INSTITUTIONAL FACTORS ASSOCIATED WITH THE TYPE OF CHILDBIRTH: WHAT HAPPENED TO PUBLIC POLICIES? – NOTES FROM BRAZIL

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ABSTRACT

Objectives: to estimate the prevalence of cesarean sections and institutional factors associated with type of delivery in Brazil.

Methods: data on births in Brazil in 2016 were collected. Demographic characteristics, related to pregnancy and birth hospital regime (public or private) were evaluated. For each raised hypothesis, the variables were modeled by binary logistic regression, whose outcome was type of delivery.

Results: the prevalence of cesarean sections in Brazil in 2016 was of 52.8%; 38.1% in public hospitals and 92.8% in private hospitals. The association between cesarean section and the hospital's legal regime was highlighted in the logistic model, with a positive association and interaction between age groups (OR = 23.26; 95% CI: 13.39-41.79 for women between 20 and 24 years old and OR = 51.04; 95% CI 31.06 - 84.23 for women aged 35 and over).

Conclusions: the performance of childbirth in Brazil meets the routines and recommendations established in the Brazilian Unified Health System policies regarding women's health and humanized childbirth.

Key-words Women's health, Cesarean section, Socioeconomic factors, Health management, Hospital administration

INTRODUCTION

The excessively over-medicalized childbirth care model has been criticized worldwide, culminating in the adoption of maternal health as a priority in the international agenda in recent years,[1,2] as well as national policies,[3,4] translated into the creation of a routine of systematic evaluation of obstetric practices, in light of what the World Health Organization (WHO) has adopted over the last decades.[5,6]

Normal childbirth is considered a physiological event that requires support, evaluation and vigilance. Evidence indicates that intervention in this process must be justified by a very valid reason.[7] A caesarean section, on the other hand, is a procedure introduced into obstetrical practice with the purpose of preserving maternal and child lives put at risk by complications during the prenatal period and during childbirth. The WHO recommends that cesarean rates should be kept below 15%.[8] However, its use has increased over the last three decades, with rates up to 50% observed in some countries.[9] Specifically regarding Latin America, most countries have high rates of cesarean delivery. Brazil is among them, and cesarean delivery rates in this country are still on the rise, increasing from 38.9% in 2000 to 46.5% in 2007. Preliminary data for 2016 indicate a rate of 56.64%, reaching 62.66% in the southern region of the country.[10] This increase in cesarean sections in Brazil, observed predominantly since

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1970, highlight the importance of identifying and studying the factors associated with the decision by type of delivery.

The diagnosis of cesarean overuse in Brazil has generated growing concerns about its indiscriminate use, generated by issues ranging from the quality of obstetric care to the meaning of parturition for women.[11,12] Thus, it is necessary to understand the factors that lead to the increase of this practice, so that public policy actions may be designed for specific population groups in order to increase their effectiveness.[13]

In this context, the aims of the present study are to describe the prevalence of cesarean sections and estimate the magnitude of the associations between type of delivery and demographic and pregnancy-related characteristics in both public and private hospitals in Brazil.

METHODS

This study consisted in a cross-sectional study, with the unit of analysis being live birth. This information is available through the Brazilian Declaration of Live Birth, which feeds the administrative registry, whose destination route to the Municipal Health Secretariat (and subsequently to the other levels of Health Information) feeds a specific Information System that contains data concerning all births in Brazil.

