Why are the rates of cesarean section in Brazil higher in more developed cities than in less developed ones?

V.S. Ribeiro[1],
F.P. Figueiredo[2],
A.A.M. Silva[2], H. Bettiol[5],
R.F.L. Batista[2],
L.C. Coimbra[3], Z.C. Lamy[4]
and M.A. Barbieri[5]

[1]Departamento de Medicina III, [2]Departamento de Saúde Pública,
[3]Departamento de Enfermagem and [4]Hospital Universitário,
Universidade Federal do Maranhão, São Luís, MA, Brasil
[5]Departamento de Puericultura e Pediatria, Faculdade de Medicina de Ribeirão Preto,
Universidade de São Paulo, Ribeirão Preto, SP, Brasil

Abstract

Correspondence

V.S. Ribeiro

Rua dos Rouxinóis

Condomínio Alphaville

Bloco 2, Apto. 402, Renascença II

65075-630 São Luís, MA

Brasil

Fax: +55-98-3235-3020

E-mail: zmribeiro@gmail.com

The objective of the present study was to investigate factors associated with cesarean sections in two cities located in different regions of Brazil and to determine factors that explain the higher cesarean section rate in the more developed city, Ribeirão Preto, compared to the less developed one, São Luís. Data from two cohort studies comprising 2846 women in Ribeirão Preto in 1994, and 2443 women in São Luís in 1997/1998 were used. Adjusted and non-adjusted risk estimates were calculated using a Poisson regression model. The cesarean section rate was 33.7% in São Luís and 50.8% in Ribeirão Preto. Adjusted analysis in a joint sequential model revealed a 51% higher risk of cesarean section in Ribeirão Preto compared to São Luís (prevalence rate ratio (PRR) = 1.51). Adjustment for category of hospital admission reduced the PRR to 1.09, i.e., this variable explained 82% of the difference in the cesarean section rate between the two cities. Adjustment for the variable "the same physician for prenatal care and delivery" reduced the PRR to 1.07, with the "physician" factor explaining 86% of the difference between rates. When simultaneously adjusted for the two variables, the PRR decreased to 1.05, with these two variables explaining 90% of the difference in the cesarean section rate between the two cities, and the difference was no longer significant. The difference in the cesarean section rate between the two Brazilian cities, one more and one less developed, was mainly explained by the physician factor and, to a lesser extent, by the category of hospital admission.

Introduction

High cesarean section rates have been reported in developed and non-developed countries. In the United States, 1 of 20 babies was delivered by cesarean section during the 1970's, with this rate reaching 1 in 4 during the 1990's (1). In France, an increase in cesarean sections from 10.7% in 1981 to 15.3% in 1995 was observed (2). In Brazil, the rate of cesarean sections increased from 15.6% in 1970 to 31.0% in 1980 (3) and from 31.6% in 1986 to 36.4% in 1996 (4). The World Health Organization (WHO) recommends that cesarean section rate should be up to 15% (5). Today, Brazil presents a very high cesarean section

rate (more than 30%), much higher than justified by indications based on good obstetrical practice (5), occupying an outstanding position both within the context of Latin America and compared to developed countries (6,7).

However, the distribution of cesarean sections in the Brazilian population is not homogenous and is strongly influenced by the source of financing or by social conditions, with higher rates being observed in the case of a lower obstetric risk and better access to medical technology, i.e., cesarean sections predominate among women of higher social strata and in more developed regions (8-10). This fact suggests that non-medical factors are responsible for most indications of this surgical intervention.

During the 1990's, a high cesarean section rate was found to be associated with private care (9), a given time of day (19 to 24 h), prenatal care and delivery performed by the same physician, and a larger number of prenatal visits (10) in the Southeast region of Brazil; in the South region, the rate of cesarean section was higher among primiparous women, women with a higher purchasing power and a higher educational level and women who attended at least 7 prenatal visits (10,11).

The justifications for cesarean sections most frequently reported by obstetricians are fetal distress, cephalopelvic disproportion, breech presentation, and previous cesarean section (1,2,9), reasons that do not always reflect the reality and might only be socially accepted justifications for an unnecessary medical intervention (10). On the other hand, vaginal delivery after a previous cesarean section is particularly associated with socioeconomic factors such as low income, low educational level, being attended by a public service, and young maternal age (12,13).

