

# The Impact of Payment Source and Hospital Type on Rising Cesarean Section Rates in Brazil, 1998 to 2008

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**ABSTRACT: Background:** High cesarean section rates in Brazilian public hospitals and higher rates in private hospitals are well established. Less is known about the relationship between payment source and cesarean section rates within public and private hospitals. **Methods:** We analyzed the 1998, 2003, and 2008 rounds of a nationally representative household survey (PNAD), which includes type of delivery, where it took place, and who paid for it. We construct cesarean section rates for various categories, and perform logistic regression to determine the relative importance of independent variables on cesarean section rates for all births and first births only. **Results:** Brazilian cesarean section rates were 42 percent in 1998 and 53 percent in 2008. Women who delivered publicly funded births in either public or private hospitals had lower cesarean section rates than those who delivered privately financed deliveries in public or private hospitals. Multivariate models suggest that older age, higher education, and living outside the Northeast region all positively affect the odds of delivering by cesarean section; effects are attenuated by the payment source–hospital type variable for all women and even more so among first births. **Conclusions:** Cesarean section rates have risen substantially in Brazil. It is important to distinguish payment source for the delivery to have a better understanding of those rates. (BIRTH 41:2 June 2014)

**Key words:** Brazil, cesarean section, hospital type, nonclinical factors, payment source

Brazil has a long history of high cesarean section rates and of large differences between the rates of surgical births in the public and private sectors (1–3). Cesarean section rates are extraordinarily high in private for-profit hospitals, and rates of 80 percent of all deliveries have been documented (2). Public hospitals, on the other hand, have previously been shown to have cesarean rates in the 20 to 30 percent range (2,4). Though considerably lower in public institutions, these rates are still up to double the 15 percent maximum level recom-

mended by the World Health Organization (5–8). These very high cesarean rates likely lead to a large number of unnecessary surgeries. Indeed, in the late 1990s, when cesarean section rates were lower than currently, it was estimated that over 850,000 unnecessary cesarean sections were performed each year in Latin America (6). In addition, like cesarean section rates in industrialized countries (9), rates for surgical delivery in Brazil have been increasing over the last decades (10).

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Although cesarean section rate differences in public and private hospitals in Brazil are well known, not all public hospital deliveries are publicly financed; likewise, some private hospital births are paid with public funds (much like a woman delivering a Medicaid-paid birth in a private hospital in the United States). Public funds for health care in Brazil come from the *Sistema Único de Saúde*, or SUS, which was established in 1988 and receives financing directly from federal and local governments. SUS is the free public health care system which was used by 75 percent of women between 15 and 49 years of age to cover their last delivery, as reported by the 2006 *Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher* (PNDS; authors' calculations). Private for-profit health insurance companies, either contracted by health care consumers on an individual basis or provided by an employer, pay for the majority of medical services in private for-profit hospitals that do not accept SUS patients. The 2006 PNDS shows that 15 percent of hospital deliveries were paid for with private insurance. Direct out-of-pocket payment is a third source of payment for health care, but it is less often used and generally only by the high income population (11). Around 8 percent of women had the last delivery at private hospitals with direct out-of-pocket payment, according to the 2006 PNDS.

Hospitals are run by either public or private entities. While public hospitals accept SUS patients and those with private health insurance, private hospitals vary in whether or not they accept SUS patients. This difference, therefore, leads to four categories of payment source–hospital type, depending on the source of funds to cover the delivery and the location where the delivery took place: 1) payment by public funds (SUS) in publicly run hospitals, 2) payment by private funds (private insurance or direct out-of-pocket payment) in public hospitals, 3) payment by public funds in privately run hospitals, and 4) payment by private funds in privately run hospitals.

This paper examines the relationship in overall cesarean section rates between 1998 and 2008 and cesarean section rates in first births in 2008 by payment source, about which less is known, and hospital type, as well other nonclinical factors such as women's education level.

### Data and Methods

This paper analyzes data from the 1998, 2003, and 2008 Brazilian household surveys, the *Pesquisa Nacional por Amostra de Domicílios* (PNAD). We focus on the three surveys conducted after the 1988 Brazilian constitution implemented SUS and that include supplemental health questions of interest.