Microdata belonging to the Information System on Live Births regarding births in hospital environments in Brazil in 2016 were utilized. The following variables were employed: age, categorized in the age ranges of: "up to 19 years old", "20 to 24 years old", "25 to 29 years old", "30 to 34 years old ", and "35 years old and over"; marital status, categorized as with no spouse ("single", "widower" and "separated") and with spouse ("married" and "consensual union"); schooling, categorized as "up to 8 years of schooling" and above "8 years of schooling"; type of pregnancy, categorized as "single" or "multiple"; gestational age, categorized as "pre-term and post-term" and "term"; primiparous, categorized as "yes" and "no"; type of health establishment, categorized as "public" and "private"; number of prenatal consultations,[4] characterized as “adequate” (7 consultations or more) or "inadequate" (less than 7 consultations);[4] place of residence, considering whether the puerperal woman resided in the same locale as her birth occurred, classified as "yes" or "no"; and, finally, the type of delivery variable categorized as "vaginal" and "cesarean section".

The dichotomous type of delivery variable was considered as the outcome variable (dependent), while the other variables were evaluated as variables of interest (independent). Hypotheses were elaborated based on the variables of interest. For each raised hypothesis, the variables were modeled through binary logistic regression, whose outcome was “cesarean section”. In order to evaluate model fits, its deviance analysis was established, in order to compare the difference between the deviances of the null model (with the intercept only) and the variable of choice.

After performing the univariate modeling, the variables were introduced in a multivariate model, based on the strength of association that each variable assumed in relation to the outcome. Differences between the deviances were observed in order to evaluate model fit. After verifying the model with the inclusion of all statistically

significant explanatory variables, the suitability of certain interaction terms was tested. The choice of interaction terms was based on the underlying theoretical framework. For this, the null hypothesis was considered as the model in which the statistically significant variables were included, obtained following the previously described step.

To validate the established logistic regression model, validation tests were first applied to verify if the adjusted logistic model was adequate. The Hosmer-Lemeshow, Pearson and Deviance tests were used for this purpose.[14]

Finally, because this is a study employing secondary, public, databases, unidentifiable according to resolution 466/2012, this study is exempt from approval by an Ethics Committee.

RESULTS

In 2016, the Information System on Live Births (*Sistema de Informações sobre Nascidos Vivos* - SINASC) registered 2,855,364 total births performed in hospitals in Brazil. The descriptive data of the study estimated the prevalence of cesarean sections at 58.2%, predominantly among young, single, high schooled, multiparous women with single, full term, gestations. Regarding prevalence of cesarean sections by type of hospital, a statistically significant difference ($p < 0.001$) was observed, with the prevalence of 38.1% of cesarean sections performed in public hospitals and 92.8% in private ones.

This profile is not the same when observing births according to type of delivery (Table 1). Generally speaking, vaginal births are more frequent among younger, single, high schooled women with single, multiparous and full-term pregnancies, while cesarean deliveries are more frequent in slightly older women. Among these, a higher frequency of married multiparous women, with higher high schooling, multiple pregnancies and premature birth rates is observed.

Since a statistically significant difference was observed for all variables in the bivariate analysis (Table 1), modelling was conducted by logistic regression. Initially, univariate models were tested in order to compare their fit with the null model, without the presence of any variables and considering only the intercept. When testing the alternative models, all variables contributed to the explanation of the phenomenon. Thus, after evaluating the differences between the deviances of the null and alternative models, multivariate modeling was performed.

Subsequently, based on the multiple logistic regression, a model was constructed to estimate the probability of a woman undergoing a cesarean section delivery in hospitals in Brazil. A reduced model with 12 parameters (9 independent variables and 3 terms of interaction) was obtained, all statistically significant at the 1% level. The explanatory power of this model was 46% (Naegelkerke's R^2). Table 2 presents more detailed information about this chosen model.

Table 1: Parturition type frequency, according to demographic and clinical characteristics. Brazil, 2016 (N= 2,979,259).

