Caesarean sections in public and private sectors and maternal mortality associated with mode of delivery in the public sector in Sao Paulo, Brazil[*]

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Keywords: caesarean section; maternal morbidity and mortality; reproductive health.

Abstract

Objectives We analized caesarean section in both public and private sectors; and maternal mortality associated with mode of delivery in the public sector (*Sistema Unico de Saude* - SUS) in Sao Paulo State, Brazil

Methods We investigated 610,630 births in public and private sectors for 2003; and SUS 1,153,034 deliveries and 314 maternal deaths for 2001-2003. We estimated caesarean section rates and odds ratios for caesarean section in association with maternal characteristics in both public and private sectors; and SUS maternal mortality associated with mode of delivery, adjusted for hypertension, other disorders, problems and complications, as well as maternal age.

Results The caesarean section rate was 32.9% in SUS, and 80.4% in the private sector. The odd ratio for caesarean section was 2.6 (95%CI:2.6-2.7) for women with 12 or more years of education. The odd ratio for maternal mortality associated with caesarean section in SUS was 3.3 (95%CI:2.6-4.3).

Conclusions Sao Paulo presented high caesarean section rates. Caesarean section compared to vaginal delivery in SUS presented higher risk for mortality even when adjusted for hypertension, other disorders, problems and complications, as well as maternal age.

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Introduction

The World Health Organization considers that there is no justification for any region to have caesarean section rates higher than 15%.[1] Caesarean section rates are rising in many countries and maternal and perinatal morbidity and mortality rates are often used both in studies in favour[2 3] and against[4 5] the efforts to keep the caesarean section rates at 15%.

Estimates available for years between 1995 and 1999 point out caesarean section rates lower than 15% in Holland, Sweden, Austria, and Norway; and from 17% to 20% in United Kingdom, Germany, Spain, Canada, and Japan. United States registered 22% (27,6% in 2003), and Chile and Brazil 40%, the highest caesarean section rate in the world.[6]

The Brazilian Health Ministry[7] regards as 'epidemic' the caesarean section deliveries in Brazil; and Sao Paulo, the country's most economically developed state, presents caesarean section rates that are not acceptable at all.[8]

Caesarean section, intrapartum or elective, has traditionally been performed only when clinically indicated and caesarean section on maternal request has been considered inappropriate[9] – but views are changing. Some authors consider acceptable cesarean section on request, as long as the woman is fully informed of the implications of the procedure.[10] Moreover, recent research in Washington State concluded that, adjusted for maternal age and severe preeclampsia, women who had caesarean delivery were not at significantly higher risk for pregnancy-related death relative to women who had vaginal delivery.[11]

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The purpose of this paper is to estimate caesarean section rates and odds ratios for caesarean section associated with maternal age, years of education, marital status, number of prenatal visits, and gestation in Sao Paulo State in both its public and private sectors for 2003; and maternal mortality associated with mode of delivery, adjusted for hypertension, other disorders, problems and complications, as well as maternal age, in a large sample size, the public health system in Sao Paulo State during 2001-2003.

The study does not make distinction between elective and intrapartum caesarean sections. Considering the Brazilian doctor's induction for surgical delivery, intrapartum caesarean sections in Brazil are not necessarily complications of planned vaginal deliveries.[12] [13] The perinatal morbidity and mortality associated with mode of delivery will not be analyzed in this paper.

Methods

The research utilizes birth certificates data for 2003 recorded by Fundacao Seade,[14] and public health hospital data for 2001-2003 recorded by the Brazilian Health Ministry for Sao Paulo State residents and hospitals.[15]

Caesarean section rates and logistic regression for caesarean section associated with maternal characteristics

Sao Paulo State vital statistics are considered of excellent quality.[16] The public health hospital data are utilized by the Brazilian Health Ministry[15] to record payments to both public and private hospitals linked to the Brazilian public health system (*Sistema Universal de Saude* - SUS). The caesarean section rates were estimated for both public and private sectors in 2003. The caesarean section rate for the private sector was estimated through the difference between the total live births in Sao Paulo State,[14] and the public health system deliveries.[15]

The birth certificates variables utilized for the logistic regression for caesarean section associated with maternal characteristics were mode of delivery, maternal age, years of education, marital status, number of prenatal visits, and gestation. The cut point to define reference and exposure categories was the caesarean section mean rate in Sao Paulo State in 2003 (reference, lower or equal the mean rate; exposure, higher than the mean rate). Only the birth certificates with simultaneous information for all mentioned variables were utilized for the logistic regression.