Although several studies analyzing the risk factors for cesarean section have been published in Brazil, there is no investigation determining the factors capable of explaining the large differences in cesarean section rates observed between Brazilian cities. The objective of the present study was to investigate some factors associated with cesarean sections in two cities from different regions of Brazil characterized by distinct levels of socioeconomic development and to determine non-medical factors that might explain the higher cesarean section rate in the more developed city, Ribeirão Preto, compared to the less developed one, São Luís.

Subjects and Methods

The data used in the present study were obtained from two birth cohort studies conducted in Ribeirão Preto, SP, Southeast Brazil, in 1994 (14) and in São Luís, MA, Northeast Brazil, in 1997/1998 (15). These cities are 2659 km apart.

In São Luís, systematic sampling stratified per maternity was used. The sample was representative of 94% of hospital births that occurred at public (Unified Health System) and private hospitals or by direct payment to the service provider over a period of one year, between March 1, 1997 and February 28, 1998. In the present study, only data of live-born singletons born to women residing in the municipality were included. A standard questionnaire was used for data collection and applied to puerperae immediately after delivery after the women had given their informed consent. In the case of doubts or insufficient information, the data were completed from the records or by interview with the physicians and/or nursing team, which was the case for a small portion of the sample. The questionnaire contained information regarding identification, demographic and socioeconomic data, reproductive health, utilization of prenatal services, and type of delivery. Losses occurred in 5.8% of cases. A total of 2443 observations were recorded. A detailed description of the methodological procedures of the São Luís cohort has been published previously (15).

In Ribeirão Preto, data were collected from all puerperae over four consecutive months (one-third of all deliveries) from

May to August 1994. This data collection was based on a previous study showing no seasonality in births or other variables used in that study (e.g., low birth weight, preterm birth, maternal age at delivery and twin pregnancies) over the year. Excluding losses (3.2%) and including only liveborn singletons from families residing in the municipality, the sample comprised 2846 livebirths. The methodological procedures have been described elsewhere (14).

For statistical analysis, the chi-square test was used to compare the frequencies of the mode of delivery in each city, with $P < 0.05$ being considered significant. Next, to study the association between the different independent variables and the mode of delivery in each city, non-adjusted risk estimates were calculated using a Poisson regression model with robust adjustment (16). The same model was subsequently used for multivariable analysis which adjusts the risks according to confounding factors.

The following variables were included in the regression model: maternal age, maternal schooling, marital status, maternal smoking, family income, parity, previous abortion or stillbirth, category of hospital admission, adequacy of prenatal care utilization, and whether the mother had the same physician for prenatal care and delivery. Family income was classified as low, middle and high based on tertile divisions. The category of hospital admission was classified as public when the mother was attended by the Unified Health System and as private when she was attended by private health insurance plans or when paying directly the service provider.

In the present study, the utilization of prenatal care was classified as adequate and inadequate. The use of care was considered to be adequate when the prenatal visits started up to the fourth month and the pregnant woman performed a minimum of six visits for a term pregnancy or a smaller number of visits according to gestational age. In all other situations the utilization of prenatal care was considered to be inadequate. Details about the classification of the adequacy of prenatal care have been described in a previous study (17).

The variables that were associated with a risk of cesarean section upon multivariable analysis in at least one of the towns were included in a joint sequential model comprising both studies. An indicator variable called "study" was created to represent the two towns, with 0 for São Luís, which presented the lower rate of cesarean section, and 1 for Ribeirão Preto. Initially, the prevalence rate ratio (PRR) of cesarean section was calculated according to "study" to estimate the non-adjusted difference in the cesarean section rate between the two towns. Next, each variable was adjusted only for the "study" variable, and this adjusted PRR was compared to the crude PRR. If the variable reduced the adjusted PRR compared to the crude PRR by at least 10%, it was considered to explain some of the difference in the cesarean section rate between the two towns. At the end, the adjusted PRR was calculated for all variables studied.

A joint model was also constructed to test the interactions between all variables and the "study" variable in order to determine whether the effect of each variable was different in each town and, therefore, explained the difference in the cesarean section rate between the two towns.