Variables	Delivery						P value
	Vaginal		Cesarean		Total		
	n	%	n	%	n	%	
Age group (years)							**<0.001**
Up to 19	354,400	26.69	156,113	9.45	510,513	17.14	
20-24	392,702	29.58	295,350	17.88	688,051	23.09	
25-29	273,102	20.57	414,316	25.09	687,418	23.07	
30-34	190,539	14.35	457,821	27.72	648,360	21.76	
35 or over	116,878	8.80	328,038	19.86	444,916	14.93	
Total	1,327,621	100.00	1.651,638	100.00	2,979,259	100.00	
Civil state							**<0.001**
Without spouse	1,022.961	77.05	846,540	51.25	1,869,501	62.75	
With spouse	304,661	22.95	805,098	48.75	1,109,758	37.25	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	
Schooling							**<0.001**
Up to 8 years	440,950	33.21	235,368	14.25	676,319	22.70	
8 years or more	886,671	66.79	1,416,270	85.75	2,302,940	77.30	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	
Type of pregnancy							**<0.001**
Single	1,317,040	99.20	1,592.055	96.39	2,909,095	97.64	
Multiple	10,581	0.80	59,583	3.61	70,164	2.36	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	
Primiparous							**<0.001**
Yes	849,487	63.99	956,618	57.92	1,806,104	60.62	
No	478,135	36.01	695,020	42.08	1,173,155	39.38	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	
Gestation							**<0.001**
Premature	1,138,574	85.76	1,384,981	83.85	2,523,553	84.70	
Up to term	189,048	14.24	266,657	16.15	455,706	15.30	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	
Pre-natal consultations							**<0.001**
Adequate	565,318	42.58	333,064	20.17	898,382	30.15	
Inadequate	762,303	57.42	1,318,574	79.83	2,080,877	69.85	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	
Type of establishment							**<0.001**
Public	1,243,455	93.66	683,403	41.38	1,926,858	64.68	
Private	84,166	6.34	968,235	58.62	1,052,401	35.32	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	
Place of residence							**<0.001**
Same as child birth place	1,219,088	91.82	1,445,296	87.51	2,664,384	89.43	
Different than child birth place	108,533	8.18	206,342	12.49	314,875	10.57	
Total	1,327,621	100.00	1,651,638	100.00	2,979,259	100.00	

Table 2. Logistic regression model with associations adjusted for statistically significant covariates and type of delivery. Brazil, 2016. (N= 2,979,259).

Variables	Levels	β	Standard error	95% CI		Wald Test (Z)	*p*	gl
				Min	Máx			
(Intercept)		-1.171	0.039	-1.248	-1.094	892.336	< 0.001	1
Establishment	Private hospital	2.846	0.192	2.485	3.240	219.840	< 0.001	1
Age[b]	20 to 24 years old	0.085	0.012	0.062	0.107	10.008	0.002	1
	25 to 29 years old	0.272	0.054	0.166	0.378	25.170	< 0.001	1
	30 a to 34 years old	0.394	0.055	0.285	0.502	50.481	< 0.001	1
	35 years old or more	0.570	0.058	0.457	0.683	98.089	< 0.001	1
Type of pregnancy[c]	Multiple	1.554	0.070	1.419	1.693	494.306	< 0.001	1
Civil statel[d]	With spouse	0.059	0.020	0.019	0.099	8.480	0.004	1
Schooling[e]	High	0.090	0.039	0.013	0.167	9.268	0.001	1
Pre-natal consultations[f]	7 or more	0.292	0.019	0.256	0.329	246.741	< 0.001	1
Place of residence[g]	Another municipality	0.524	0.028	0.469	0.578	356.417	< 0.001	1
Number of child births[h]	Primiparous	0.186	0.041	0.106	0.267	11.871	< 0.001	1
Type of gestation[i]	Pre-term and Post-term	0.253	0.024	0.207	0.300	113.124	< 0.001	1
Interaction term 1	Private*20 to 24 years old	0.083	0.021	0.041	0.125	7.152	< 0.001	1
(establishment*age group)	Private *25 to 29 years old	0.146	0.020	0.106	0.186	10.006	< 0.001	1
	Private *30 to 34 years old	0.238	0.020	0.199	0.278	101.409	< 0.001	1
	Private *35 years old or more	0.520	0.023	0.475	0.565	355.574	< 0.001	1
Interaction term 2	High*20 to 24 years old	0.169	0.056	0.059	0.279	9.006	0.003	1
(schooling*age group)	High *25 to 29 years old	0.218	0.059	0.102	0.335	13.550	<0.001	1
	High 30 a 34 anos	0.310	0.062	0.188	0.432	24.850	<0.001	1
	High 35 years old or more	0.477	0.067	0.345	0.609	50.240	<0.001	1
Interaction term 3	Primiparous*20 a 24 anos	0.181	0.055	0.074	0.289	10.923	0.001	1
(number of childbirths*age group)	Primiparous	0.379	0.061	0.259	0.498	38.452	< 0.001	1
	Primiparous*30 to 34 years old	0.368	0.077	0.217	0.520	22.743	< 0.001	1
	Primiparous*35 years old or more	0.459	0.105	0.254	0.667	19.010	< 0.001	1
Interaction term 4	Private*Primiparous	0.175	0.056	0.065	0.285	10.601	0.004	1
(establishment * number of childbirths)								

