinatal outcomes in Europe found that Iceland was in the group with the lowest multiple birth rates with

less than 15 per 1000 in 2010.[16] This study concluded that Europe showed wide variation in twin birth rates and trends with no obvious pattern between geographical areas during the study period.[16] While changes in twin birth rates for Iceland were not calculated in this study's comparison of 2004–2010, results indicated decreased rates for Denmark, the Netherlands, and Norway but increased rates for all other participating countries, with the largest increase seen in the Brussels region of Belgium, Luxembourg, and Malta.[16]

The Icelandic regulations for embryo transfer were passed in 2009, but our study found that twin birth rates began to decrease before this time. It appears likely that Iceland began changes to clinical practice as a reflection of other international policies and regulations which had been published earlier. In 2004, the original fertility guideline by the National Institute for Health and Care Excellence (NICE) was first published in the UK,[17] suggesting limits to the number of embryos transferred, and in 2006 the UK Human Fertilization and Embryo Authority (HFEA) declared full-term singleton births with normal birth weight as the definition of success for assisted reproduction technologies.[18] In Iceland, IVF treatments have not been subject to mandatory reporting within the birth register. However, according to a report from the University Hospital in Reykjavík, using data obtained from the private fertility treatment company in Iceland, twins conceived by IVF have been declining in recent years, from 17 sets of twins in 2011 to six sets of twins in 2018.[19]

Spontaneous labor is more likely to start earlier in multiple pregnancies than in singleton pregnancies.[13] Birth guidelines pertaining to twin births are more complex compared with singletons, can vary greatly between different medical societies, and are largely based on chorionicity, amnionicity, and other factors including presentation, fetal weight, and various complications.[3,20] Throughout the world, the average gestational age at delivery for twins is 36 weeks, compared with 39 weeks for singletons.[13] Our study indicates that the average gestational age at delivery for twins in Iceland was similar to the global average.

Obstetric intervention rates have been increasing in middle- and high-income countries over the past 30 years with wide variation between countries.[9] Twin births are at an increased risk for obstetric intervention.[8] There is little debate that the optimal mode of birth for triplets continues to be elective CS as the probability of successful vaginal birth in this group is very low;[21] there is, however, conflicting evidence regarding optimal mode of birth for twins. Despite a lack of evidence to support that elective CS results in improved outcomes, elective CS rates for twins have increased worldwide, up to 75% in the US in 2008 and 45% in France in 2010.[22] The Twin Birth Study, a randomized control trial of elective CS or vaginal birth for twin pregnancy, enrolled 2804 women from 25 different countries from 106 centers between 2003 and 2011. The results of the study indicated that for twins of gestational age 32^{+0} to 38^{+6} weeks with the first twin in cephalic presentation, elective CS did not significantly increase or decrease the risk of neonatal morbidity or mortality compared with planned vaginal birth.[4] A study examining CS trends in Nordic countries using the Robson classification found decreasing cesarean rates for Robson groups 8–10 (Robson group 8 includes multiples) in Finland, Iceland, Norway, and Sweden.[23]

Induction of labor rates have been increasing globally over recent decades.[24] In twin pregnancies, IOL is often indicated because of higher rates of pregnancy complications and higher risk for late stillbirth.[2] A study of 462 twin pregnancies in Sweden between 1993 and 2013 found that 48% had IOL.[2] NICE guidelines for antenatal care for twin and triplet pregnancies were implemented in 2013 at the National University Hospital of Iceland (Landspitali), where the vast majority of multiple pregnancies are delivered, and likely contributed to the increase in IOL in Iceland.[26] There is conflicting evidence as to whether IOL increases the risk of CS in twin pregnancies.[25] An additional study examining obstetric interventions in Iceland during 1995–2014 found decreasing urgent CS for multiples, increasing IOL rates with stable, relatively low rates of instrumental delivery.[9] Our findings of decreased CS rates despite marked increased IOL rates do not indicate that IOL should increase the risk of CS for twin births.

