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The Project Appropriate Birth and a reduction in caesarean section rates: an analysis using the Robson classification system

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Objective The objective of this study was to assess caesarean section (CS) rates before and after the implementation of the Project Appropriate Birth (PPA), based on the Robson ten group classification system.

Design A before-and-after study.

Setting Maternity hospital in South Brazil.

Population All pregnant women attending from April 2016 to April 2017 (period 1, pre-implementation of PPA) and from June 2017 to June 2018 (period 2, post-implementation of PPA).

Methods Maternal and obstetric characteristics were evaluated, including Robson's classification, based on the characteristics of pregnancy and childbirth. A chi-square test and crude and adjusted relative rates were used to analyse the study variables. The significance level was set at 5%.

Main outcome measures The CS rate for each group, their contribution to the overall CS rate and the differences in these contributions before and after PPA implementation.

Results The CS rates decreased from 62.4 to 55.6%, which represented a 10.9% reduction after the implementation of the PPA. Pregnant women in Robson classification groups 1–4 had a 21.4% reduction in CS rates, ranging from 49.1 to 38.6%. The greatest contributors to the overall CS rates were group 5 and group 2, accounting for more than 60% of the CS deliveries.

Conclusion The study results suggest that Project Appropriate Birth had an impact on the reduction of CS rates, especially in Robson classification groups 1 through 4, which indicates that providing mothers with evidence-based interventions for labour and childbirth assistance contributed to reduce CS rates.

Keywords caesarean section, health plans and programmes, Robson classification.

Tweetable abstract The Project Appropriate Birth is an innovative project that has demonstrated promising results, suggesting that interventions based on scientific evidence can lead to real changes in childbirth care, contributing to reduce CS rates. The aim of the PPA is to promote activities to improve childbirth care and encourage vaginal delivery. In this study, 6238 pregnant women admitted to the hospital for delivery were included and classified into one of the Robson 10-group classification. Findings revealed a 10.9% reduction in the overall CS rate and a 21.4% reduction for pregnant women in Robson classification groups 1 through 4, after the implementation of the PPA.

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Introduction

Quality health care during delivery and childbirth is vital to reduce maternal and neonatal morbidity and mortality. An important global indicator for the quality of maternal and newborn care assessment is the rate of caesarean section (CS) deliveries.[1–3] The World Health Organization (WHO) states that CS rates above 10–15% are not associated with reductions in maternal and neonatal mortality rates.[4–7] CSs should only be performed out of medical necessity and not to reach a specific rate. CS is a surgery to prevent maternal risks or treat perinatal complications, and the appropriate rate must be associated with the lowest possible maternal mortality rate and perinatal morbidity and mortality.[8]

In 2015, about 29.7 million children (21.1% of the 140.6 million live births) were birthed by CS, which corresponds

to a 12% increase in relation to live births in 2000.[9] Brazil ranks second in CS rates worldwide, which represents 55.6% of live births per year.[10] In both developed and developing countries CS rates have been gradually increasing, and the reasons for this increase remain controversial. It is believed that the increase is largely driven by CS without clinical indication.[1,2] According to the international literature, the most common reasons for CS are based on social, demographic, cultural and economic factors.[5,11–13]

Systematic reviews have evaluated different CS classifications, and the Robson ten group classification system, as proposed by Robson in 2001, was considered the most appropriate to compare the rates of CS surgery.[1,14] This system helps to monitor and audit institutions and provides a standardised method of comparison between institutions, countries and time points,[14–16] and is endorsed by the WHO.[4]

In collaboration with the Brazilian Ministry of Health, the National Supplementary Health Agency (ANS), the Albert Einstein Israelite Hospital and the Institute for Healthcare Improvement (IHI) have developed the Project Appropriate Birth (PPA), aiming to identify innovative and viable care models during labour and childbirth that value normal birth and reduce CS rates. It is expected that by 2020, all Brazilian women will have access to evidence-based maternity care and a positive experience.[17–20]

In view of the scenario showing high CS rates, this study aims to categorise pregnant women according to the Robson classification system and assess CS rates before and after the implementation of PPA in a maternity hospital in southern Brazil.

Methods

Study design, data sources and participants

This was a before-and-after study about delivery care for parturient women attending a maternity hospital in southern Brazil (Hospital Nossa Senhora da Conceição, HNSC). Three thousand births on average occur annually in this maternity hospital, which is a reference for high-risk pregnancies for the entire region of southern Santa Catarina State, Brazil. The maternal and child centre encompasses an obstetric centre, a human milk bank, rooming-in space and a neonatal intensive care unit. There are 45 beds, including the obstetric centre and the joint accommodation, in addition to two pre-delivery, delivery and puerperium (PPP) rooms and four operating rooms. The labour and delivery professionals include physicians (77%) and obstetric nurses (23%) in tenure positions, and there is practically no staff turnover.