Results

The cesarean section rate was 50.8% in Ribeirão Preto in 1994 and 33.7% in São Luís in 1997/1998, with this difference being statistically significant ($P < 0.001$). In both cities, the cesarean section rate was higher in the private than in the public sector. For the private sector, the rate was higher in São Luís (93.7%) than in Ribeirão Preto (77.9%), whereas for the public sector the rate was higher in Ribeirão Preto (33.9%) than in São Luís (26.3%).

Practically all variables submitted to univariable analysis were found to be risk factors for cesarean section in the two towns: maternal age older than 20 years, fewer than five children, five years or more of schooling, being married, being a non-smoker, middle or high family income, adequate prenatal care use, delivery in a private hospital, and the same physician for prenatal care and delivery. Only in São Luís was a history of abortion or stillbirth associated with a higher risk of cesarean section (Table 1).

Table 1. Non-adjusted analysis of risk factors for cesarean section (Ribeirão Preto, 1994 and São Luís, 1997/1998).

Variable	Ribeirão Preto (N = 2846)				São Luís (N = 2443)			
	N	Cesarean section (%)	Prevalence rate ratio (95%CI)	P*	N	Cesarean section (%)	Prevalence rate ratio (95%CI)	P*
Maternal age (years)				<0.001				<0.001
<20	499	35.9	1.00		719	23.1	1.00	
20-34	2069	52.7	1.47 (1.30, 1.66)		1620	37.2	1.61 (1.39, 1.87)	
≥35	271	64.2	1.79 (1.54, 2.07)		102	53.9	2.33 (1.87, 2.92)	
Missing	7	57.1			2	50.0		
Parity				<0.001				0.002
5 children or more	166	31.3	1.00		105	15.2	1.00	
2 to 4 children	1496	49.4	1.58 (1.25, 1.99)		1148	34.9	2.29 (1.45, 3.62)	
1 child	1156	55.7	1.78 (1.41, 2.24)		1190	34.2	2.24 (1.42, 3.55)	
Missing	28	42.9			–	–		
Maternal schooling				<0.001				<0.001
≤4 years	395	29.4	1.00		265	24.1	1.00	
5 to 11 years	1890	51.1	1.74 (1.48, 2.04)		2053	31.8	1.32 (1.05, 1.64)	
≥12 years	369	77.2	2.63 (2.23, 3.09)		119	87.4	3.62 (2.89, 4.53)	
Missing	192	41.7			6	50.0		
Marital status				<0.001				<0.001
No companion	347	42.4	1.00		592	27.5	1.00	
Cohabiting	702	30.2	0.71 (0.60, 0.84)		1146	25.9	0.94 (0.80, 1.11)	
Married	1679	60.6	1.43 (1.26, 1.63)		704	51.7	1.88 (1.62, 2.18)	
Missing	118	59.3			1	0		
Maternal smoking				<0.001				0.007
Yes	588	40.5	1.00		145	22.8	1.00	
No	2156	53.5	1.32 (1.19, 1.47)		2298	34.4	1.51 (1.11, 2.05)	
Missing	102	53.9			–	–		
Family income				<0.001				<0.001
Low	597	34.3	1.00		1244	23.8	1.00	
Middle	636	47.5	1.38 (1.20, 1.59)		593	36.3	1.52 (1.32, 1.76)	
High	781	68.4	1.99 (1.76, 2.25)		443	60.3	2.53 (2.23, 2.87)	
Missing	832	48.8			163	28.2		
Previous abortion/stillbirth				>0.05				<0.001
No	2291	51.2	1.00		1866	31.9	1.00	
Yes	536	49.6	0.97 (0.88, 1.07)		577	39.5	1.24 (1.10, 1.40)	
Missing	19	47.4			–	–		
Category of hospital admission				<0.001				<0.001
Public	1699	33.9	1.00		2174	26.3	1.00	
Private	1003	77.9	2.30 (2.14, 2.47)		269	93.7	3.56 (3.30, 3.84)	
Missing	144	62.5			–	–		
Adequacy of prenatal care utilization				<0.001				<0.001
Inadequate	758	30.3	1.00		1161	22.7	1.00	
Adequate	1839	58.5	1.93 (1.72, 2.16)		1254	43.9	1.93 (1.71, 2.18)	
Missing	249	57.0			28	32.1		
Same physician for prenatal care and delivery				<0.001				<0.001
No	1635	32.3	1.00		2140	25.5	1.00	
Yes	1051	78.7	2.43 (2.25, 2.63)		303	92.1	3.62 (3.34, 3.91)	
Missing	160	56.9			0	–		

Prevalence rate ratio estimated by simple Poisson regression model with robust adjustment.
*P values for the log-likelihood ratio test.