Our main outcome variable is defined as whether a woman delivered in a hospital by cesarean section or vaginally in the previous 12 months, and we restrict the sample to women between the ages of 15 and 49. Our independent variables are age, years of schooling, live birth order, region of residence, and the four-category variable, described above, for payment source and type of hospital in which the delivery took place. We created the live birth order variable by adding the number of children born to the woman who lived in the household at the time of the survey, number of children who lived in another place, and number of children who were already deceased. This allows us to identify first births by cesarean; however, we are unable to identify repeat cesarean sections in these data.

Out of a total of 314,369 women of reproductive age in the pooled sample in the three surveys, 30,170 received health care in the previous 12 months. Of these women, 13,266 were included for having had a cesarean or vaginal delivery as their most recent health care contact. Finally, we deleted 698 records (0.05% of the sample) that had missing values for any of the independent variables. Based on these criteria, our sample of 12,568 women in the pooled sample includes 4,645 records from the 1998 PNAD, 4,263 from the 2003 PNAD, and 3,660 records from the 2008 PNAD. Fertility declines in Brazil between 1998 and 2008 (12) likely account for the progressively lower number of women surveyed over the time period who had a delivery in the year before the survey.

Female sterilization at the time of delivery is also an important predictor of cesarean section (2), as sterilizations at the time of cesarean are much easier to obtain in Brazil than in the interval after delivery (13,14). Unfortunately, the PNAD surveys do not contain this variable, so we are unable to include it in our models.

In the analysis, we construct cesarean section rates for each survey year for each of the independent variables. We then construct 2008 cesarean section rates for the independent variables for each payment source–hospital type category. Next, we run logistic regression models to predict the odds of delivering by cesarean for each survey year, first estimating the effects for age, years of schooling, live birth order, and region. In a second set of models, we add in the payment–hospital variable. Finally, we run logistic regression models to predict the odds of delivering a first birth by cesarean in 2008. We used Stata 10.0 SE (Stata Corp., College Station, TX, USA) for the statistical analysis.

### Results

The overall cesarean rate rose from 42 percent to 44 percent in the 5 years between the 1998 and 2003 sur-

veys and then jumped to 53 percent in 2008 (Table 1), which is a 26 percent increase in the cesarean rate over the 10-year period. Rates are higher than average in all three survey periods for women 25 and over compared with younger women, women with completed high school or higher compared with those with less than high school, those with one or two children compared with women with three or more children, and women who live in the Southeast, South, and Central West compared with those who live in the North and Northeast regions.

On average, women who deliver publicly financed births in public hospitals are younger, less educated,

and have more children than all other groups, whereas women delivering privately financed deliveries in private hospitals are the oldest (by about 3 years), most highly educated (by about 4 years), and have the lowest number of children (about 0.5 children fewer). Women in the intermediate categories fall neatly in between these two groups; for instance, women in the SUS/private group are older than those delivering in SUS/public but younger than those delivering in non-SUS/public. These relationships hold across all three survey years (data not shown).

Table 1 also shows that cesarean rates are lowest among SUS-financed births delivered in public hospitals

**Table 1. Percentage Distribution of Women and Cesarean Section Rates by Categories of Individual and Structural Variables, Brazil, 1998, 2003, and 2008\***

