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20-year trend in Caesarean section rates in primiparous women in a regional obstetric unit in Hong Kong

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Introduction: Using the Robson classification, we analysed the 20-year trend of Caesarean section (CS) rates among primiparous women in a regional obstetric unit in Hong Kong.
Methods: Deliveries over a 20-year period (1997-2016) from United Christian Hospital were classified into one of 10 categories according to the Robson classification. The annual CS rate was calculated for each category, and data were stratified into four 5-year intervals to determine any trends.
Results: A total of 86 908 deliveries from 1997 to 2016 were included for analysis. The overall CS rate increased from 17.5% to 23.5% over the period. However, the overall primiparous CS rate only increased modestly from 20.8% to 22.8%, with main contributors being breech presentation (category 6), multiple pregnancies (category 8), and preterm labour (category 10). Contrarily, the CS rate declined mildly among those with spontaneous and induced labour (category 1 and 2). These trends were significant ($p<0.001$) after stratification into four 5-year intervals.
Conclusion: Despite a sharper rise in overall CS rate over the past 20 years, the CS rates in primiparous women increased modestly, mainly because of modest increases in rates of breech presentation, multiple pregnancies, and preterm labour.

Keywords: Cesarean section; Obstetric labor complications; Parity

Introduction

Caesarean section (CS) is increasingly performed worldwide, especially in middle- and high-income countries[1]. The increasing trend has also been reported in Hong Kong[2,3]. In 1985, the World Health Organization stated that there was no justification for any region to have a CS rate higher than 10% to 15%[4]. Despite this, the CS rate continued to rise to as high as 47.6% in China[5]. The strive for an 'optimal' rate remains theoretical and controversial, as many factors have to be considered. In developing countries, a modest increase in the CS rate has been reported to be associated with significant improvement in maternal and neonatal morbidity and mortality[2,6]. This supports the argument that a rise in the CS rate is likely to improve pregnancy outcomes. However, in developed countries, a sharp increase in CS rate has not been shown to improve pregnancy outcomes and could be associated with increased adverse maternal complications[7-10].

The Robson classification is a systematic, all-inclusive, mutually exclusive, and replicable method to enable standardised comparisons between institutions[10,11]. It classifies pregnant women into 10 categories based on five parameters: gestational age (preterm or term), onset of labour (spontaneous, induced, or CS before onset of labour), fetal presentation and lie (cephalic, breech, transverse), parity (including previous CS), and number of foetuses (Table 1). Indications for CS are not required. Efforts have been made to audit and to reduce the CS rate using the Robson classification[1,5,11-13]. One of the main focuses is on the ever-increasing primary CS rates[14,15] and the vicious cycle of repeat CS. Previous CS has been reported to be one of the principal contributing factors to rising CS rates in Hong Kong[16]. As most primary CSs are performed on primiparous women with first delivery, this study aims to evaluate CS rate trends in primiparous women over a 20-year period in a regional obstetric unit and compare them with the overall CS rate trends. Applying the Robson classification to the data would allow identification of primiparous subgroups that had increasing CS rates.

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Methods

This study was approved by the Kowloon Central / Kowloon East Cluster Research Ethics Committee. Obstetric data from United Christian Hospital from 1997 to 2016 were obtained from the Clinical Information System. Pregnancies were then categorised into primiparous and multiparous according to the standard definition of previous delivery beyond 24 weeks of gestation. Maternal epidemiological risk factors (advanced maternal age, induction of labour) and pregnancy characteristics (multiple pregnancies, breech presentation, preterm deliveries, and induction of labour) were collected.

Table 1. The Robson classification for Caesarean section (CS)

Category	Characteristics
1	Primiparous women with a single cephalic pregnancy, ≥37 weeks' gestation, in spontaneous labour
2	Primiparous women with a single cephalic pregnancy, ≥37 weeks' gestation, who have induction of labour or CS prior to labour onset
3	Multiparous women without a previous uterine scar, with a single cephalic pregnancy of ≥37 weeks' gestation in spontaneous labour
4	Multiparous women without a previous uterine scar, with a single cephalic pregnancy of ≥37 weeks' gestation, with induction of labour or CS prior to labour onset
5	Multiparous women with one or more previous uterine scar(s) and a single cephalic pregnancy of ≥37 weeks' gestation
6	Primiparous women with a single breech pregnancy
7	Multiparous women with a single breech pregnancy, with/without previous uterine scar(s)
8	Women with multiple pregnancies with/without previous uterine scar(s)
9	Women with a single pregnancy with a transverse or oblique lie, with/without previous uterine scar(s)
10	Women with a single cephalic pregnancy at ≤36 weeks' gestation