Upon multivariable analysis, the following variables continued to be associated with a risk of cesarean section in Ribeirão Preto and São Luís: maternal age older than 35 years (PRR 1.54 and 1.45), adequate utilization of prenatal care (PRR 1.29 and 1.24), and the same physician for prenatal care and delivery (PRR 1.66 and 2.17). The association with a number of children of less than five (PRR 1.99), being married (PRR 1.19), middle family income (PRR 1.24) and private care (PRR 1.21) persisted only in São

Luís. Only in Ribeirão Preto was a high family income associated with a higher risk of cesarean section (Table 2).

Adjusted analysis in a joint sequential model revealed a 51% higher risk of cesarean section in Ribeirão Preto compared to São Luís. Adjustment for category of hospital admission reduced the PRR to 1.09, i.e., this variable explained 82% of the difference in the cesarean section rate between the two towns. Adjustment for the variable "the same physician for prenatal care and deliv-

Table 2. Multivariable analysis of risk factors for cesarean section (Ribeirão Preto, 1994 and São Luís, 1997/1998).

Variable	Ribeirão Preto		São Luís	
	Prevalence rate ratio (95%CI)	P*	Prevalence rate ratio (95%CI)	P*
Maternal age (years)		<0.001		0.005
<20	1.00		1.00	
20-34	1.19 (0.99, 1.42)		1.25 (1.06, 1.47)	
≥35	1.54 (1.25, 1.89)		1.45 (1.15, 1.82)	
Parity		>0.05		0.016
≥5 children	1.00		1.00	
2 to 4 children	1.05 (0.78, 1.38)		1.93 (1.22, 3.07)	
1 child	1.13 (0.84, 1.52)		1.99 (1.25, 3.19)	
Maternal schooling		>0.05		>0.05
≤4 years	1.00		1.00	
5 to 11 years	1.06 (0.86, 1.30)		0.94 (0.74, 1.18)	
≥12 years	0.99 (0.79, 1.24)		1.04 (0.81, 1.34)	
Marital status		0.023		<0.001
No companion	1.00		1.00	
Cohabiting	0.88 (0.70, 1.11)		0.93 (0.79, 1.09)	
Married	1.12 (0.93, 1.34)		1.19 (1.01, 1.39)	
Maternal smoking		>0.05		>0.05
Yes	1.00		1.00	
No	1.04 (0.92, 1.18)		1.10 (0.82, 1.48)	
Family income		0.048		0.017
Low	1.00		1.00	
Middle	1.09 (0.94, 1.26)		1.24 (1.07, 1.43)	
High	1.19 (1.02, 1.38)		1.17 (0.99, 1.38)	
History of abortion/stillbirth		>0.05		0.043
No	1.00		1.00	
Yes	1.05 (0.95, 1.17)		1.12 (1.00, 1.25)	
Category of hospital admission		>0.05		0.044
Public	1.00		1.00	
Private	1.16 (0.98, 1.36)		1.21 (1.00, 1.46)	
Adequacy of prenatal care use		0.001		0.003
Inadequate	1.00		1.00	
Adequate	1.29 (1.11, 1.49)		1.24 (1.08, 1.42)	
Same physician for prenatal care and delivery		<0.001		<0.001
No	1.00		1.00	
Yes	1.66 (1.39, 1.99)		2.17 (1.81, 2.60)	

Prevalence rate ratio estimated by multiple Poisson regression model with robust adjustment. Adjustment was performed for all variables presented in the table.
*P values for the log-likelihood ratio test.

ery" reduced the PRR to 1.07, with the "physician factor" explaining 86% of the difference between rates. When simultaneously adjusted for the two variables, the PRR decreased to 1.05 and the confidence interval included 1, indicating that these two variables accounted for 90% of the difference in the cesarean section rate between the two towns, and the difference was no longer significant. The variables marital status, family income, adequacy of prenatal care use, and maternal age contributed little to explain this difference. Analysis adjusting the model for all variables revealed an inversion in the relative risk although the confidence interval marginally included one, suggesting that, if all variables had presented an equal distribution between towns, the risk of cesarean section would have been higher in São Luís (Table 3).