a. The reference range is Public establishment"; b. The refernce range is "until 19 years of age"; c. The reference range is "only one"; d. The reference range is "no spouse"; e. The reference range is "Low - until 8 schooling years"; f. The reference range is "Less than 7 consultations"; g. The reference range is "Same as the birth locale"; h. The reference range is "Multiparous"; i. The reference range is "Full term gestation (37 to 41 weeks)".

After defining the model, the Hosmer-Lemeshow and Deviance adjustment adequacy statistics were applied, to verify the hypotheses regarding the acceptance of the model. The hypotheses were thus formulated as H_0, where the fit of the data is good versus H_1, where the adjustment of the data is not good. Analysis of the residues by the chi-square test for the deviances yielded a value of 0.96, while th Hosmer-Lemeshow statistic resulted in 2.84 (10 gl), thus leading to a value of 0.94.

In addition to the presented statistics, three other model discrimination indices o were also evaluated. The C statistic evaluates the discrimination capability of the model by calculating the ROC curve area, and ranges from 0.5 to 1, where values closer to 1 indicate a more appropriate the model. The value for this statistic for the chosen model was 0.82, classified as excellent according to the Hosmer and Lemeshow criteria.[11] The D_{xy} statistics (Somers correlation) establishes the correlation between the estimated probabilities and the observed responses, and ranges from 0 and 1, where zero means that the prediction models are completely random, and 1 means that the model is perfectly discriminatory. The obtained value for the chosen model was 0.69. Finally, the sensitivity and specificity of the model were evaluated through contingency tables, with values of 66% and 89%, respectively. This indicates that this is indeed a more specific model, with higher and more accurate discriminatory rates concerning cesarean section cases compared to vaginal delivery cases. Thus, the model was considered adequate for the purposes of the present study.

After performing the model adjustments, it was then applied to estimate the probability of a pregnant woman undergoing a cesarean section. Considering the particular interest in observing the difference of this probability for public and private hospitals, we chose to estimate the probabilities, chances and odds ratios for the terms concerning type of establishment (public or private hospitals). All variables included in the estimated probability formulas are of the dummy type, so that the calculation of the success probability (cesarean section) for each type of establishment is calculated by setting the values of the other variables, assigning the value of 1 when the location is public and zero when private. Thus, the estimated probabilities and the odds according to the values presented in Table 3 were obtained for each age group.

Finally, Figures 1 and 2, respectively, represent the curves regarding the estimated probability of performing a cesarean section and of undergoing a vaginal delivery per type of establishment according to age group, as well as the propensity of increasing the odds ratio for each age group. It should be noted that the estimated probability increases with increasing age, at a different level for each type of establishment (unequivocally, a greater probability in private hospitals is observed). However, it is important to note that the two curves are not parallel, evidencing an interaction effect between age and type of hospital (public or private). The evidence regarding the possibility of a cesarean section being higher with increasing age is, thus, reinforced, with a trend for age strata present.