Variables	1998		2003		2008	
	Total percent	Cesarean section percent	Total percent	Cesarean section percent	Total percent	Cesarean section percent
<b>Age</b>						
15–19	18.9	27.5	17.5	25.3	16.3	40.4
20–24	29.0	37.7	29.9	40.1	29.1	44.6
25–29	24.5	45.6	24.1	47.1	24.9	55.5
30–49	27.6	53.2	28.5	55.3	29.7	65.7
<b>Years of schooling</b>						
0–3	22.2	25.8	14.8	25.6	8.0	35.7
4–7	39.1	37.4	32.8	34.5	25.3	42.1
8–10	18.0	44.3	21.5	42.6	24.2	46.4
11	14.2	59.8	22.2	56.0	30.3	60.1
12+	6.5	79.2	8.7	78.4	12.2	82.0
<b>Live birth order</b>						
One child	41.2	43.9	43.7	46.1	46.6	57.5
Two children	29.7	47.1	27.7	48.5	31.2	53.7
Three or more children	29.1	34.0	28.6	34.7	22.2	42.3
<b>Region of residence</b>						
North	4.3	37.7	7.2	33.0	9.7	48.7
Northeast	30.2	28.5	29.3	31.1	29.5	44.2
Southeast	40.5	49.2	40.9	51.4	39.7	57.3
South	17.5	44.1	15.1	48.4	13.0	59.8
Central West	7.6	54.3	7.6	49.1	8.2	57.4
<b>Payment source<sup>†</sup>/type of hospital</b>						
SUS/public	63.6	31.0	65.7	31.6	70.6	41.2
SUS/private	9.7	40.8	9.4	39.7	2.9	56.5
Non-SUS/public	5.0	49.1	2.8	57.5	2.9	72.4
Non-SUS/private	21.6	72.9	22.1	78.8	23.6	85.0
<i>n</i> (analytic weight)	4,645	42.0	4,263	43.5	3,660	52.9
<i>N</i> (frequency weight)	2,111,531		1,911,071		1,773,573	

\*Analytic weight was used to estimate these frequencies, preserving the sample size (4,645 in 1998, 4,263 in 2003, and 3,660 in 2008); <sup>†</sup>SUS is the Brazilian governmentally funded health system (“Sistema Único de Saúde”). Source: 1998, 2003, and 2008 Brazilian household surveys (PNAD).

(31%, 32%, and 41% in the survey years, respectively). These publicly financed births in public hospitals also accounted for an increasing percentage of the distribution of all deliveries over the period, from 64 percent in 1998 to 71 percent in 2008. As expected, the cesarean section rates are considerably higher among privately financed births in private hospitals (73% in 1998, 79% in 2003, and 85% in 2008). These privately funded private hospital births also experienced little change in the coverage of deliveries between 1998 and 2008, accounting for 22 to 24 percent of deliveries in Brazil over the period. Intermediate rates were found for deliveries in which the payment source did not match the hospital ownership type. That is, SUS-financed deliveries in private hospitals are closer to the rates found among publicly funded public hospital deliveries, whereas privately funded deliveries in public hospitals are closer to the rates found among privately funded births in private hospitals. Finally, the share of deliveries in these intermediate categories decreased over the 10-year period.

Focusing on 2008, we find that cesarean section rates increase as we move across the four payment-hospital type categories for all but one age category (Table 2). For example, 36 percent of women 20–24 years old had a cesarean section among SUS/public deliveries, compared with 52 percent of this age group among SUS/private births, 61 percent among privately funded/public deliveries, and 79 percent among privately funded/private births. Likewise, cesarean section rates also increase across the categories for all but one of the education categories, with high to very high cesarean section rates among women with 12 or more years of education in all four categories (58% in SUS/public, 63% in SUS/private, 92% in non-SUS/public, and 89% in non-SUS/private). Cesarean section rates for women delivering a first or second child also increase across the four categories, with very high rates (>83%) among privately financed deliveries in private hospitals. Cesarean section rates for women delivering a third or high-order child, however, do not follow this pattern: Cesarean section deliveries in public hospitals (regardless of payment source) are much lower than those in private hospitals. In addition, although the intermediate payment-hospital type categories do not show a consistent regional pattern in cesarean section rates, they are typically low in all regions for publicly financed public hospital deliveries, whereas privately financed private hospital births are the highest across regions.

Next, in two sets of logistic regression models, we predict the odds of delivering by cesarean section in Brazil for each of the three survey years (Table 3). In the first set of models, which include controls for woman's age, years of schooling, live birth order, and region of residence, we find that the odds of delivering by cesarean increases with age and schooling in all sur-

vey years (although the difference between 15–19 year olds and 20–24 year olds is not statistically significant in 2008). Compared with women who delivered two children, women who delivered a first child had the same odds of delivering by cesarean in 1998 and 2003 and increased odds of delivering by cesarean in 2008. On the other hand, women delivering a third or high-order child had decreased odds of delivering by cesarean in all three survey years, compared with women with fewer children. In addition, compared with women who delivered in the Northeast, women in other regions