In the joint model in which interactions between the variables and the "study" factor were tested, two interactions were significant. The risk for cesarean section was lower in Ribeirão Preto than in São Luís for mothers with a smaller number of children and those who had the same physician for prenatal care and delivery (Table 4).

Discussion

Since clinical factors do not completely explain the large difference in cesarean section rates between different countries or cities and because mode of insurance (private versus public), convenience for the doctor and social class are related to cesarean section (9,18-20), we undertook the present study to identify which non-clinical factors may explain why cesarean section rates are very much higher in a developed Brazilian city compared to another less developed one. Clinical factors have not been included because their association with cesarean section has been well established and in some situations there was incomplete or insufficient information regarding clinical factors in the medical records.

Although in the joint sequential model practically the same variables were associated with cesarean section in the two towns, differences in the variables "category of hospital admission" and "the same physician for prenatal care and delivery" were capable of completely explaining the variation in the cesarean section rate between towns. Adjustment of the model for all variables shows

Table 3. Multivariable analysis of risk factors for cesarean section in a joint sequential model (Ribeirão Preto, 1994 and São Luís, 1997/1998).

Sequential adjustment	Prevalence rate ratio (95%CI)	% Reduction of the risk with inclusion of the variable(s)
Study	1.51 (1.41, 1.61)	
Study and category of hospital admission	1.09 (1.02, 1.16)	-82.35%
Study and same physician for prenatal care and delivery	1.07 (1.01, 1.14)	-86.27%
Study and parity	1.53 (1.43, 1.63)	+3.92%
Study and maternal age	1.42 (1.33, 1.52)	-17.65%
Study and marital status	1.22 (1.14, 1.31)	-56.86%
Study and maternal schooling	1.45 (1.36, 1.55)	-11.76%
Study and maternal smoking	1.57 (1.47, 1.68)	+11.76%
Study and family income	1.27 (1.18, 1.36)	-47.06%
Study and history of abortion or stillbirth	1.51 (1.42, 1.62)	0.00%
Study and adequacy of prenatal care use	1.33 (1.24, 1.42)	-35.29%
Study, category of hospital admission and same physician for prenatal care and delivery	1.05 (0.98, 1.12)	-90.20%
For all factors	0.94 (0.87, 1.01)	-117.65%

Prevalence rate ratio comparing the risk for cesarean section in Ribeirão Preto with that in São Luís estimated by Poisson regression model with robust adjustment.

that, if there had been no difference in the percentage of women who had the same physician for prenatal care and delivery between the two towns, the cesarean section rates in Ribeirão Preto and São Luís would have been the same.

The main strength of the present study resides in the fact that it permits the comparison of rates and risk factors of cesarean section between two towns of highly distinct socioeconomic levels, and importantly that the data were collected in a similar manner. However, it was not possible to determine the indications for cesarean section in the two places, although there is strong evidence that in Brazil non-clinical factors are more important than biological factors for the indication of this surgery (7), and that the biological reasons cited in the medical records are only socially acceptable justifications for a cesarean section (10).

In both Ribeirão Preto and São Luís the risk for cesarean section was generally higher for categories of lower obstetric risk, suggesting that non-medical indications predominated. These findings agree with those observed in other regions of the country (9,21,22). In a study conducted in Ribeirão Preto in 1994, a higher risk of cesarean section was demonstrated for specific periods of the day (end of the afternoon and beginning of the night), indicating that medical convenience is a determinant factor for performing a cesarean section (10). Studies have shown that high cesarean section rates as those observed here do not necessarily reflect medical indications. Higher rates have been reported for women of higher income and educational level (9,23,24) who attended a larger number of prenatal visits and for primiparous women (11). Among women of low income attended by a public or philanthropic service, cesarean section was associated with a shorter time since graduation of the prenatal physician and the lack of compliance with the norms of the prenatal program (21). It was noted in these studies that

a greater obstetric risk was not the only determinant factor for cesarean section. High cesarean section rates have been indicated in some studies to be due to the behavior of the physician, either due to a lack of opportunity or ability to detect the preference of the pregnant woman or to the equivocal conclusion that pregnant women prefer cesarean sections (21,25-28), the impression that a cesarean section is safer for the fetus and