Table 3: Estimated probabilities, chances and odds ratio for cesarean section delivery in women according to age group. Brazil, 2016 (N=2,855,364).

Age group	π_1	π_0	π_1 ratio	π_0 ratio	*Odds Ratio*	95% CI	
20 to 24 years old	0.89	0.25	7.85	0.34	23.26	13.39	33.13
25 to 29 years old	0.93	0.29	13.04	0.41	32.03	19.27	44.79
30 to 34 years old	0.95	0.37	17.03	0.46	37.03	23.1	50.96
35 years old or more	0.97	0.45	27.98	0.55	51.04	31.96	70.12

$_{OR}$ 95% CI: Confidence interval of the odds ratio at a significance level of 95%.

Figure 1: Estimated probability curves for cesarean section and vaginal delivery per type of establishment according to age group. Brazil, 2016 (N=2,855,364).

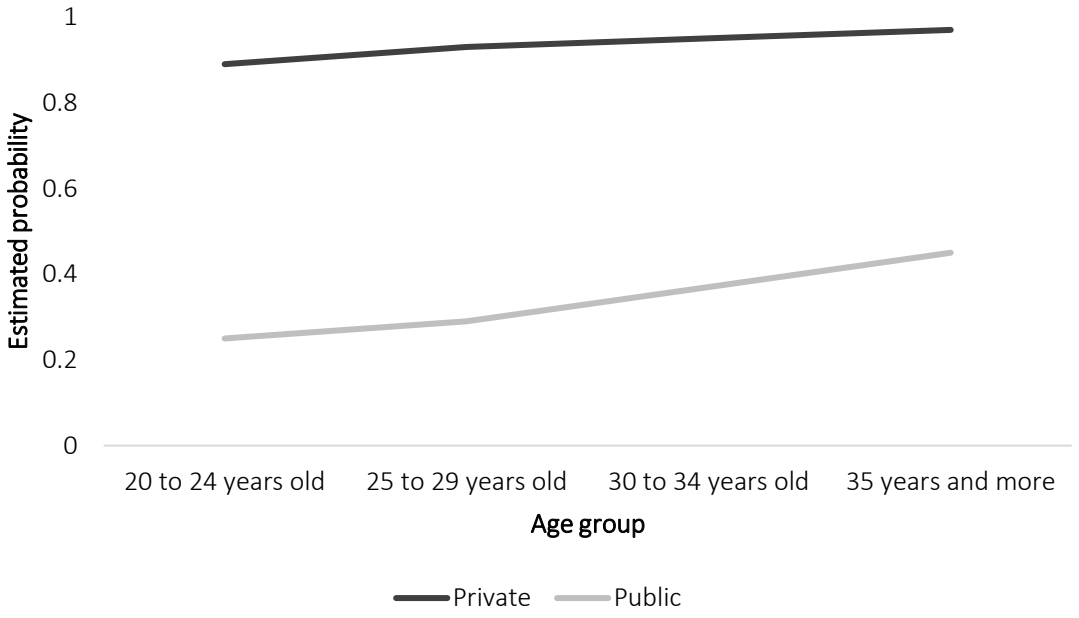
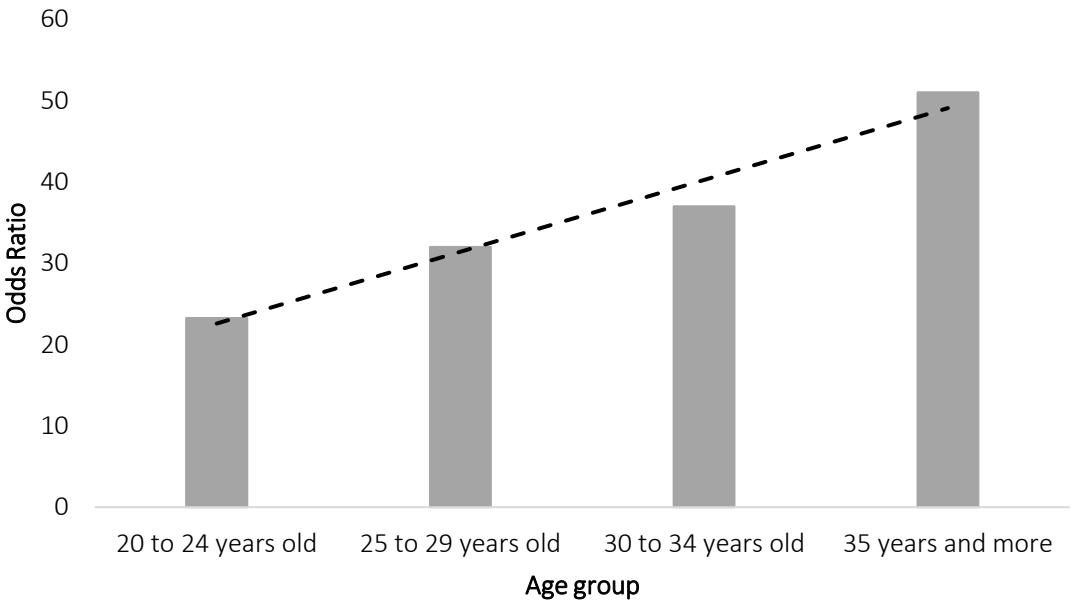