**Table 2. Cesarean Section Rates by Payment Source and Type of Hospital and Individual and Structural Variables, Brazil, 2008\***

Variables	Payment source <sup>†</sup> /type of hospital			
	SUS/ public	SUS/ private	Non-SUS/ public	Non-SUS/ private
<b>Age</b>				
15–19	35.8	27.6	64.8 <sup>‡</sup>	81.6
20–24	36.4	51.5	61.4	78.6
25–29	42.9	54.3	75.8	86.9
30–49	50.5	78.4	79.8	87.2
<b>Years of schooling</b>				
0–3	34.4	34.9 <sup>‡</sup>	52.3 <sup>‡</sup>	76.2
4–7	38.3	60.7	49.8	77.5
8–10	40.4	49.4	55.3	83.5
11	46.1	62.0	79.2	83.7
12+	58.4	62.8	92.3	88.8
<b>Live birth order</b>				
One child	44.1	57.8	82.4	86.3
Two children	41.3	50.0	73.6	83.2
Three or more children	36.5	63.0	36.0	84.6
<b>Region of residence</b>				
North	44.9	40.9 <sup>‡</sup>	16.3 <sup>‡</sup>	75.2
Northeast	38.1	61.1	37.6	84.7
Southeast	42.4	56.3	87.4	83.8
South	43.4	58.2	82.5	88.6
Central West	41.9	53.2 <sup>‡</sup>	38.5 <sup>‡</sup>	91.2
Overall Average	41.2	56.5	72.4	85.0
<i>n</i> (analytic weight)	2,582	108	107	863
<i>N</i> (frequency weight)	1,251,358	52,197	51,670	418,348

\*Analytic weight was used to estimate these frequencies, preserving the sample size; <sup>†</sup>SUS is the Brazilian governmentally funded health system ("Sistema Único de Saúde"); <sup>‡</sup>Calculated on fewer than 10 cases. Source: 2008 Brazilian household survey (PNAD).

**Table 3. Logistic Regression Odds Ratio (OR) and 95 Percent Confidence Interval (95% CI) Estimates Predicting Cesarean Section Delivery During the Year Before the Survey, Brazil, 1998, 2003, and 2008**