Table 4. Multivariable analysis of risk factors for cesarean section in a joint model (Ribeirão Preto, 1994 and São Luís, 1997/1998).

	Prevalence rate ratio (95%CI)	P*
Main effects		
Maternal age		<0.001
<20	1.00	
20-34	1.22 (1.08, 1.38)	
≥35	1.52 (1.31, 1.77)	
Maternal schooling		>0.05
≤4 years	1.00	
5 to 11 years	1.00 (0.86, 1.17)	
≥12 years	0.99 (0.84, 1.18)	
Marital status		<0.001
No companion	1.00	
Cohabiting	0.91 (0.80, 1.04)	
Married	1.16 (1.03, 1.31)	
Maternal smoking		>0.05
Yes	1.00	
No	1.05 (0.94, 1.18)	
Family income		0.004
Low	1.00	
Middle	1.16 (1.05, 1.29)	
High	1.20 (1.07, 1.33)	
History of abortion/stillbirth		0.029
No	1.00	
Yes	1.09 (1.01, 1.18)	
Adequacy of prenatal care use		<0.001
Inadequate	1.00	
Adequate	1.26 (1.14, 1.39)	
Category of hospital admission		0.007
Public	1.00	
Private	1.18 (1.05, 1.33)	
Interactions		
Parity and study		0.059
5 children or more	1.00	
2 to 4 children	0.55 (0.32, 0.93)	
1 child	0.59 (0.35, 1.00)	
Same physician for prenatal care and delivery and study		<0.001
No	1.00	
Yes	0.72 (0.63, 0.82)	

Prevalence rate ratio estimated by multiple Poisson regression model with robust adjustment. Adjustment was performed for all variables presented in the table.
*P values for the log-likelihood ratio test.

more comfortable for the mother (21), and the convenience of programmed intervention which permits the physician to gain time (21,25,27). These conclusions are supported by the present study since the variables "physician" and "category of hospital admission" explained more the difference in the cesarean section rate between the two Brazilian cities.

Results from developed countries indicate that cesarean section does not necessarily produce better perinatal outcomes (29). In eight Latin American countries including Brazil, in 1995, the high cesarean section rate was associated with high antibiotic use after labor, increased maternal morbidity and mortality and higher fetal and neonatal morbidity and mortality. Cesarean section delivery does not necessarily indicate good medical practice, has currently become a banal procedure and may even cause iatrogenic damage. Furthermore, cesarean section has a U-shaped association with perinatal outcomes. Worse perinatal outcomes are found when cesarean section is under- or over-performed (20).

In the model testing interactions, two variables showed a different effect in the two towns. The risk of cesarean section for women with 2 to 4 children was higher in São Luís than in Ribeirão Preto. This fact may reflect the higher frequency of tubal ligation during cesarean section in São Luís, in agreement with the data of the National Research on Demography and Health conducted in 1996 which showed that female sterilization was more frequent in the Northeast (43.9%) than in São Paulo (33.6%) (4). The risk related to the "physician" factor was also greater in São Luís. While in Ribeirão Preto 78.7% of the women who had the same physician for prenatal care and delivery underwent a cesarean section, this percentage was 92.1% in São Luís.

The greater risk related to the "physician" factor observed in São Luís seems to contradict the fact that this factor explained

86.3% of the non-adjusted difference in the cesarean section rate between the two towns. However, the prevalence of the risk factor "physician", i.e., the percentage of women attended by the same physician during prenatal care, was more than three times higher in Ribeirão Preto than in São Luís (39.1 *vs* 12.4%). Thus, to explain the difference in the cesarean section rate between the two towns, both the risk (which was greater in São Luís and better demonstrated in the interaction model) and the prevalence of the risk factor (which was higher in Ribeirão Preto and better demonstrated in the joint sequential model) should be taken into account.