Table 2. Annual rates of major epidemiological risk factors and primiparous Caesarean section (CS) in the relevant Robson categories from 1997 to 2016

	Year																			
	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Total deliveries, n	3501	3371	3534	3850	3522	3844	3787	4558	5078	4244	4682	5169	4951	5251	5648	4968	4079	4350	4253	4258
Overall CS rate, %	18.1	19.1	16.6	16.5	15.8	17.4	18.2	19.5	18.2	18.6	18.8	22.1	20.9	23.1	23.1	23.4	23.6	24.6	22.3	23.8
Multiparous CS rate, %	15.1	18.0	15.5	13.3	13.4	16.0	17.3	18.1	17.1	1.5	16.9	22.8	21.7	24.6	26.4	26.2	25.3	26.6	22.8	23.8
Primiparous, %	47.3	47.4	50.2	50.2	50.5	51.5	49.6	52.4	50.7	48.2	47.5	48.4	47.7	49.0	47.1	48.1	50.2	49.0	49.4	48.5
Primiparous age >35 years, %	2.6	4.6	5.1	6.8	17.6	6.7	8.1	7.5	6.1	8.2	9.9	11.4	14.6	12.5	11.2	14.9	15.5	16.3	18.5	16.0
Primiparous with induction of labour, %	11.5	12.7	15.1	14.3	14.2	11.5	11.9	9.4	10.5	9.6	12.3	12.8	15.3	14.3	17.9	16.8	19.1	19.7	21.5	21.8
Primiparous with multiple pregnancies, %	0.49	0.87	0.79	0.88	0.73	2.57	1.33	1.00	0.89	1.17	1.97	1.63	1.52	1.28	1.94	1.84	1.61	2.20	1.85	2.76
Overall primiparous CS rate, %	21.6	20.3	20.6	19.6	18.1	18.7	19.1	20.8	19.3	18.7	20.9	21.4	20.0	21.3	19.4	20.4	21.9	22.5	21.7	23.8
Category 1 CS rate, %	12.8	12.6	14.8	13.4	10.3	11.6	11.4	14.7	12.3	11.0	13.4	13.3	11.8	11.8	10.6	10.9	12.3	12.1	12.0	13.1
Category 2 CS rate, %	39.1	35.6	29.1	30.1	35.1	32.0	33.1	35.9	37.4	31.8	36.5	35.1	35.5	41.9	31.5	29.6	37.0	35.1	20.4	26.9
Category 6 CS rate, %	82.5	86.9	77.9	89.5	95.6	95.4	91.5	94.6	97.2	97.0	93.0	97.4	96.7	97.3	95.9	94.2	96.4	96.9	98.8	97.8
Category 8 CS rate, %	62.5	64.3	71.4	58.8	61.5	78.4	84.0	87.5	82.6	79.1	86.4	85.3	96.7	84.8	86.5	95.5	84.8	89.4	81.6	89.4
Category 9 CS rate, %	100	100	100	100	100	94.4	100	91.6	92.3	100	100	95.6	93.7	100	93.3	92.8	100	100	100	100
Category 10 CS rate, %	21.3	24.4	17.2	17.3	17.1	27.3	21.2	23.1	19.1	25.6	24.1	19.2	23.3	27.9	29.3	29.7	26.9	25.8	29.5	29.5

All primiparous cases were classified into one of the Robson categories, and CS rates were calculated for each category in each year to observe for any trends and to compare with multiparous CS rates. The total number of patients in each category was then stratified into four 5-year intervals (1997-2001, 2002-2006, 2007-2011, and 2012-2016), and the four 5-year intervals were compared using a 4x2 contingency table and Mantel-Haenszel Chi squared tests for linear trends. A p value of <0.05 was taken as statistically significant.

Results

A total of 86 908 deliveries from 1997 to 2016 were included for analysis. The annual delivery rate increased steadily from 3501 in 1997 to 5648 in 2011, with a gradual decline to 4258 in 2016. The rate of primiparous delivery remained constant over the period, ranging from 47.3% to 52.4%. The primiparous CS rate varied between years; it was lowest at 18.1% in 2001 and gradually increased to 23.8% in 2016 (Table 2 and Figure 1). In contrast, the multiparous CS rate increased sharply from 15.1% in 1997 to 26.4% in 2011 and remained high at 23.8% in 2016.