The research data were collected from April 2016 to June 2018. Period 1 (before) refers to the pre-implementation period of the PPA (from April 2016 to April 2017) and period 2 (after) refers to the post-implementation period of the PPA (from June 2017 to June 2018). As May 2017 was the date of implementation, this was considered a transition period and was therefore excluded from the analysis.

All parturient woman from the period of interest in the study were included, with no exclusion. In the case of twin pregnancy, the mother's data were counted only once. Research data were collected from the electronic medical records. There was no patient or public involvement.

The PPA intervention

The aim of the PPA was to promote activities to improve childbirth care in Brazil in order to encourage vaginal delivery.[19] The PPA hypothesis was centred on the possibility that evidence-based changes in the delivery care model, with the participation of maternity care professionals and other stakeholders, would contribute to implementing good practices, thus reducing CS rates and unnecessary obstetric interventions.

In November 2016, hospitals and maternity hospitals across Brazil could apply to participate in the PPA. The selection criteria for the hospitals to participate were: at least 500 deliveries per year; a CS rate preferably equal to or greater than 75%; geographic location, with hospitals throughout all regions of the country included, located both in state capitals and in different municipalities. In February 2017 the selection of 153 hospitals was announced, including the HNSC in Tubarão, Santa Catarina.

In May 2017, the PPA was implemented in maternity hospitals, and that month was considered the transition month between the before and the after period of the current analysis. After the implementation of the PPA, the maternity hospital began to make changes and improvements to adhere to the project guidelines and objectives, which included the following: scheduling visits to the maternity hospital, guided by obstetric nurses; promoting lectures and events related to normal birth for the general population; providing training courses for pregnant women focused on physiological childbirth and encouraging the companion's participation during labour; telling stories about births carried out in the maternity hospital to motivate other women; centralised scheduling of elective CSs at 39 weeks of gestation; developing a model birth plan; standardising a routine for collecting, organising and disseminating project data; establishing an organisational learning framework to be commonly used in the obstetric centre; developing care protocols; forming a multidisciplinary team in childbirth care with the active participation of obstetric nurses; daily rounds by the maternal and child centre staff; providing non-pharmacological methods, labour analgesia and changing birth positions; placing doulas to support women throughout labour and childbirth; encouraging early skin-to-skin contact and breastfeeding;

bathing newborns only after 24 hours of birth; training medical and nursing staff; and providing pre-delivery, delivery and post-delivery rooms.[17]

Variables and Robson classification system

Sociodemographic characteristics examined in the study included maternal age (<20, 20–34 and >35 years), race/skin color (White, Brown, Black, Indigenous, Yellow), marital status (with or without a partner), education (illiterate, complete or incomplete primary education, complete or incomplete secondary education, complete or incomplete higher education, postgraduate), religion (Catholic, Evangelical, no religion, others), obstetric parity (0, 1, ≥2), previous normal delivery (0, 1, ≥2), previous CS (0, 1, ≥2), type of pregnancy (singleton or multiple), type of delivery (vaginal, forceps or vacuum extraction, CS). High-risk pregnancies included the following complications: hypertensive syndromes; haemorrhagic syndrome; active infectious diseases; cardiopathy, pneumopathy, neurological, renal, autoimmune and severe psychiatric disorders; alcoholism, drug addiction; and fetal growth restriction and congenital malformations.

Robson classification system

The Robson classification system (Box 1) includes the following obstetric variables: parity (nulliparous, multiparous with or without a previous uterine scar), onset of delivery (spontaneous, induced or prelabour CS), fetal presentation (cephalic, breech or transverse lie), number of fetuses (singleton or multiple) and gestational age (term, preterm). Individual groups are defined by these characteristics in a mutually exclusive and totally inclusive manner, in which all pregnant women are included, and no woman is classified into more than one group. This classification system does not require data on indications for CS or perinatal results. In this study, all women were classified into one of the ten groups described by Robson.[17] Groups 2 and 4 were subdivided into (a, induced labour) and (b, prelabour CS), and group 5 was subdivided into 5.1 (one previous CS) and 5.2 (two or more previous CSs).

Box 1 Robson classification system

1. Nulliparous women with a single cephalic pregnancy, at ≥37 weeks of gestation, in spontaneous labour
2. Nulliparous women with a single cephalic pregnancy, at ≥37 weeks of gestation, who either had labour induced or were delivered by caesarean section before labour
3. Multiparous women without a previous uterine scar, with a single cephalic pregnancy, at ≥37 weeks of gestation, in spontaneous labour
4. Multiparous women without a previous uterine scar, with a single cephalic pregnancy, at ≥37 weeks of gestation, who either had labour induced or were delivered by caesarean section before labour
5. All multiparous women with at least one previous uterine scar, with a single cephalic pregnancy, at ≥37 weeks of gestation
6. All nulliparous women with a single breech pregnancy
7. All multiparous women with a single breech pregnancy, including women with previous uterine scars
8. All women with multiple pregnancies, including women with previous uterine scars
9. All women with a single pregnancy, with a transverse or oblique lie, including women with previous uterine scars
10. All women with a single cephalic pregnancy, at <37 weeks of gestation, including women with previous uterine scars