The category of hospital admission was also found to explain the difference in the cesarean section rate between the two towns in the joint sequential model. Although the rate was higher for the private sector in São Luís compared to Ribeirão Preto, for the public sector the rate was higher in Ribeirão Preto than in São Luís. However, more women were attended by private services in Ribeirão Preto than in São Luís (37.1 *vs* 11.0%).

It seems that cesarean section deliveries, especially in private hospitals, reflect a complex social process affected by clinical status, social and family pressures, the desire of some women to undergo a cesarean, influenced by the legal system and available technology (20). A recent study has shown that the preference of the pregnant woman was one of the factors responsible for cesarean section (11). However, other investigations have demonstrated the occurrence of cesarean sections not desired by the pregnant women in four Brazilian cities where, despite the high rates (72% at private services and 32% at public services), the antenatal preference of almost all women from both sectors was vaginal delivery, in contrast to public opinion. The difference in the rate between groups was due to the higher percentage of unwanted cesarean sections

among women attended by private services (22). Dissatisfaction of women with the non-involvement in the decision to deliver by unprogrammed cesarean section has also been demonstrated in developed countries (30,31), and in private hospitals (32). In the present study, in univariable analysis the frequency of cesarean sections was higher among women of higher educational level, a finding also reported in other studies (8-10). However, in the adjusted analysis health service-related factors (category of hospital admission and physician) better explained the difference in cesarean section rates between the two Brazilian cities than maternal-related factors, suggesting that factors related to the physicians and health services have a higher explanatory power of the cesarean section risk than maternal factors.

The results identified some non-medical factors that contributed to explain the higher cesarean section rate observed in the more developed city, Ribeirão Preto, compared to the less developed one, São Luís. Clinical variables were not included. In summary, the difference in the cesarean section rate between the two Brazilian cities was mainly explained by the physician factor and, to a lesser extent, by the category of hospital admission.

References

1. Porreco RP, Thorp JA. The cesarean birth epidemic: trends, causes, and solutions. *Am J Obstet Gynecol* 1996; 175: 369-374.

2. Guihard P, Blondel B. Trends in risk factors for caesarean sections in France between 1981 and 1995: lessons for reducing the rates in the future. *BJOG* 2001; 108: 48-55.

3. Faúndes A, Cecatti JG. Which policy for caesarean sections in Brazil? An analysis of trends and consequences. *Health Policy Plan* 1993; 8: 33-42.

4. Bemfam (Bem-Estar Familiar no Brasil). *Pesquisa Nacional sobre Demografia e Saúde 1996*. Rio de Janeiro: Bemfam; 1997.

5. Anonymous. Appropriate technology for birth. *Lancet* 1985; 2: 436-437.

6. Belizan JM, Althabe F, Barros FC, Alexander S. Rates and implications of caesarean sections in Latin America: ecological study. *BMJ* 1999; 319: 1397-1400.

7. Barros FC, Vaughan JP, Victora CG, Huttly SR. Epidemic of caesarean sections in Brazil. *Lancet* 1991; 338: 167-169.

8. Freitas PF, Drachler ML, Leite JC, Grassi PR. Social inequalities in cesarean section rates in primiparae, Southern Brazil. *Rev Saúde Pública* 2005; 39: 761-767.

9. Yazlle ME, Rocha JS, Mendes MC, Patta MC, Marcolin AC, de Azevedo GD. Incidence of cesarean section regarding the financial support source for delivery care. *Rev Saúde Pública* 2001; 35: 202-206.

10. Gomes UA, Silva AA, Bettiol H, Barbieri MA. Risk factors for the increasing caesarean section rate in Southeast Brazil: a comparison of two birth cohorts, 1978-1979 and 1994. *Int J Epidemiol* 1999; 28: 687-694.

11. Behague DP, Victora CG, Barros FC. Consumer demand for caesarean sections in Brazil: informed decision making, patient choice, or social inequality? A population based birth cohort study linking ethnographic and epidemiological methods. *BMJ* 2002; 324: 942-945.