Figure 2: Increasing trend of the odds ratio for type of delivery according to type of establishment for each age group.



From the information displayed in aforementioned tables and graphs, an advantage of women in private hospitals being submitted to cesarean sections compared to women in public hospitals is clear. In addition, an interaction with age was also observed, or, in other words, this advantage presents a different magnitude according to age. Finally, this advantage grows with increasing age. For example, women aged 35 or more display an advantage concerning a cesarean section 5000% higher compared to women under 19 in private hospitals. It is worth noting that the estimated probability for 35-year-old women in private hospitals is approximately 97%, or, in other words, almost all the births performed in these institutions occur in this age group.

DISCUSSION

Maternal factors associated with cesarean sections were observed in Brazil. The risk factors presented herein are consistent with those presented in the literature. A cross-sectional study conducted in Rio Grande do Sul evaluating 2591 live births observed a significant association for age group and choice of delivery for age groups 20-24 (OR = 1.13), 25-29 (OR = 1, 36) and 30 years old or more (OR = 1.21); for marital status with partner (OR = 1.26); for high schooling (OR = 1.28); for multiple pregnancies (OR = 2.01); and for protective association in multiparous women (OR = 0.94).[15]

Some associations seem to hold even among patients who perform prenatal care in public facilities, as observed in a study carried out with 322 pregnant women performing prenatal care at a Basic Health Unit in Rio de Janeiro, in which an association for the most advanced age group (OR = 4.82) and married marital status (OR = 3.05) were found. [16]

Studies carried out in maternities also corroborate the direction of the observed associations. For example, a case-control study at a public maternity hospital in the city of Rio de Janeiro evaluated 231 cesarean deliveries (cases) and 230 vaginal deliveries (controls). Through multivariate logistic regression analyses, the authors found a positive association for cesarean sections in women older than 35 (OR = 7.3) and for primiparous women within the multiparous reference category (OR = 6.7).[17] In addition, in the evaluation of a general hospital sample of 15,336 women (therefore, not a maternity), Padua *et al*.[18] found a significant association for the more advanced age groups, stratified as 20 to 24 years old (OR = 1.26), 25 to 29 (OR = 1.54), 30 to 34 (OR = 1.82), and 35 years or more (OR = 2.05). The same study found a significant association for the married civil status (OR = 1.25) and for a greater number of prenatal consultations (OR = 1.24).