Our study was limited by the lack of assisted reproduction data within the birth register, which was not collected in the register until 2005 and is not subject to mandatory reporting. Despite this limitation, we were able to provide calculated twin birth rates in Iceland over a 22-year period, examine the changes to the trend in twin birth rates during the study period, as well as provide an estimate of the effect of the regulatory changes on overall twin birth rates. Utilizing the national register data was a major strength of the study because of its reliability due to prospective collection of data and fewer missing data. Furthermore, we were able to provide a detailed examination of obstetric intervention rates specifically for twin births.

5 | CONCLUSION

Twin births decreased during the study period, with the largest decrease in the last two birth year periods compared to 1997–2002 and for women aged 30+ years. These results indicate that the limited multiple embryo regulations introduced in 2009 may have had some effect on reducing twin birth rates in Iceland, although the main decrease may have happened earlier in response to international guidelines. Both elective and urgent CS rates for twin births decreased during the study period while IOL rates increased considerably.

AUTHOR CONTRIBUTIONS

JO analyzed the data and wrote the first draft of the manuscript. The study was conceived, designed, and led by KE, who played a key role supervising aspects of data collection, interpretation of findings, and writing of the manuscript. JG assisted with the definition of outcomes by diagnostic codes, the interpretation of findings, and writing of the manuscript and, along with TA, supported the study as a member of the committee for the study. SAG assisted with derived data and tables and figures generated using R. All authors

contributed to the writing of the paper by assisting with revisions and approved the final version.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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REFERENCES