Statistical analysis

The data were entered into EPI INFO 7.2 and a MICROSOFT EXCEL spreadsheet and exported to SPSS 21.0 for analysis. Quantitative variables were described as measures of central tendency and dispersion. Qualitative variables were described in absolute (n) and relative (%) frequency. The main outcome of the study was the rate of CS. The characteristics of pregnant women included in the study were reported for each period, along with the proportion of women undergoing CS. The following variables were analysed for each period and Robson classification group: relative size of the obstetric population, % = (n of women in the group/total N women) × 100; total CS rate, % = (n of CSs in the group/total N of women in the group) × 100; the absolute contribution to the total CS rate, % = (n of CSs in the group/total N of women); and the relative contribution to the total CS rate, % = (n of CSs in the group/total N of CSs) × 100.[21]

Comparisons of CS rates before and after the implementation of the PPA were made by comparing proportions using Pearson's chi-square test. The relative rates (RRs) of CS rates before and after PPA implementation was calculated with 95% confidence intervals (95% CIs) and a 5% significance level. A Poisson regression model was used to estimate the change in CS rates in the target population of the hospital in each period, before the start of the PPA (baseline period, from April 2016 to April 2017) and after the set-up period of the PPA (full implementation period, from June 2017 to June 2018). The RRs were adjusted according to sociodemographic variables, e.g. age, education, race, marital status and religion, plus the clinical measures of parity, previous CS, high-risk pregnancy and presence of maternal complications (n = 837; 13%).

The percentage change in CS rates, or the percentage reduction based on the pre-implementation period, was calculated using the formula:

$$\left(\frac{\text{after rate} - \text{before rate}}{\text{before rate}}\right) \times 100.$$

Results

In this study, all 6238 women admitted for delivery were included and classified into one of the Robson classification groups. Of the total, 3135 were included in the pre-implementation period of the PPA (the before period) and 3103 were included in the post-implementation period (the after period). There were 6379 births in total, a higher figure than the number of participants as a result of 137 twin births and two triplet births, which together accounted for 2.2% of the total births (Table 1).

The mean maternal age was 28 years (SD ± 6.41 years), ranging from 13 to 48 years (interquartile range 32.6 years), 89.9% of the patients were White, 52.7% had at least completed secondary education, 86.3% of the patients had a steady partner and 70.8% were Catholic.

Regarding parity, 2580 (41.4%) parturient women were primipara, 17% of them had at least one previous normal delivery, 22.4% had at least one previous CS and 16.1% had previous abortions.

Table 2 shows the distribution of parturient women into the Robson classification groups during the study periods. Both in periods 1 and 2 participants in groups 1–4 accounted for around 60%, those in groups 6–9 accounted for approximately 5% and those in group 10 accounted for around 10%. Group 5 was the largest group in both periods, accounting for around 25% of the parturient women, followed by group 2 representing approximately 20% of the parturient women. Robson classification groups 2 and 5 together accounted for 61.9 and 67.6% of CSs in periods 1 and 2, respectively.

The general CS rate in this study was 59%, being 62.4% in period 1 and 55.6% in period 2, which represented a 10.9% statistically significant reduction in CS rate after the implementation of the PPA (Table 3).

The greatest reduction in CS rate occurred in groups 1–4, showing a rate of 49.1% in period 1 and 38.6% in period 2. Therefore, there was a statistically significant reduction of 21.4% ($P < 0.001$) in CS rate for these groups after the implementation of the project (RR 0.79; 95% CI 0.73–0.85). In group 5, there was a decrease in CS rate, from 88.7 to 83.7% ($P = 0.005$). Groups 6–9 also had a reduction in CS rate, but this was not statistically significant ($P = 0.082$). Group 10 showed a slight but non-significant increase in CS rate after the implementation of the PPA.

The different adjustment models used, considering sociodemographic and clinical variables, showed some minor changes in the crude estimates (Table 3), indicating a reduction in CS rates for all categories and, separately, for Robson classification groups 1–4 and group 5.

The main indications for CS, both in the before and the after period, were the same: non-reassuring fetal status, previous CS, induction failure and breech presentation. CS indications that presented the greatest reductions with the implantation of the PPA were intrapartum indications, such as cephalopelvic disproportion, induction failure and dystocia (data not shown).