It is important to emphasize the importance of understanding the social representations of normal and cesarean sections births for women, which is a qualitative aspect difficult to measure. A qualitative study was conducted with 20 women in Santa Catarina who experienced both birth types. The results reveal several representations in the motherhood experience, such as the search for information, the experience of parturition alone versus accompanied, and the idea that the woman has no choice. Vaginal childbirth encompassed central themes such as feelings of ambivalence, positive perception and hospitalization. Cesarean sections were also related to feelings of ambivalence, the solution of a problem and the preference for the procedure. In other words, vaginal birth is considered a challenge for women, although positive feelings outweigh difficulties, while cesarean sections are associated to physical benefits related to its accomplishment.[19]

It is also noteworthy that lack of humanized attention and induction often results in women opting for a caesarean section. In addition, unpreparedness for vaginal delivery interferes directly with the emotional system of the pregnant or parturient patient, reducing her confidence in the ability to be the protagonist of her delivery if she is not received by a providing health service. Thus, she cannot understand the advantages of vaginal delivery and concludes that the cesarean section will bring more benefits for her and the baby.[20]

A difference was observed between public and private services regarding type of delivery choice. This data, the most consistent of all explanatory variables, is corroborated by the literature. For example, the study conducted by Barros *et al*.[21] on a cohort made up of all the newborns from the urban area of Pelotas in 2004 indicated a 45% prevalence of cesarean sections for the population. When stratified by type of service, rates were 36% among patients from the Unified Health System and 81% in the private service. Similarly, another study[15] indicated a cesarean section rate of 43% for the public group and of 86% for the private group. In addition, a recent study was conducted in Maringá to evaluate the temporal trend of childbirth delivery routes according to funding source,[5] during 11 years of observation. The results indicated that 77.1% of deliveries were cesarean sections and only 22.9% were vaginal deliveries. In addition, an increasing trend for cesarean sections and decreasing trend for vaginal

delivery in both types of funding (public and private) was evidenced. Cesarean section rates in private hospitals were always higher than 90% and more frequent than in public hospitals, even with a 36% increase in public hospitals during the study period.

It is important to note that factors such as excessive intervention during the gestation, delivery and puerperium processes are obstacles to the success of women´s national policy, making it difficult to reach the goals of decreasing maternal mortality.[22] This problem occurs even in women displaying low obstetric risks.[23] This phenomenon of intense medicalization of the birth process associated with the maintenance of high maternal and perinatal mortality, is known as the Brazilian perinatal paradox.[24] This is, therefore, evidence that justifies the reorientation of the model of attention to pregnancy, childbirth and the puerperium. In this sense, progress has been made in recent years in Brazil to organize obstetric care in the SUS network. Particularly noteworthy is the "Stork" Network, standardized by Administrative Rule No. 1459, that aims to increase access and improve the quality of prenatal, childbirth and puerperium care, as well as child care up to 24 months of age,[4] as a stimulus to decrease maternal mortality. In this context, attempts to systematize the routines and the itinerary of pregnant women are made, providing pregnant and puerperal women and newborns with a humane and quality care. This is achieved by linking pregnant women to the reference unit for childbirth and safe transport and by the implementation of good practices in childbirth and birth care.[4,25]

This study has limitations, in particular, the use of secondary SINASC data, thus making it impossible to evaluate other variables that are not present in the Declarations of Live Births. However, since this database considers births throughout Brazil, it displays excellent accuracy,[26] and the evidence produced from its analysis should be taken into account.

This study indicates that childbirth delivery in Brazil meets the routines and recommendations established in the women's health and humanized childbirth policies stated by the Unified Health System. It is, therefore, important that there be a reflection on this theme, so that measures to monitor obstetric practices are implemented, complying with international recommendations for better clinical management and the humanization of the labor process.

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