The increase in the primiparous CS rate over the four 5-year intervals was significant, as were the increases of the rates of induction of labour (11.5% in 1997 to 21.8% in 2016), advanced maternal age of >35 years (2.6% in 1997 to 16% in 2016), and multiple pregnancies (0.49% in 1997 to 2.76% in 2016) among primiparous pregnancies (Table 3).

Using the Robson classification, among primiparous pregnancies, the increasing trend of CS was significant in category 6 (breech presentation) from lowest 77.9% in 1999 to highest 97.8% in 2016, category 8 (multiple pregnancies) from lowest 58.8% in 2000 to highest 96.7% in 2009 and remained high at 89.4% in 2016, and category 10 (preterm deliveries) from lowest 17.1% in 2001 to 29.5% in 2016 (Table 2). These increases were significant over the four 5-year intervals. From the first to the fourth 5-year interval, there were increases in category 6 (breech presentation) from 86.6% to 96.6% (p<0.001), category 8 (multiple pregnancies) from 63.6% to 88.6% (p<0.001), and category 10 (preterm deliveries) from 19.4% to 28.5% (p<0.001) [Table 3]. No specific trend was observed for category 1 (primiparous with term spontaneous labour),

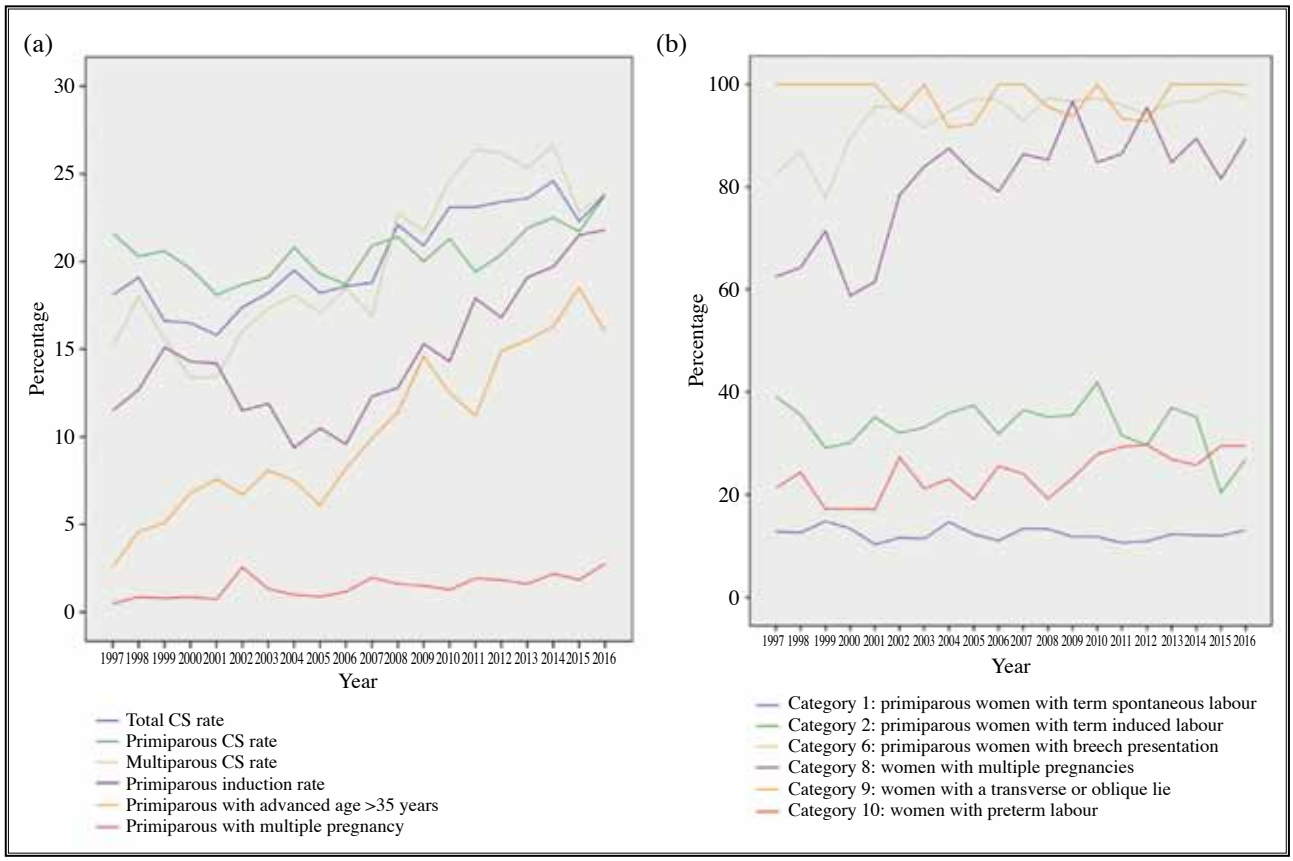

Figure 1. Comparison of (a) trends of total, multiparous, and primiparous Caesarean section (CS) rates and other epidemiological risk factors; and (b) trends of CS in primiparous women categorised by the Robson classification

Table 3. Comparison of Caesarean section (CS) rates in 5-year intervals for Robson categories for primiparous women

Characteristic	5-year interval				
	1997-2001	2002-2006	2007-2011	2012-2016	p value
Total deliveries, n	17 778	21 511	25 701	21 908	
Total CS, n (%)	3108 (17.5)	3960 (18.4)	5584 (21.7)	5158 (23.5)	<0.001
Primiparous total, n (%)	8702 (48.9)	10 868 (50.5)	12 348 (48.0)	10 732 (49.0)	<0.001
Primiparous age >35 years, n (%)	472 (5.4)	789 (7.3)	1472 (11.9)	1750 (16.3)	<0.001
Primiparous with induction of labour, n (%)	1189 (13.7)	1143 (10.5)	1804 (14.6)	2118 (19.7)	<0.001
Primiparous with multiple pregnancy, n (%)	66 (0.76)	147 (1.35)	206 (1.67)	230 (2.14)	<0.001