Table 1. Sociodemographic and obstetric characteristics of parturient women attending a hospital in southern Brazil, from April 2016 to June 2018, according to the period considered for the implementation of Project Appropriate Birth ($N = 6238$)

	Total		Before		Period 2	
	n	(%)	*n*	(%)	*n*	(%)
Total	6238	100	3135	50.3	3103	49.7
Maternal age						
<20 years	702	(11.3)	339	(10.8)	363	(11.7)
20–34 years	4555	(73.0)	2299	(73.3)	2256	(72.7)
≥35 years	981	(15.7)	497	(15.9)	484	(15.6)
Race						
White	5606	(89.9)	2826	(90.1)	2780	(89.6)
Brown	131	(2.1)	50	(1.6)	81	(2.6)
Black	343	(5.5)	168	(5.4)	175	(5.7)
Indigenous	12	(0.2)	8	(0.3)	4	(0.1)
Asian Brazilians	146	(2.3)	83	(2.6)	63	(2.0)
Marital status						
Single	793	(12.7)	375	(12.0)	418	(13.5)
Married	2624	(42.1)	1356	(43.2)	1268	(40.8)
Civil union	2759	(44.2)	1375	(43.9)	1384	(44.7)
Divorced	47	(0.8)	21	(0.7)	26	(0.8)
Widowed	10	(0.1)	4	(0.1)	6	(0.2)
Unknown	5	(0.1)	4	(0.1)	1	(0.0)
Education						
Primary school (complete or not)	1659	(26.6)	812	(26.3)	847	(27.9)
Secondary–incomplete higher	3289	(52.7)	1635	(52.9)	1654	(54.5)
Higher education–postgraduate	1177	(18.9)	641	(20.8)	536	(17.6)
Unknown	113	(1.8)	47	(1.5)	66	(2.1)
Religion						
Catholic	4415	(70.8)	2259	(72.0)	2156	(69.5)
Evangelical	1386	(22.2)	683	(21.8)	703	(22.6)
No religion	177	(2.8)	72	(2.3)	105	(3.4)
Other	200	(3.2)	97	(3.1)	103	(3.3)
Unknown	60	(1.0)	24	(0.8)	36	(1.2)
Previous pregnancy*						
0	2580	(41.4)	1335	(42.6)	1245	(40.1)
1	1973	(31.6)	969	(30.9)	1004	(32.4)
≥2	1685	(27.0)	831	(26.5)	854	(27.5)
Previous CS						
0	4405	(70.6)	2240	(71.4)	2165	(69.8)
1	1397	(22.4)	682	(21.8)	715	(23.0)
≥2	436	(7.0)	213	(6.8)	223	(7.2)
Type of delivery						
Vaginal	2553	(40.9)	1179	(37.6)	1374	(44.3)
Forceps/vacuum	3	(0.1)	0	(0.0)	3	(0.1)
CS	3682	(59.0)	1956	(62.4)	1726	(55.6)

*Abortion was included as a previous pregnancy.

Table 2. Robson classification groups of parturient women attending a hospital in southern Brazil, 2016–2018, before and after the implementation of the project (*N* = 6238)

Before the implementation of the project

	No. of normal births	No. of CSs	Total no. of births	Group size (%)*	CS rate in the group (%)**	Absolute contribution to CS rate (%)***	Relative contribution to CS rate (%)****
1	405	228	633	20.19	36.02	7.27	11.66
2	92	522	614	19.58	85.01	16.65	26.69
3	397	76	473	15.09	16.07	2.42	3.89
4	68	103	171	5.45	60.23	3.28	5.26
5	88	688	776	24.76	88.65	21.94	35.17
6	1	49	50	1.59	98.00	1.56	2.51
7	3	46	49	1.56	93.88	1.47	2.35
8	2	68	70	2.23	97.14	2.17	3.48
9	0	12	12	0.38	100.00	0.38	0.61
10	123	164	287	9.15	57.14	5.23	8.38
	1179	1956	3135	100	62.39		100

After implementation of the project

	No. of normal births	No. of CSs	Total no. of births	Group size (%)*	CS rate in the group (%)**	Absolute contribution to CS rate (%)***	Relative contribution to CS rate (%)****
1	432	102	534	17.21	19.10	3.29	5.91
2	171	502	673	21.69	74.59	16.18	29.09
3	412	24	436	14.05	5.50	0.77	1.39
4	97	72	169	5.45	42.6	2.32	4.17
5	129	664	793	25.56	83.73	21.40	38.47
6	4	52	56	1.80	92.86	1.68	3.01
7	3	54	57	1.84	94.74	1.74	3.13
8	7	62	69	2.22	89.86	2.00	3.59
9	0	7	7	0.23	100.00	0.23	0.41
10	122	187	309	9.96	60.52	6.03	10.83
	1377	1726	3103	100	55.62		100

*(Number of births in the group)/(total number of births) × 100.
**(Number of CS deliveries)/(number of births in the same Robson classification group) × 100.
***(Number of CS deliveries in the group)/(total number of births) × 100.
****(Number of CS deliveries in the group)/(total number of CS deliveries) × 100.