Variables	1998				2003				2008			
	Model 1		Model 2 (includes payment source/type of hospital)		Model 1		Model 2 (includes payment source/type of hospital)		Model 1		Model 2 (includes payment source/type of hospital)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<b>Age</b>												
15-19	1.00		1.00		1.00		1.00		1.00		1.00	
20-24	1.57**	1.27-1.95	1.50**	1.20-1.87	1.91**	1.50-2.42	1.82**	1.43-2.32	1.15	0.90-1.46	1.13	0.88-1.44
25-29	2.12**	1.67-2.69	1.93**	1.51-2.46	2.72**	2.10-3.53	2.42**	1.85-3.17	1.78**	1.37-2.32	1.68**	1.28-2.19
30-49	3.33**	2.59-4.27	2.93**	2.27-3.79	3.86**	2.95-5.04	3.22**	2.44-4.25	2.80**	2.13-3.69	2.42**	1.82-3.22
<b>Years of schooling</b>												
0-3	1.00		1.00		1.00		1.00		1.00		1.00	
4-7	1.51**	1.24-1.83	1.43**	1.17-1.74	1.38**	1.09-1.75	1.30*	1.02-1.66	1.30	0.95-1.77	1.25	0.92-1.70
8-10	1.78**	1.41-2.25	1.45**	1.14-1.84	1.90**	1.46-2.46	1.59**	1.22-2.08	1.44*	1.06-1.97	1.30	0.95-1.79
11	2.90**	2.26-3.72	2.02**	1.56-2.63	2.49**	1.91-3.24	1.63**	1.23-2.16	2.03**	1.49-2.78	1.42*	1.04-1.96
12+	5.90**	4.06-8.57	2.98**	1.99-4.46	5.26**	3.64-7.58	1.92**	1.27-2.91	4.62**	3.11-6.88	1.91**	1.26-2.92
<b>Live birth order</b>												
One child	1.04	0.87-1.23	1.00	0.84-1.20	1.08	0.90-1.30	1.06	0.87-1.28	1.33**	1.10-1.60	1.36**	1.12-1.65
Two children	1.00		1.00		1.00		1.00		1.00		1.00	
Three or more children	0.58**	0.47-0.70	0.60**	0.49-0.72	0.59**	0.48-0.72	0.64**	0.52-0.79	0.66**	0.53-0.82	0.75*	0.60-0.95
<b>Region of residence</b>												
North	1.53**	1.15-2.04	1.42*	1.07-1.89	1.06	0.84-1.34	1.02	0.80-1.29	1.24	0.98-1.57	1.22	0.94-1.56
Northeast	1.00		1.00		1.00		1.00		1.00		1.00	
Southeast	1.91**	1.61-2.27	1.63**	1.37-1.94	1.75**	1.46-2.09	1.45**	1.20-1.76	1.33**	1.10-1.61	1.09	0.90-1.33
South	1.53**	1.26-1.87	1.29*	1.05-1.58	1.62**	1.30-2.02	1.44**	1.15-1.81	1.53**	1.20-1.95	1.25	0.97-1.61
Central West	2.61**	2.08-3.26	2.14**	1.70-2.69	1.87**	1.48-2.36	1.58**	1.25-2.01	1.49**	1.18-1.88	1.23	0.96-1.58
<b>Payment source<sup>†</sup>/type of hospital</b>												
SUS/public	1.00		1.00		1.00		1.00		1.00		1.00	
SUS/private	1.35*	1.07-1.70	1.35*	1.07-1.70	1.26	0.97-1.62	1.26	0.97-1.62	1.75*	1.12-2.75	1.75*	1.12-2.75
Non-SUS/public	1.65**	1.21-2.25	1.65**	1.21-2.25	2.29**	1.49-3.52	2.29**	1.49-3.52	2.81**	1.77-4.46	2.81**	1.77-4.46
Non-SUS/private	3.47**	2.83-4.24	3.47**	2.83-4.24	4.80**	3.82-6.01	4.80**	3.82-6.01	5.43**	4.21-7.00	5.43**	4.21-7.00
<b>Number of observations</b>	4,645		4,645		4,263		4,263		3,660		3,660	

\*Significant at p ≤ 0.05; \*\*Significant at p ≤ 0.01; †SUS is the Brazilian governmentally funded health system ("Sistema Único de Saúde"). Source: 1998, 2003, and 2008 Brazilian household surveys (PNAD).

generally had increased odds of delivering by cesarean in all survey years.

When we introduce the payment source–hospital type variable into the full model, we find that all of the above relationships hold but the overall magnitude of the odds ratios is reduced, some to the point where the relationship is no longer statistically significant. The one notable exception is for women delivering a first child in 2008, who had increased odds of delivering by cesarean section compared with delivering a second child; this relationship holds in the full model. The reduced magnitude in the full model is especially true for the education variable in the models; for instance, before introducing the payment source–hospital type variable, the odds of delivering by cesarean among women with 12 or more years of schooling are over four-and-a-half times higher than for women with less than 4 years of schooling. But after introducing the key payment source–hospital type variable in the full

model, the odds of delivering by cesarean for the most educated are now less than two times that of the least educated. Results also indicate that, compared with publicly funded public hospital births, the odds of delivering by cesarean section are higher in all other payment source–hospital type combinations. Moreover, the difference among the payment source–hospital type categories increased over the 10-year period. Compared with women who had publicly financed births in public hospitals, women in 1998 who had privately financed births in private hospitals had an over threefold increase in their odds of delivering by cesarean; by 2003, women in this category had an over fourfold increase in their odds of delivering by cesarean; by 2008, the odds had increased to over fivefold.