Maternal mortality associated with mode of delivery

Information about obstetric procedures was brought into the Brazilian public health hospital database in 2001. Thus, for 2001-2003, it was possible to analyze maternal mortality in the public health system by mode of delivery, adjusted for hypertension, other disorders, problems and complications, as well as maternal age, according to the International statistical classification of diseases and related health problems, 10th revision (ICD-10) utilized by the public health hospital database. Chapter XV (first character, letter O) compiles morbidity and mortality causes related to pregnancy, childbirth and the puerperium divided in eight blocks, and four-character subcategories. Considering that hospital information is recorded according to the cause of hospitalization, some deliveries are also classified in other ICD-10 chapters.

Hospital mortality rates in vaginal delivery and caesarean section were estimated per 100 thousand deliveries in the public health system from 2001 to 2003. It is important to take into account that hospital deaths associated with mode of delivery in the public health hospital database includes only deaths occurred in hospitalizations with delivery. The mode of delivery was not informed for postpartum rehospitalizations (and deaths).

The public health system data provided information for mode of delivery separated for multiple gestation (codes O30, O31, O32.5, O33.7, O63.2, O66.1, O66.3, O69.2, O84); maternal hypertension (O10-O16); and other disorders, problems and complications (including deliveries in hospitalizations classified outside chapter XV). It also provided information for single vaginal delivery (spontaneous, O80; by forceps and vacuum extractor, O81; and other assisted deliveries, O83) and caesarean section (O82), excluded maternal hypertension, and other disorders, problems and complications.

Multiple gestation was excluded from the logistic regression analysis. The independent variables used in the model were mode of delivery (reference: vaginal; exposure: caesarean section), maternal hypertension (reference: absence; exposure: presence), other disorders, problems and complications (reference: absence; exposure: presence), and maternal age (reference: under 35 years old; exposure: 35 years or older). Considering that maternal deaths are relatively rare, the odds ratio in the present model can be analyzed as relative risk (OR = $p1/(1-p1) \ / \ p0/(1-p0)$; p = probability; if p is very small, $1 - p$ is approximately equal to 1, and OR is approximately equal to $p1/p0$).

Results

Caesarean section rates and logistic regression for caesarean section associated with maternal characteristics

Fundacao Seade[14] recorded 610,630 live births of residents in Sao Paulo State in 2003 (the mode of delivery was not informed in 4,581 records). The caesarean section rate accomplished 51.4% of overall live births (Table 1).

The public health system recorded 370,147 deliveries for Sao Paulo State residents and hospitals in 2003 (61.1% of the total live births recorded in Sao Paulo State). Caesarean section rate was 32.9% in the public health system, and 80.4% in private sector.

Considering the caesarean section rate of 51.4% as the cut point to define reference and exposure categories, the reference categories for caesarean section were women under 25 years old; under 8 years of education; not-married (single, not-married union, and widowed); under seven prenatal visits; and single gestation. The exposure categories were women 25 years or older; eight or more years of education (divided in two subcategories, 8 to 11; and 12 or more); married or divorced; seven or more prenatal visits; and multiple gestation.

For the logistic regression analysis 555,501 birth certificates with simultaneous information for all mentioned variables were utilized (91% of total Sao Paulo State live births in 2003). Table 2 presents the unadjusted and adjusted odds ratios and confidence interval for each one of the independent variables. All the independent variables are statistically significant at 95%.

Maternal mortality associated with mode of delivery

The public health system recorded 1,458,592 hospitalizations in chapter XV and other ICD-10 chapters and blocks (infections with a predominantly sexual mode of transmission, HIV disease, heart disease etc.) with obstetric procedures, and in chapter XV without obstetric procedures in Sao Paulo State in 2001-2003. According to Table 3 (first section), the public health system recorded 1,153,034 deliveries, 781,053 vaginal and 371,981 caesarean sections.