Multiparous CS rate, n (%)	1368/9076 (15.2)	1853/10 643 (17.4)	3085/13 395 (23.0)	2795/11 176 (25.0)	<0.001
Primiparous CS rate, n (%)	1811 (20.8)	2222 (20.4)	2726 (22.0)	2455 (22.8)	<0.001
Category 1 CS rate, n (%)	897/6985 (12.8)	1056/8569 (12.3)	1111/9107 (12.2)	881/7302 (12.1)	0.51
Category 2 CS rate, n (%)	399/1194 (33.4)	391/1192 (32.8)	661/1837 (35.9)	671/2314 (29.0)	<0.001
Category 6 CS rate, n (%)	298/344 (86.6)	452/474 (95.4)	519/540 (96.1)	459/475 (96.6)	<0.001
Category 8 CS rate, n (%)	42/66 (63.6)	120/147 (81.6)	175/206 (84.9)	194/219 (88.6)	<0.001
Category 9 CS rate, n (%)	82/82 (100)	66/69 (95.6)	81/84 (96.4)	57/58 (98.2)	-
Category 10 CS rate, n (%)	93/480 (19.4)	137/590 (23.2)	179/740 (24.2)	193/678 (28.5)	0.004

which remained stable over the period, ranging from 10.6% to 14.7% (mean, 12%), category 2 (primiparous with term induced labour), which showed a wider fluctuation between 29.1% and 41.9%, with the highest rate in the third 5-year interval (2007-2011) at 35.9% but the lowest in the fourth 5-year interval (2012-2016) at 29%, and category 9 (transverse lie), which remained high throughout the period at 98% to 100% (Table 3).

The absolute number of CS in each Robson category was then used to calculate the percentage contribution of each category to the total CS rates for each 5-year interval (Figure 2). For category 1 (primiparous with term spontaneous labour), the mean CS rate was around 12%, but it constituted over one third of all CSs. For category 2 (primiparous with term induced labour), the mean CS rate was around 30%, but it constituted over 20% of all CSs. Over the study period, contribution from category 1 gradually decreased while that from categories 2, 8, and 10 gradually increased (Figure 2). Although the absolute percentage change in categories 1 and 2 was small in comparison to that in other categories (Figure 2), these two categories carried overwhelming weighting on the total CS rate because of the large numbers. Specifically, the decrease in the percentage of CS in category 1 in the fourth 5-year interval significantly mitigated the overall increase in primiparous CS rate.