Finally, to better understand the increased odds of delivering a first child in 2008 compared with a second or high-order child, we conducted logistic regression analysis on the subsample of women with first births

**Table 4. Logistic Regression Odds Ratio (OR) and 95 Percent Confidence Interval (95% CI) Estimates Predicting Cesarean Section Delivery for Women Delivering First Births During the Year Before Survey, Brazil, 2008**

Variables	2008			
	Model 1		Model 2 (includes payment source/type of hospital)	
	OR	95% CI	OR	95% CI
<b>Age</b>				
15–19	1.00		1.00	
20–24	1.19	0.90–1.56	1.20	0.91–1.59
25–29	1.74**	1.26–2.41	1.50*	1.07–2.10
30–49	2.64**	1.83–3.81	2.19**	1.50–3.2
<b>Years of schooling</b>				
0–3	1.00		1.00	
4–7	0.81	0.47–1.40	0.82	0.47–1.41
8–10	0.82	0.48–1.40	0.72	0.42–1.24
11	1.33	0.78–2.26	0.94	0.55–1.62
12+	2.56*	1.41–4.60	0.97	0.52–1.81
<b>Region of residence</b>				
North	1.46*	1.07–2.00	1.39*	1.00–1.93
Northeast	1.00		1.00	
Southeast	1.45*	1.11–1.90	1.17	0.88–1.54
South	1.65*	1.17–2.32	1.35	0.95–1.93
Central West	1.73*	1.22–2.47	1.48*	1.03–2.14
<b>Payment source<sup>†</sup>/type of hospital</b>				
SUS/public			1.00	
SUS/private			1.68	0.87–3.27
Non-SUS/public			3.52**	1.82–6.81
Non-SUS/private			6.10**	4.40–8.48
<b>Number of observations</b>	1,685		1,685	

\*Significant at  $p \leq 0.05$ ; \*\*Significant at  $p \leq 0.01$ ; <sup>†</sup>SUS is the Brazilian governmentally funded health system (“Sistema Único de Saúde”). Source: 2008 Brazilian household survey (PNAD).

to predict their odds of a cesarean section in 2008 (Table 4). Like we found for all women for 2008, older women are more likely than younger women to deliver a first child by cesarean. However, the impact of education on cesarean section rates for first births is diminished considerably compared with the sample of all women, with only the estimate for the highest-educated women remaining significant (and much smaller) than the estimate in the model for all women. Women in the North region also have an increased odds of delivering a first birth by cesarean section, compared with no difference among all women. After introducing the payment source–hospital type variable into the full model, rising levels of education no longer exert a statistically significant influence on the risk of delivering a first birth by cesarean section. And although no regional differences were found for all women, women who live in the North and Central West regions have a higher risk of delivering a first child by cesarean section compared with those living in the Northeast. Finally, compared with women who deliver a publicly funded first birth in a public hospital, there does not exist a statistically significant increase in the risk of a first birth by cesarean section among women who have a publicly financed delivery in a private hospital. However, the odds for delivering by cesarean section in the first birth are higher for women who deliver privately financed births in either public or private hospitals, and these estimates are higher than they are for the sample of all women.

### Discussion

Brazilian cesarean section rates, which started high in 1998, ended up significantly higher by 2008 across all categories of age, education, live birth order, region of residence, and payment source–hospital type. Distinguishing between payment source and hospital ownership tells an important story: Women who delivered publicly funded births in either public or private hospitals had lower cesarean section rates than those who delivered privately financed deliveries in public or private hospitals. Moreover, with very few exceptions, cesarean section rates in 2008 rise across payment source–hospital type categories for all categories of age and education and for first and second births, such that rates are the lowest for the youngest and least-educated women delivering a first or second publicly funded birth in public hospitals. The highest rates are found among the oldest, most-educated women whose first or second births are privately funded in private hospitals. Intermediate rates are found among publicly funded private hospital births, followed by privately funded public hospital births. Regional patterns are less consis-

tent, although the Southeast and South do follow the pattern of increasing rates across the four payment–hospital types.