The total 459 maternal deaths at the public health system in Sao Paulo State in 2001-2003 includes 56 deaths associated to abortion and undelivered gestation; 314 deaths in hospitalizations with delivery; 34 deaths in postpartum rehospitalizations (with mode of delivery not informed – see Methods); and 55 unspecified deaths (undelivered gestation or postpartum rehospitalizations). Taking into account the two limits for the unspecified deaths

(0 and 55), the 314 deaths occurred in hospitalizations with delivery are between 77.9% (314/403; 314+34+55=403) and 90.2% (314/348; 314+34=348) of the total deaths in the public health system during both hospitalizations with delivery and postpartum rehospitalizations.

Mortality rates per 100 thousand hospitalizations with delivery was 14.3 for all vaginal deliveries, and 54.3 for all caesarean sections in 2001-2003. Mortality rate per 100 thousand hospitalizations for single gestation without maternal hypertension and other disorders, problems and complications was 13.5 for vaginal delivery (spontaneous, forceps and other) and 49.6 for caesarean section. Mortality rate per 100 thousand hospitalizations for women 35 years or older was 32.9 for all vaginal deliveries, and 102.1 for all caesarean sections (Table 3).

For the logistic regression analysis, excluding 12,245 multiple gestation (3 deaths), 1,140,789 deliveries (311 deaths) were utilized. In the adjusted model, all the independent variables, except other disorders, problems and complications, are statistically significant at 95% (Table 4). The OR for maternal mortality associated with caesarean section compared to vaginal delivery in the public health system during 2001-2003, adjusted for hypertension, other disorders, problems and complications, as well as maternal age, was 3.3 (95% CI 2.6, 4.3).

Discussion

According to the results of the present research, the private sector was responsible for 38.9% of the total deliveries in Sao Paulo State in 2003. This number is consistent with the estimates for people with private health insurance in Sao Paulo State in 1998, 39.2%.[17] Recklessly the caesarean section rate in the private sector in Sao Paulo State in 2003 (80.4%) is very close to the lowest limit of vaginal deliveries recommended by the Word Health Organization (85%).

The odd ratio for caesarean section associated with seven or more prenatal visits, adjusted for maternal age, years of education, marital status, and gestation was 2.2 (95% CI 2.2, 2.2) and seems to reflect the medical culture of caesarean section produced in the historical process of pregnancy and delivery medicalization. In Latin America, obstetricians created the high demand for caesarean section by offering them to the higher socio-economic groups as a distinctive way of giving birth; and people from other social groups imitate this trend assuming that if the more privileged prefer it, it must be better.[18] Corroborating with

this conclusion, the odd ratio for caesarean section in Sao Paulo State, adjusted for maternal age, marital status, number of prenatal visits and gestation, was 2.6 (95% CI 2.6, 2.7) for women with 12 or more years of education compared to women with less than eight years of education.

Caesarean section in Brazil is considered the modern and convenient mode of delivery in a pattern of medicine fascinated by technology that prepares poorly its physicians to vaginal delivery. Facing the physician's lack of confidence in vaginal delivery, caesarean section is now been justified in Brazil as preventive medicine.[12]

Research in both public and private sectors in Brazil revealed that while physicians claim to suffer pressure from the women for surgical delivery, the majority of first-time mothers who delivered by caesarean section entered the hospital wanting to deliver vaginally. The author of the study considers that Brazilian obstetricians do not want to attend women going through long labors and clearly have more decision-making power in the hospital birthing situation. Doctors often marshaled their medical expertise and authority to convince a woman to 'choose' a caesarean section, transforming surgical procedure into routine practice.[13]

Another research developed among physicians and women who had caesarean section deliveries in the public health system in the states of Sao Paulo and Pernambuco also concludes that, in spite of the physician's statements, there is no support for the argument that women have preference for caesarean section. According to the research, 90% of women who had both vaginal and caesarean section deliveries, and more than 70% of women who had only caesarean delivery declared preference for vaginal delivery. The authors consider that the obstetricians, based on the reasons manifested by a small number of women that demand for caesarean section, expand those demand and reasons to justify the current medical pro-surgical practice.[19]