Discussion

Although the overall CS rate increased from 17.5% to 23.5% over the 20-year period, the primiparous CS rate only increased modestly from 20.8% to 22.8%. This is in line with our previous findings that the main contributor for the increase in the CS rate was from multiparous women with previous CS[16].

The World Health Organization global survey for 24 countries between 2004 and 2008 reported an overall CS rate of 26%[17], whereas the World Health Organization multi-country survey of maternal and newborn health from 2010 to 2011 reported an increase in the overall CS rate to 31%[18], of which a large proportion of the increase was attributed to previous CS[5,19]. In Hong Kong, a territory-wide audit performed by the Hong Kong College of Obstetricians and Gynaecologists in 2014 reported an increase in the overall CS rate from 27.1% in 1999 to 42.1% in 2009[20]. Our local CS figures aligned well with the ever-rising trends in CS observed in Asia as well as worldwide.

As the increase in the overall CS rate was strongly associated with previous CS, it is important to control primary CS. In China, a high CS rate of 54.5% among

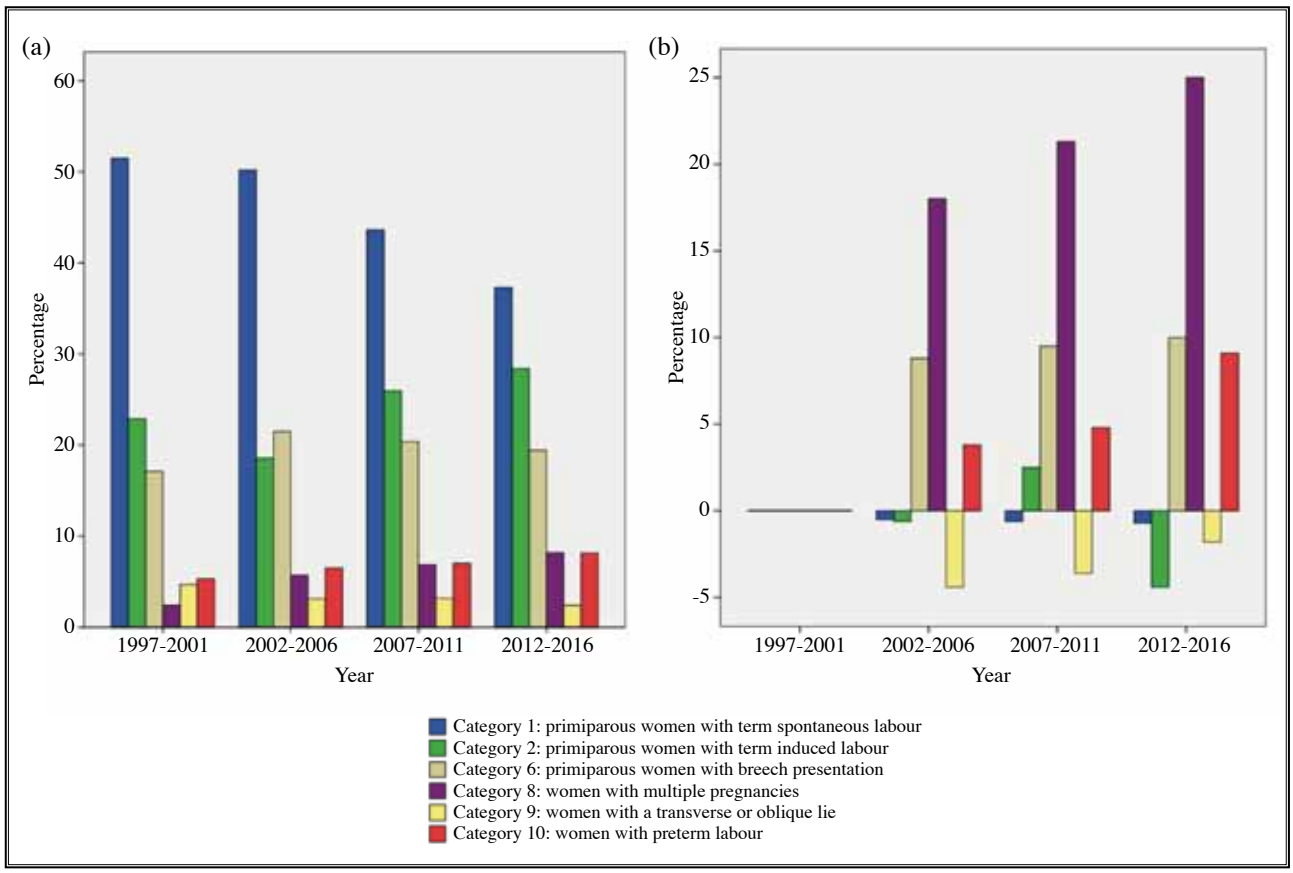

Figure 2. (a) Percentage contribution of Robson categories related to primiparous women to overall primiparous Caesarean section (CS) rate, and (b) percentage change in contribution of Robson categories related to primiparous women to overall primiparous CS rate

112 138 women has been reported, with non-indicated CS on maternal request constituting 38.4% of them and the majority of these being primary CS in primiparous women[21]. Women treated in the private sector have a higher risk of both elective and emergency CS compared with women treated in public sector[22,23]. In almost 30 000 nulliparous deliveries in Ireland where the practice settings and overall CS rate (26.1%) were similar to the Hong Kong system, a large excess 'private sector' effect remained even after adjusting for maternal, clinical, and hospital characteristics[24]. In Hong Kong, the prevalence of maternal preference for elective CS has been reported to be 17.2% at mid-trimester and 12.7% at term. Moreover, among women booked to deliver in the public sector, more women who preferred CS at term changed to deliver in the private sector than those who preferred vaginal delivery[25]. In public obstetric units, the incidence of non-indicated CS has been low, and this could be one of the key factors that contributed to controlling CS rates in our centre at reasonable levels. Practically, there is a need to avoid non-indicated CS in primiparous women in order to prevent the vicious cycle of CS in future pregnancies.

Categories 1 (term spontaneous labour) and 2 (term induced labour)