Our multivariate models for the entire sample of women suggest that older age, higher education, and living in a region other than the Northeast all positively affect the odds of delivering by cesarean section. However, these effects are attenuated by the introduction of the payment source–hospital type variable. This suggests that the combination of who finances the delivery and who owns the hospital in which the delivery takes place exerts more influence than do women’s individual variables on whether or not the delivery will be surgical. However, one variable for which the payment source–hospital type variable does not reduce the odds of delivering by cesarean is live birth order. Compared with women delivering a second child, the odds of delivering a first child by cesarean have increased over the 10-year period, even after controlling for the payment source–hospital type variable. In our models predicting cesarean section rates among first births for 2008, we found that after including the payment–hospital ownership variable, rising education levels no longer increase the risks of delivering a first birth by cesarean, nor are publicly financed births in private hospitals associated with an increased risk compared with publicly funded births in public hospitals. However, privately financed births in both publicly and privately owned hospitals exert an even larger impact on the odds of cesarean section in a first birth. Brazilian women, therefore, now appear to be even more likely to deliver a first child by cesarean, compared with those with higher parity, which suggests that cesarean rates in Brazil will continue to rise in the future, as the practice of performing repeat cesareans is firmly entrenched in Brazil. This suggests that the rate of increase in Brazilian cesarean section rates may be increasing, unlike the rates in industrialized countries, where the rate of increase appears to be slowing down (9).

These findings raise the question as to why the location where a woman delivers and who pays for that delivery has such a significant effect on whether or not it will be surgical. Is it because of the organizational structure and regulation of the health system in Brazil? Economic incentives for doctors contribute to the high rate of cesarean sections performed in private hospitals (2,4,7,15), and could explain the influence of how a delivery is paid for on whether the woman has a surgical or vaginal birth. Until 1980, obstetricians were paid more for cesarean deliveries than for vaginal deliveries. Although payment schemes have long since been equalized, a surgical delivery still tends to be far more profitable per hour worked in the delivery room. Cesarean section deliveries also allow physicians who attend

women with private health insurance to schedule surgical deliveries, many of which have no medical indication (16), so as to not conflict with their normal office hours. The time element is particularly important because Brazilian obstetricians who attend private patients typically do not work in teams, but instead individually attend to the labor and delivery of all their private clientele. Scheduling cesarean deliveries minimizes professional and personal life disruptions and maximizes an obstetrician's ability to attend more private patients.

Another possible explanation for the strong relationship between how a delivery is paid for and whether or not the birth is surgical could be a stronger preference for a cesarean section among women who deliver privately financed births in private hospitals. Studies to measure Brazilian women's preferences for mode of delivery in the mid-to-late 1990s found that large majorities of women (70–80%) preferred to deliver vaginally, and there were no differences between those who delivered in public hospitals and those who delivered in private hospitals (2,4). More recent studies elsewhere in the world also have found preference for cesarean section to be low (17–19), so it is unlikely that women's demand for surgical birth is driving much, or any, of the rising rates in cesarean section in Brazil.

Another potential hypothesis is that women who have privately financed deliveries by cesarean section do so to obtain a surgical sterilization. A limitation of this study is that we do not have a measure for sterilization, which we know to have a significant impact on the rate of cesarean sections, especially in the private sector (20). Indeed, evidence suggests that women who would otherwise have had a publicly funded delivery in a public hospital are instead choosing to deliver by cesarean in the private sector to get sterilized (13,21–29). Our finding that women with at least three children have a significantly lower chance of delivering by cesarean section than women with two children likely means that poorer women with higher fertility, whose births are overwhelmingly publicly funded, have a lower chance of getting a cesarean (with associated sterilization) compared with wealthier, more educated women who typically stop childbearing at two children.

A notable change in the Brazilian health system was the federal government's approval of the family planning law in 1997 (30). The goal of this law was to legalize and regulate the practice of female sterilization, with an aim at preventing this procedure from being performed during cesarean sections in public hospitals, while also regulating access to other contraceptive methods (30). The law prohibits sterilizations to be performed at the time of birth or abortion except when a history of multiple cesarean sections could put a woman at risk in a subsequent pregnancy. Not surprisingly, access to sterilization in public hospitals did not

increase after implementation of the law (21,31,32). However, the incidence of sterilization performed during cesarean sections is still a common practice in the country, especially in private hospitals.

These findings suggest that private sources of payment exert a positive influence on cesarean rates in Brazil over and above the influence of hospital ownership. And although the proportions of privately financed deliveries in public hospitals and publicly financed deliveries in private hospitals have declined since 1998, they still represent nearly one in 17 births in Brazil in 2008. Therefore, where possible, it is important to identify the payment source for delivery, and whether the hospital is owned by a public or private entity, to better understand the dynamics of cesarean section rates in Brazil.

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