In 2004, the Sao Paulo Medical Council[20] promoted a 'debate' about caesarean section on maternal request with two professors of obstetrics, both supporting caesarean section on maternal request. One of the professors made reference to the Washington State research[11] that concluded that women who had caesarean delivery were not at significantly higher risk for mortality relative to those who had vaginal delivery; and declared that studies that present higher maternal morbidity and mortality in caesarean section are based on old or not accurately analyzed statistics. The professor argued that there have been considerable technical improvements in surgical procedures; and many studies confound caesarean section with diseases related to maternal death that do not depend on the mode of delivery. In a study

developed at a university hospital in Sao Paulo,[21] the same professor concluded that no association was found between maternal complications and mode of delivery; and considers that elective caesarean section presents lower probability of infection than intrapartum caesarean section. Taking into account the high caesarean section rates in Sao Paulo, those two statements, side by side, suggest, instead of vaginal delivery, the substitution of elective caesarean section for intrapartum caesarean section.

The Washington State research[11] analyzed 265,471 deliveries and 11 deaths classified as pregnancy-related. In the unadjusted model, women who had caesarean delivery were at significantly higher risk for pregnancy-related death relative to women who had vaginal delivery (OR 4.3, 95% CI 1.4, 14.0). However, in the logistic regression model adjusted for five maternal age groups and severe preeclampsia, women who had caesarean delivery were not at significantly higher risk for pregnancy-related death relative to women who had vaginal delivery (OR 2.2, 95% CI 0.6, 7.9). Nevertheless, these results were derived from a sample with 11 deaths that does not allow processing the number of variables utilized in the model.

Likewise, the analysis developed for 988 caesarean sections and 760 vaginal deliveries in a university hospital in Sao Paulo[21] that concludes there is no statistically significant association between maternal complications and mode of delivery also utilized a relatively small sample (eg, hysterectomy for hemorrhage: six for caesarean sections; one for vaginal deliveries). Although caesarean section compared to vaginal delivery presented higher rates for all sort of complications analyzed in the study, the differences were not statistically significant due the multiplicity of complications analyzed and the sample's size (the study also does not mention the follow-up time). Taking into account the total infection and hemorrhage complications, including hysterectomy, altogether (29 for caesarean sections and 10 for vaginal deliveries), caesarean delivery would be at significantly higher risk for morbidity relative to vaginal delivery.

The results of the present research, in a large sample size, indicates that caesarean section compared to vaginal delivery, adjusted for hypertension, other disorders, problems and complications, as well as maternal age, presents a significant higher risk for maternal death (OR 3.3, 95% CI 2.6, 4.3).

It is important to point out that maternal mortality ratio in Sao Paulo State is extremely high. According to the World Health Organization,[22] maternal mortality ratio per 100 thousand live births was 260 in Brazil in 2000 (in Sweden, Spain, Austria, Denmark, Italy, and Portugal it was 5 or less). However, the World Health Organization's estimate was

adjusted for 2000 making use of the Brazilian maternal mortality proportion in the total deaths of women in reproductive age in 1983-1996. For 2001, the maternal mortality ratio per 100 thousand live births was estimated in 63.8 for Brazil, and 39.8 for Sao Paulo State.[16]

According to the results of this research, the mortality rate per 100 thousand caesarean section in the public health system was 54.3. To realize the significance of these rates in Sao Paulo State, it is useful to consider that the specific homicide rate for women in reproductive age in Sao Paulo, Brazilian state well known as one of the most violent region in the world, was 7.6 per 100 thousand women 10 to 49 years old in 2001.[16]

Brazilian Health Ministry considers that, despite the advances on surgical techniques, the high caesarean section rate is determinant to maternal morbidity and mortality in Brazil.[7] To stem unnecessary caesarean section, the payments of physician fees in the public health system were equalized for vaginal and caesarean section deliveries; but doctors are said to prefer caesarean section deliveries because they tend to work fewer hours to perform a surgical delivery, particularly a surgery that is scheduled in advance.[20] In addition, both public and private hospitals linked to the public health system continue to receive twice for caesarean section compared to vaginal delivery.[15] And the limits for caesarean section rates designed for the public health system payments to reduce gradually the number of caesarean section[23] are not been carried out in some Brazilian states, and are recurrently postponed by the Brazilian Health Ministry.[7]

Acknowledgments

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Table 1 - Live births in the public health system and private sector - Sao Paulo State, 2003

	Vaginal (a)	Caesarean (b)	Total (c=a+b)	Total (%)	(b/c) (%)
Public health system*	248400	121747	370147	61.1	32.9
Private sector	46185	189717	235902	38.9	80.4
Total live births**	294585	311464	606049	100.0	51.4

Source: Fundacao Seade (2004)[14]; Brasil (2004).[15]

* Deliveries: Sao Paulo State residents and hospitals.