The CS rate was static for category 1 (spontaneous labour at term) but decreased for category 2 (induced labour at term). These encouraging trends are in sharp contrast to those reported in mainland China[21,26]. As these two categories constituted the largest absolute number of primiparous CS, controlling the CS rate in these two categories are important in primiparous women. The stable trend of CS reflects our adoption of evidence-based active management of labour, including close monitoring of intrapartum cardiotocography, use of partograms[14], early amniotomy with oxytocin augmentation[27,28], and regular clinical audits for CS indications within unit[13,29]. Originally aimed to shorten the labour duration, active management of labour resulted in reduced CS rates, better neonatal outcomes, and improved maternal satisfaction[30]. Later studies investigated the effects of individual interventions on reducing CS rates, and the conclusions were mixed[31,32]. In 2013, a meta-analysis of seven randomised trials reported that the CS rate was lower in those with active labour management, but the difference

was not significant[33]. Despite the controversies surrounding active labour management, reducing the CS rate in low-risk primiparous women with spontaneous labour appears safe and reasonable. In a study of nulliparous women with singleton cephalic livebirths at term in Australia from 2009 to 2010, the overall CS rate was 28.1%, and perinatal outcomes were similar despite significant variations in prelabour and intrapartum CS rates between different hospital centres. Although differences in case-mix and clinical practice were substantial contributors to variations in the CS rate, the CS rate in some hospitals can be safely lowered without adversely affecting pregnancy outcomes[34].

Although primiparous women with induced labour have a higher baseline CS rate than those in spontaneous labour, induction of labour per se has been demonstrated to decrease rather than increase the CS rate. A meta-analysis of 37 randomised controlled trials included 27 trials of uncomplicated term pregnancies and 10 trials evaluating induction versus expectant management in pregnancies with suspected macrosomia, diabetes in pregnancy, oligohydramnios, twins, intrauterine growth restriction, pregnancy-induced hypertension, and women with a high-risk score for Caesarean section[35]. This meta-analysis determined that a policy of induction was associated with a reduction in the risk of CS compared with expectant management (odds ratio=0.83)[35]. In a prospective randomised controlled trial of low-risk nulliparous women at 39 weeks (n=6000), routine labour induction did not result in a significantly lower frequency of a composite adverse perinatal outcome but demonstrated a significantly lower rate of CS delivery (18.6% vs 22.2%)[36]. Mathematical modelling revealed that elective induction of labour at 39 weeks resulted in lower population risks, specifically lower the rates of CS, maternal morbidity, and perinatal morbidity and mortality[37]. In our cohort, the labour induction rate in primiparous women increased from 11% in 1997 to 21% in 2016. This two-fold increase in labour induction could be a contributor for the modest but significant drop in the CS rate among primiparous women.