Discussion

Main findings

There was a significant reduction in CS rates after the implementation of the PPA, with all Robson classification groups demonstrating reduced or stable contributions. Parturient women classified into groups 1–4, who were the major target audience of the PPA, showed the greatest reduction in CS rate.

Group 5 and group 2 had the greatest impact on CS rates. Together, they accounted for 61.8% of the CSs in period 1 and 67.6% in period 2.

Strengths and limitations

This is one of the pioneering studies evaluating the results of implementing the PPA in a Brazilian hospital setting. The inclusion of all women admitted for delivery and the collection of data from each woman's medical record was exhaustive, although very important for the reliability of the Robson classification system, which is a useful and reproducible tool for monitoring CS rates.

Our results have limitations, some of which are intrinsic to the Robson classification system, such as the lack of other epidemiological information,[21,22] mainly in relation to women with advanced maternal age (over 35 years old)

Table 3. Caesarean section rates according to the Robson classification system in the pre-implementation period (before) and in the post-implementation period (after) of Project Appropriate Birth in a hospital in southern Brazil, 2016–2018 (N = 6238)****

Robson classification	Before (%)	After (%)	Variation %	RR** (95% CI)	*P*	aRR*** (95% CI)
All (1–10)	62.4	55.6	−10.9%	0.89 (0.86–0.93)	<0.0001*	0.91 (0.87–0.95)*
1–4 (n = 3703)	49.1	38.6	−21.4%	0.79 (0.73–0.85)	<0.0001*	0.71 (0.60–0.84)*
1 and 2 (n = 2454)	60.1	50.0	−20.2%	0.83 (0.77–0.89)	<0.001*	0.82 (0.66–1.02)
3 and 4 (n = 1249)	27.8	15.9	−74.8%	0.57 (0.46–0.71)	<0.001*	0.59 (0.47–0.74)*
5 (n = 1569)	88.7	83.7	−0.6%	0.94 (0.91–0.98)	0.005*	0.95 (0.91–0.99)*
6 and 9 (n = 370)	96.7	92.6	−4.2%	0.96 (0.91–1.00)	0.082	0.97 (0.90–1.03)
10 (n = 596)	57.1	60.5	+5.9%	1.06 (0.93–1.21)	0.403	1.03 (0.89–1.20)

*Statistically significant difference at a significance level of 5%.
**RR: relative rate, considering period 1 as the reference category (before PPA implementation).
***aRR: adjusted relative rate, considering the variables of age (continuous), education, race, marital status and religion of the mother, plus the clinical measures of parity, previous CS and high-risk pregnancy, estimated by a Poisson regression model with a robust error variance.
****Cases with unknown information for the adjustment variables were excluded: education (n = 113), race (n = 139), marital status (n = 5), religion (n = 60). In total, 276 cases were excluded.

who are at high risk for pre-eclampsia, gestational diabetes and, consequently, CS.[23] Although the study was designed to evaluate the CS rates before and after the implementation of the PPA, the intervention occurred independently of the study and, for that reason, we could not select a control group. Moreover, the fact of being selected to participate in the project could influence the overall practice of the health team, independently of each intervention action implemented. For this reason, the changes observed in CS rates in the study period may indicate a beneficial effect of the project, even though it could not be attributable solely to the PPA.

Interpretation

Brazil has one of the highest CS rates in the world (55.6%), together with the Dominican Republic (59.6%), China (52.5%), Cyprus (52.2%) and Egypt (51.7%).[9,24,25] CS rates have increased substantially over the years, both globally and nationally, without an understanding of their determinants and future consequences.[1,9,10,26] CSs without clinical indication cause unnecessary risks to the health of women and their babies, and have immediate and long-term risks, especially when performed before 39 weeks of gestation.[27–30] These risks can persist for many years after delivery, and may also compromise future pregnancies.[2,4,11,17,27]

Healthcare providers are particularly important to help with mother's decisions about birthing methods.[31,32] A systematic review showed that obstetricians were directly involved in the decision to perform a CS and are a determinant factor for the overall CS rates in any country.[33]

Although there is almost universal consensus that CS use has increased beyond the reasonable level of need in many countries, effective interventions to optimise CS use have proven elusive.[34,35] The PPA is based on strategies that prioritise positive human relationships, address beliefs about childbirth and quality care, and promote respectful and collaborative multidisciplinary teamwork, thus providing an effective tool for championing the physiological labour process and safe childbirth. Moreover, the implementation of evidence-based guidelines, using a standard classification system, is paramount to improve care and allow for comparisons between healthcare services in different settings.[17,36]

The results of this study have shown a significant reduction in the overall CS rates after the implementation of the PPA, especially among women classified into Robson classification groups 1–4 (single, full-term, cephalic pregnancy, without a previous uterine scar, differentiated only for parity and labour onset). These women are the main focus of the PPA and also of the 'Safe Prevention of the Primary Cesarean Delivery' movement of the American College of Obstetricians and Gynaecologists (ACOG).[37,38] The greatest decline in CS rates occurred among women in groups 1 and 3, but women in groups 2 and 4 also had a reduction in their CS rates.