** The mode of delivery was not informed in 4,581 records.

Table 2 - Logistic regression for caesarean section* (public and private sectors) - Sao Paulo State, 2003

Variable	Category		Unadjusted		Adjusted	
n = 555501	Reference	Exposure	OR	95% CI	OR	95% CI
Maternal age	Under 25	25 or older	2.1	2.1 - 2.1	1.7	1.7 - 1.7
Years of education	Under 8	8 to 11	1.7	1.7 - 1.7	1.6	1.6 - 1.6
		12 or more	4.0	3.9 - 4.1	2.6	2.6 - 2.7
Marital status	Not-married	Married**	2.6	2.5 - 2.6	1.7	1.7 - 1.8
Number of prenatal visits	Under 7	7 or more	2.8	2.8 - 2.9	2.2	2.2 - 2.2
Gestation	Single	Multiple	3.7	3.5 - 3.9	3.8	3.6 - 4.0

Source: Fundacao Seade (2004).[14]

* Compared to vaginal delivery.

** Included divorced.

Table 3 - Maternal mortality in the public health system - Sao Paulo State, 2001-2003*

Obstetric procedure (ICD-10 coding)	Hospitalization (a)	Hospitalization (%)	Death (b)	(b/a) p/100,000
Total hospitalization and deaths	1458592	100.0	459	31.5
Abortion and undelivered gestation	253269	17.4	56	22.1
Delivery	1153034	79.1	314	27.2
Vaginal	781053	53.5	112	14.3
Caesarean	371981	25.5	202	54.3
Postpartum rehospitalization	7304	0.5	34	465.5
Unspecified (undelivered or postpartum)	44985	3.1	55	122.3
Vaginal delivery	781053	53.5	112	14.3
Multiple gestation	8088	0.6	1	12.4
Maternal hypertension (O10-O16)	7133	0.5	6	84.1
Other disorders etc.	33550	2.3	6	17.9
Single	732282	50.2	99	13.5
Spontaneous (O80)	692203	47.5	88	12.7
Forceps and other (O81, O83)	40079	2.7	11	27.4
Caesarean section	371981	25.5	202	54.3
Multiple gestation	4157	0.3	2	48.1
Maternal hypertension (O10-O16)	20189	1.4	43	213.0
Other disorders etc.	113550	7.8	41	36.1
Single (O82)	234085	16.0	116	49.6
Vaginal delivery by maternal age	781053	53.5	112	14.3
Under 35	723275	49.6	93	12.9
35 or older	57778	4.0	19	32.9
Caesarean section by maternal age	371981	25.5	202	54.3
Under 35	330861	22.7	160	48.4
35 or older	41120	2.8	42	102.1

Source: Brasil (2004).[15]

* Sao Paulo State residents and hospitals.

Table 4 - Logistic regression for maternal mortality associated with mode of delivery in the public health system - Sao Paulo State, 2001-2003[*]

Variable	Category		Unadjusted		Adjusted	
n = 1140789	Reference	Exposure	OR	95% CI	OR	95% CI
Method of delivery	Vaginal	Caesarean	3.8	3.0 - 4.8	3.3	2.6 - 4.3
Maternal hypertesion	Absence	Presence	7.6	5.6 - 10.4	4.4	3.2 - 6.1
Other disorders, etc.	Absence	Presence	1.2	0.9 - 1.6	0.8	0.6 - 1.1
Maternal age	Under 35	35 or older	2.6	1.9 - 3.4	2.1	1.6 - 2.8

Source: Brasil (2004).[15]

* Sao Paulo State residents and hospitals.