Category 6 (breech pregnancies)

The rate of CS for breech pregnancies showed a significant increase from the 86% in 1997-2001 to over 95% for the later three 5-year intervals, and the figure had remained relatively consistent over these 15 years. This is most likely due to the Term Breech Trial[38] published in 2000. This landmark paper involved 2088 women from 26 countries, and concluded that elective CS for the term breech reduced perinatal mortality, neonatal mortality and serious neonatal morbidity. International guidelines such as the RCOG Green-top guidelines[39] later incorporated these findings, and the data from this cohort reflected our compliance with these recommendations. A potential method of reducing CS in this category is indeed external cephalic version to enhance the chances for a successful vaginal delivery[40]. However, it should be noted that women who have a successful version will no longer remain in this category and will be assigned to category 1 or 2.

Category 8 (multiple pregnancies)

Category 8 increased the most in the CS rate among primiparous women from 63.6% to 88.6% across the four 5-year intervals. This trend is similar to that reported in other studies. The rate for twin CS in the United States has risen from 55% in 1995 to >75% in 2008; in Germany it has risen from 60% in 1990 to 77% in 2012[41]. Prior to the Twin Birth Study in 2005[42], CS was considered a safer delivery modality with a lower risk of mortality for both twins. A retrospective study of >8000 Scottish twin births from 1985 to 2001 with term gestations reported that planned CS might reduce the risk of perinatal death by 75% compared with planned vaginal delivery, by reducing the risk of death from intrapartum anoxia of the second twin. However, the Twin Birth Study in 2013 reported that there were no significant benefits in planned CS for uncomplicated twins pregnancies[43]. The JUMODA study confirmed that planned CS (compared with planned vaginal delivery) for twins could be associated with increased composite neonatal mortality and morbidity, particularly when delivery was before 37 weeks[44]. Nevertheless, there is a strong preference among mothers with twin pregnancies for planned CS, which is likely to be compounded by the clinician's lack of confidence in conducting complex vaginal deliveries[45]. The high CS rate for twin pregnancies is unlikely to be reduced in the future.

Category 10 (preterm labour)

Results for the optimal mode of delivery in this group were mixed, with no good evidence favouring CS[46]. A Cochrane review in 2012 reported no significant difference between CS and vaginal delivery with regards to birth injury, markers of possible birth asphyxia, or other complications of prematurity such as neonatal seizures, hypoxic ischaemic encephalopathy, and respiratory distress syndrome[47]. The National Institute for Health and Care Excellence guideline does not recommend CS over vaginal delivery for infants in preterm labour[48]. However, indications for CS in preterm deliveries were not studied in detail. In our cohort, a proportion of planned preterm CS were due to conditions such as early-onset fetal growth restriction or pre-eclampsia, frequently with evidence of

fetal compromise. Therefore, the modest increase in the preterm CS rate appeared to be iatrogenic. The prevalent medicolegal implications of delivering a compromised baby may have played a role in clinical decision on the mode of delivery.

Strengths and limitations

As the study was based on a single centre, the temporal effects of changes in clinical protocols in line with international recommendations on the CS rate could be readily traced and audited. The large sample size over the 20-year period enable observation of trends. Nonetheless, one might question whether our findings would be generalisable to other public obstetric units or private hospitals. According to the Hospital Authority annual obstetric reports, similar increases in the CS rates have been observed in all other obstetric units, with variable extents. As practices and policies within the Hospital Authority are similar, it is reasonable to conclude that our findings may reflect the overall trend in the CS rate among public hospitals. In private obstetric units, the CS rate has all along been much higher[3]. With the prevalence of non-indicated CS due to maternal preference in recent years, the trends from private hospital settings would be anticipated to be very different from our findings. We look forward to similar analyses from other public and private obstetric units to compare with our data.

Conclusion

The increase in the CS rate is a global phenomenon and is also observed in our unit. However, the CS rate in primiparous women has remained fairly stable over the past 20 years. The modest increase was mainly associated with mild increases in the CS rate in those with breech presentation, multiple pregnancies, or preterm labour. Future efforts should continue to be focused on maintaining a static CS rate in primiparous women to avoid the escalating CS rates in multiparous women due to previous CS.

Declaration

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