The groups with the greatest impact on CS rates were groups 5 and 2. They accounted for the highest CS rates in both the before and the after periods, as well as in a Brazilian nationally based study and in studies based in countries such as France, Canada and the USA.[22,25,39,40] Given that CS rates have been steadily increasing in recent decades,[13,41] the proportion of women with previous CS (group 5) has also been increasing. Group 5 accounted for approximately one-third of all CSs, in both periods. However, there was a significant reduction in CS rates in group 5, with no increase in complications (data not shown), which shows that vaginal delivery after a previous

CS, when performed in ideal conditions, is clinically safe and contributes to reduce maternal morbidity associated with multiple CSs.[42–44] A study carried out in Brazilian hospitals participating in an initiative to improve the quality of care also found an increase in vaginal births as compared with the years 2014–2016.[19]

The CS rates and contributions remained practically unchanged in groups 6–9, with a small, non-significant reduction of 4.2% after the implementation of the PPA. In this subset of participants, group 7 had the greatest reduction and group 9 had a CS rate of 100% in both periods, as expected.

Our data demonstrated that women belonging to group 10 represented 10% of all births in both periods, being the only group that had a slight, though not significant, increase in CS rates. These data were very similar to those of a national survey conducted in Brazil,[25] in which group 10 represented 9.7% of the childbirths and had a CS rate of 50.1%, as well as in Latin America, in which group 10 represented 7.1% of the childbirths and had a CS rate of 43%.[45] Contrastingly, countries with low rates of preterm births have lower CS rates in this group than those found in our study. The CS rate is 37% in the USA,[40] 7.1% in the Netherlands,[44] and 8.3% in France.[22]

Conclusion

The PPA is an innovative project that has shed light on this gloomy field of the increase in CS rates in Brazil, without understanding its determinants or with no regard to future consequences. This study suggests that the PPA had an impact on the reduction of CS rates, especially in Robson classification groups 1–4, which indicates that providing mothers with evidence-based interventions for labour and childbirth assistance contributed to reducing CS rates.[19,46]

The Robson classification system is a tool freely available to all health institutions to help examine CS rates and identify groups that may benefit from specific actions, such as the PPA. It is extremely important that the PPA is extended to all maternity hospitals, not only in Brazil, but also in other countries with such high CS rates. The main goal should be to reduce elective CSs and those without clinical indication. Waiting for the right time for the baby to be born should be promoted and vaginal delivery should be encouraged, even after a previous CS delivery.

Disclosure of interests

None declared. Completed disclosure of interests form available to view online as supporting information.

Contribution to authorship

Conception: DFDM. Design and development: DFDM and BPMI. Questionnaire development: DFDM, BPMI and KBDC. Data collection: DFDM, ARW, DD, DA, GFK, KMZ, KBDC, NVG and OTF. Data analysis: DFDM and BPMI. Preparation of tables: DFDM and BPMI. Initial draft of the manuscript: DFDM and BPMI. Manuscript writing, review and approval: all authors.

Details of ethics approval

This research follows the guidelines and regulatory standards for research involving human beings, proposed by resolution no. 466/2012 of the National Health Council of Brazil, and was approved by the local Research Ethics Committee (approval no. 3215923).

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Data availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available in accordance with privacy and ethical restrictions. ■

References

1 Vogel JP, Betrán AP, Vindevoghel N, Souza JP, Torloni MR, Zhang J, et al. Use of the Robson classification to assess caesarean section trends in 21 countries: a secondary analysis of two WHO multicountry surveys. *Lancet Glob Heal* 2015;3:e260–70.
2 Birsner ML, Flint Porter T. Cesarean delivery on maternal request - ACOG. *Am Coll Obstet Gynecol* 2019;133:e73–7.
3 Victora CG, Aquino EM, Do Carmo Leal M, Monteiro CA, Barros FC, Szwarcwald CL. Maternal and child health in Brazil: progress and challenges. *The Lancet* 2011;377:1863–76.
4 World Health Organization. *WHO Statement on Caesarean Section Rates*. Geneva, Switzerland: World Health Organization; 2015.
5 Betran AP, Torloni MR, Zhang JJ, Gülmezoglu AM. WHO statement on caesarean section rates. *BJOG: Int J Obstet Gynaecol* 2016;123:667–70.
6 Betran AP, Torloni MR, Zhang J, Ye J, Mikolajczyk R, Deneux-Tharaux C, et al. What is the optimal rate of caesarean section at population level? A systematic review of ecologic studies. *Reprod Health* 2015;12:57.
7 Ye J, Zhang J, Mikolajczyk R, Torloni MR, Gülmezoglu AM, Betran AP. Association between rates of caesarean section and maternal and neonatal mortality in the 21st century: a worldwide population-based ecological study with longitudinal data. *BJOG: Int J Obstet Gynaecol* 2016;123:745–53.
8 Althabe F, Belizán JM. Caesarean section: the paradox. *The Lancet* 2006;368:1472–3.
9 Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L, et al. Global epidemiology of use of and disparities in caesarean sections. *The Lancet* 2018;392:1341–8.
10 Barros AJD, Victora CG, Horta BL, Wehrmeister FC, Bassani D, Silveira MF, et al. Antenatal care and caesarean sections: trends and inequalities in four population-based birth cohorts in Pelotas, Brazil, 1982–2015. *Int J Epidemiol* 2019;48:I37–45.
11 Mylonas I, Friese K. Indications for and risks of elective cesarean section. *Dtsch Arztebl Int* 2015;112:489–95.