12. Cecatti JG, Pires HM, Faundes A, Duarte Osis MJ. Factors associated with vaginal birth after previous cesarean section in Brazilian

women. *Rev Panam Salud Publica* 2005; 18: 107-113.

13. D'Orsi E, Chor D, Giffin K, Barbosa GP, Angulo-Tuesta AJ, Gama AS, et al. Factors associated with vaginal birth after cesarean in a maternity hospital of Rio de Janeiro. *Eur J Obstet Gynecol Reprod Biol* 2001; 97: 152-157.

14. Bettiol H, Barbieri MA, Gomes UA, Andrea M, Goldani MZ, Ribeiro ER. Perinatal health: methodology and characteristics of the studied population. *Rev Saúde Pública* 1998; 32: 18-28.

15. Silva AA, Coimbra LC, da Silva RA, Alves MT, Lamy FF, Carvalho LZ, et al. Perinatal health and mother-child health care in the municipality of São Luís, Maranhão State, Brazil. *Cad Saúde Pública* 2001; 17: 1413-1423.

16. Barros AJ, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol* 2003; 3: 21.

17. Coimbra LC, Silva AA, Mochel EG, Alves MT, Ribeiro VS, Aragao VM, et al. Factors associated with inadequacy of prenatal care utilization. *Rev Saúde Pública* 2003; 37: 456-462.

18. MacFarlane A. Holding back the tide of caesareans. *Br Med J* 1998; 297: 852.

19. Roberts CL, Tracy S, Peat B. Rates for obstetric intervention among private and public patients in Australia: population based descriptive study. *BMJ* 2000; 321: 137-141.

20. Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A, et al. Caesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. *Lancet* 2006; 367: 1819-1829.

21. Silveira DS, Santos IS. Factors associated with cesarean sections among low-income women in Pelotas, Rio Grande do Sul, Brazil. *Cad Saúde Pública* 2004; 20 (Suppl 2): S231-S241.

22. Potter JE, Berquo E, Perpetuo IH, Leal OF, Hopkins K, Souza MR, et al. Unwanted caesarean sections among public and private patients in Brazil: prospective study. *BMJ* 2001; 323: 1155-1158.

23. Gentile F, Noronha FG, Cunha A. The relationship between payment for childbirth care and prevalence of cesarean sections in

maternity hospitals in Rio de Janeiro: a review of Carlos Gentile de Mello's hypothesis. *Cad Saúde Pública* 1997; 13: 221-226.

24. Silva AA, Lamy-Filho F, Alves MT, Coimbra LC, Bettiol H, Barbieri MA. Risk factors for low birthweight in northeast Brazil: the role of caesarean section. *Paediatr Perinat Epidemiol* 2001; 15: 257-264.

25. Goyert GL, Bottoms SF, Treadwell MC, Nehra PC. The physician factor in cesarean birth rates. *N Engl J Med* 1989; 320: 706-709.

26. Green JM, Coupland VA, Kitzinger JV. Expectations, experiences, and psychological outcomes of childbirth: a prospective study of 825 women. *Birth* 1990; 17: 15-24.

27. Hopkins K. Are Brazilian women really choosing to deliver by cesarean? *Soc Sci Med* 2000; 51: 725-740.

28. Faundes A, Padua KS, Osis MJ, Cecatti JG, Sousa MH. Brazilian women and physicians' viewpoints on their preferred route of deliv-

ery. *Rev Saúde Pública* 2004; 38: 488-494.

29. Li T, Rhoads GG, Smulian J, Demissie K, Wartenberg D, Kruse L. Physician cesarean delivery rates and risk-adjusted perinatal outcomes. *Obstet Gynecol* 2003; 101: 1204-1212.

30. Graham WJ, Hundley V, McCheyne AL, Hall MH, Gurney E, Milne J. An investigation of women's involvement in the decision to deliver by caesarean section. *Br J Obstet Gynaecol* 1999; 106: 213-220.

31. Geary M, Fanagan M, Boylan P. Maternal satisfaction with management in labour and preference for mode of delivery. *J Perinat Med* 1997; 25: 433-439.

32. Ryan K, Schnatz P, Greene J, Curry S. Change in cesarean section rate as a reflection of the present malpractice crisis. *Conn Med* 2005; 69: 139-141.