1. Monden C, Pison G, Smits J. Twin peaks: more twinning in humans than ever before. *Hum Reprod*. 2021;36:1666-1673. doi:10.1093/humrep/deab029
2. Jonsson M. Induction of twin pregnancy and the risk of caesarean delivery: a cohort study. *BMC Pregnancy Childbirth*. 2015;15:1-7. doi:10.1186/s12884-015-0566-4
3. Santana EFM, Corrêa VM, Bottura I, Filho JPP. Time and mode of delivery in twin pregnancies. In: Elito J Jr., ed. *Multiple Pregnancy - New Challenges*. IntechOpen; 2019. doi:10.5772/intechopen.80092
4. Barrett JFR, Hannah ME, Hutton EK, et al. A randomized trial of planned cesarean or vaginal delivery for twin pregnancy. *N Engl J Med*. 2013;369:1295-1305. doi:10.1056/NEJMoa1214939
5. Rissanen A-RS, Jernman RM, Gissler M, Nupponen I, Nuutila ME. Maternal complications in twin pregnancies in Finland during 1987–2014: a retrospective study. *BMC Pregnancy Childbirth*. 2019;19:337. doi:10.1186/s12884-019-2498-x
6. Evensen A, Anderson JM, Fontaine P. Postpartum hemorrhage: prevention and treatment. *Am Fam Physician*. 2017;95:442-449.
7. Ministry of Health Iceland. Regulations on Assisted Reproduction: [Ministry of Health Iceland website]. 2009 https://www.reglugerd.is/reglugerdir/eftir-raduneytum/heilbrigdis/nr/10797 (accessed April 26, 2021).
8. Murray SR, Stock SJ, Cowan S, Cooper ES, Norman JE. Spontaneous preterm birth prevention in multiple pregnancy. *The Obstetrician & Gynaecologist*. 2018;20:57-63. doi:10.1111/tog.12460
9. Swift EM, Tomasson G, Gottfreðsdóttir H, Einarsdóttir K, Zoega H. Obstetric interventions, trends, and drivers of change: a 20-year population-based study from Iceland. *Birth*. 2018;45:368-376. doi:10.1111/birt.12353
10. Gunnarsdóttir J, Swift EM, Jakobsdóttir J, Smárason A, Thorkelsson T, Einarsdóttir K. Cesarean birth, obstetric emergencies, and adverse neonatal outcomes in Iceland during a period of increasing labor induction. *Birth*. 2021;48:493-500. doi:10.1111/birt.12564
11. Grétarsdóttir ÁS, Aspelund T, Steingrímsdóttir Þ, Bjarnadóttir RI, Einarsdóttir K. Preterm births in Iceland 1997–2016: preterm birth rates by gestational age groups and type of preterm birth. *Birth*. 2020;47:105-114. doi:10.1111/birt.12467
12. Adashi EY, Gutman R. Delayed childbearing as a growing, previously unrecognized contributor to the national plural birth excess. *Obstet Gynecol*. 2018;132:999-1006. doi:10.1097/AOG.0000000000002853
13. Dudenhausen JW, Maier RF. Perinatal problems in multiple births. *Dtsch Arztebl Int*. 2010;107:663-668. doi:10.3238/arztebl.2010.0663
14. Mills M, Rindfuss RR, McDonald P, te Velde E. Why do people postpone parenthood? Reasons and social policy incentives. *Hum Reprod Update*. 2011;17:848-860. doi:10.1093/humupd/dmr026
15. Pison G, Monden C, Smits J. Twinning rates in developed countries: trends and explanations. *Popul Dev Rev*. 2015;41:629-649. doi:10.1111/j.1728-4457.2015.00088.x
16. Heino A, Gissler M, Hindori-Mohangoo AD, et al. Variations in multiple birth rates and impact on perinatal outcomes in Europe. *PLoS One*. 2016;11:e0149252. doi:10.1371/journal.pone.0149252
17. Fields E, Chard J, James D, Treasure T. Fertility (update): summary of nice guidance. *BMJ (Online)*. 2013;346:f650. doi:10.1136/bmj.f650
18. Miller LM, Hodgson R, Wong TY, Merrilees M, Norman RJ, Johnson NP. Single embryo transfer for all? *Aust N Z J Obstet Gynaecol*. 2016;56:514-517. doi:10.1111/ajo.12478
19. Directorate of Health Iceland. Birth Registration Report 2018 Women and Children's Department Landspítali [Directorate of Health Iceland website]. 2020 https://www.landlaeknir.is/servlet/file/store93/item49526/Arsskyrsla2020_LOKAmfors_pdf (accessed June 23, 2021).
20. D'Alton M, Breslin N. Management of multiple gestations. *Int J Gynecol Obstet*. 2020;150:3-9. doi:10.1002/ijgo.13168
21. Lappen JR, Hackney DN, Bailit JL. Maternal and neonatal outcomes of attempted vaginal compared with planned cesarean delivery in triplet gestations. *Am J Obstet Gynecol*. 2016;215:493.e1-493.e6. doi:10.1016/j.ajog.2016.04.054
22. Schmitz T, Prunet C, Azria E, et al. Association between planned cesarean delivery and neonatal mortality and morbidity in twin pregnancies. *Obstet Gynecol*. 2017;129:986-995. doi:10.1097/AOG.0000000000002048
23. Pyykönen A, Gissler M, Løkkegaard E, et al. Cesarean section trends in the Nordic countries - a comparative analysis with the Robson classification. *Acta Obstet Gynecol Scand*. 2017;96:607-616. doi:10.1111/aogs.13108
24. World Health Organization. WHO recommendations: Induction of labour at or beyond term [WHO website]. 2018 https://apps.who.int/iris/bitstream/handle/10665/277233/9789241550413-eng.pdf (accessed August 10, 2021).
25. Coates D, Makris A, Catling C, et al. A systematic scoping review of clinical indications for induction of labour. *PLoS One*. 2020;15:e0228196. doi:10.1371/journal.pone.0228196
26. Excellence NifC. Twin and triplet pregnancy. Clinical Guideline. 2019 https://www.nice.org.uk/guidance/ng137 (accessed March 22, 2023).

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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