12 Patah LEM, Malik AM. Modelos de assistência ao parto e taxa de cesárea em diferentes países. *Rev Saude Publica* 2011;45:185–94.

13 Ramires De Jesus G, Ramires De Jesus N, Peixoto-Filho FM, Lobato G. Caesarean rates in Brazil: what is involved? *BJOG: Int J Obstet Gynaecol* 2015;122:606–9.

14 Torloni MR, Betran AP, Souza JP, Widmer M, Allen T, Gulmezoglu M, et al. Classifications for cesarean section: a systematic review. *PLoS One* 2011;6:e14566.

15 Robson MS. Classification of caesarean sections. *Fetal Maternal Med Rev* 2001;12:23–39.

16 Bittencourt AC, Negrão M, Paulo S. Iniciativas para diminuir o número de cesáreas excessivas no Brasil: Projeto Parto Adequado. 2017. http://hdl.handle.net/10438/18978

17 Agência Nacional de Saúde Suplementar Sociedade Beneficente Israelita Brasileira Hospital Albert Einstein, Institute for Healthcare Improvement. *Nova organização do cuidado ao parto e nascimento para melhores resultados de saúde. Projeto Parto Adequado - Fase 1*. Rio de Janeiro, Brazil: Agência Nacional de Saúde Suplementar Sociedade Beneficente Israelita Brasileira Hospital Albert Einstein, Institute for Healthcare Improvement; 2016. http://www.ans.gov.br/images/stories/Materiais_para_pesquisa/Materiais_por_assunto/web_total_parto_adequado.pdf

18 ANS. *Agência Nacional de Saúde Suplementar - Projeto Parto Adequado*. Brasília, Brazil: ANS. https://www.ans.gov.br/gestao-em-saude/parto-adequado

19 Borem P, de Cássia SR, Torres J, Delgado P, Petenate AJ, Peres D, et al. A quality improvement initiative to increase the frequency of vaginal delivery in Brazilian hospitals. *Obstet Gynecol* 2020;135:415–25.

20 Torres JA, Leal MdC, Domingues RMSM, Esteves-Pereira AP, Nakano AR, Gomes ML, et al. Evaluation of a quality improvement intervention for labour and birth care in Brazilian private hospitals: a protocol. *Reprod Health* 2018;15:194.

21 Betrán AP, Vindevoghel N, Souza JP, Gülmezoglu AM, Torloni MR. A systematic review of the Robson classification for caesarean section: what works, doesn't work and how to improve it. *PLoS ONE* 2014;9:e97769.

22 Le Ray C, Blondel B, Prunet C, Khireddine I, Deneux-Tharaux C, Goffinet F. Stabilising the caesarean rate: which target population? *BJOG: Int J Obstet Gynaecol* 2015;122:690–9.

23 Megli C, Caughey AB. 921: 40 is the new 30! risk of cesarean section increases exponentially with age. *Am J Obstet Gynecol* 2017;216:S525.

24 Hellerstein S, Feldman S, Duan T. China's 50% caesarean delivery rate: is it too high? *BJOG: Int J Obstet Gynaecol* 2015;122:160–4.

25 Nakamura-Pereira M, Do Carmo Leal M, Esteves-Pereira AP, Domingues RMSM, Torres JA, Dias MAB, et al. Use of Robson classification to assess cesarean section rate in Brazil: the role of source of payment for childbirth. *Reprod Health* 2016;13:128.

26 Sobhy S, Arroyo-Manzano D, Murugesu N, Karthikeyan G, Kumar V, Kaur I, et al. Maternal and perinatal mortality and complications associated with caesarean section in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet* 2019;393:1973–82.

27 Mascarello KC, Horta BL, Silveira MF. Maternal complications and cesarean section without indication: systematic review and meta-analysis. *Rev Saude Publica* 2017;51:105.

28 Deneux-Tharaux C, Carmona E, Bouvier-Colle MH, Bréart G. Postpartum maternal mortality and cesarean delivery. *Obstet Gynecol* 2006;108:541–8.

29 Mascarello KC, Matijasevich A, Santos IdSd, Silveira MF. Early and late puerperal complications associated with the mode of delivery in a cohort in Brazil. *Rev Bras Epidemiol* 2018;21. https://doi.org/10.1590/1980-549720180010

30 Tita ATN, Landon MB, Spong CY, Lai Y, Leveno KJ, Varner MW, et al. Timing of elective repeat cesarean delivery at term and neonatal outcomes. *N Engl J Med* 2009;360:111–20.

31 Domingues RMSM, Dias MAB, Nakamura-Pereira M, Torres JA, d'Orsi E, Pereira APE, et al. Process of decision-making regarding the mode of birth in Brazil: from the initial preference of women to the final mode of birth. *Cad Saude Publica* 2014;30(suppl 1):S101–16.

32 Kingdon C, Downe S, Betran AP. Women's and communities' views of targeted educational interventions to reduce unnecessary caesarean section: a qualitative evidence synthesis. *Reprod Health* 2018;15. https://doi.org/10.1186/s12978-018-0570-z

33 Panda S, Begley C, Daly D. Clinicians' views of factors influencing decision-making for caesarean section: a systematic review and metasynthesis of qualitative, quantitative and mixed methods studies. *PLOS ONE* 2018;13:e0200941.

34 Betrán AP, Temmerman M, Kingdon C, Mohiddin A, Opiyo N, Torloni MR, et al. Interventions to reduce unnecessary caesarean sections in healthy women and babies. *The Lancet* 2018;392:1358–68.

35 Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: global, regional and national estimates: 1990–2014. *PLoS One* 2016;11:e0148343.

36 Sandall J, Tribe RM, Avery L, Mola G, Visser GH, Homer CS, et al. Short-term and long-term effects of caesarean section on the health of women and children. *The Lancet* 2018;392:1349–57.

37 The American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine with the assistance of Caughey AB, Cahill AG, Guise J-M, Rouse DJ. Safe prevention of the primary cesarean delivery. *Am Coll Obstet Gynecol* 2014;210:693–711.

38 Spong CY, Berghella V, Wenstrom KD, Mercer BM, Saade GR. Preventing the first cesarean delivery: summary of a joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-fetal Medicine, and American College of Obstetricians and Gynecologists Workshop. *Obstet Gynecol* 2012;120:1181–93.

39 Kelly S, Sprague A, Fell DB, Murphy P, Aelicks N, Guo Y, et al. Examining caesarean section rates in Canada using the Robson classification system. *J Obstet Gynaecol Canada* 2013;35:206–14.

40 Hehir MP, Ananth CV, Siddiq Z, Friedman AM, Alton MED. Cesarean delivery in the United States 2005–2014: a population-based analysis using the Robson ten group classification system. *Am J Obstet Gynecol* 2018;219:105.e1–105.e11.

41 Caparelli E, Meirelles E, Coaracy Pedro Ivo Alcantara G, Albuquerque Carolina Velho C, Cristina Matos A, Carlos Borges de Oliveira Jucilene Rocha R. Quem espera, espera. Unicef Brazil; 2017.

42 Royal College of Obstetricians and Gynaecologists. *Birth After Previous Caesarean Birth* [Internet], vol. 45. London, UK: Royal College of Obstetricians and Gynaecologists; 2015. [https://www.rcog.org.uk/globalassets/documents/guidelines/gtg_45.pdf]. Accessed 3 February 2020.

43 Chen I, Opiyo N, Tavender E, Mortazhejri S, Rader T, Petkovic J, et al. Non-clinical interventions for reducing unnecessary caesarean section. *Cochrane Database Syst Rev* 2018;9:CD005528.

44 Zhang J, Geerts C, Hukkelhoven C, Offerhaus P, Zwart J, De Jonge A. Caesarean section rates in subgroups of women and perinatal outcomes. *BJOG: Int J Obstet Gynaecol* 2016;123:754–61.

45 Betrn AP, Gulmezoglu AM, Robson M, Merialdi M, Souza JP, Wojdyla D, et al. WHO global survey on maternal and perinatal health in Latin America: classifying caesarean sections. *Reprod Health* 2009;6:1–8.

46 Agencia Nacional de saúde. *Projeto Parto Adequado conquista novas vitórias, com redução expressiva de cesáreas e de internações em UTI neonatal - ANS - Agência Nacional de Saúde Suplementar* [Internet]. Brasília, Brazil: Agencia Nacional de saúde; 2016. [http://ans.gov.br/comunicacao-e-imprensa/releases/sociedade/3263-projeto-parto-adequado-conquista-novas-vitorias-com-reducao-expressiva-de-cesareas-e-de-internacoes-em-uti-neonatal]. Accessed 9 May 2021.