

Recent trends in cesarean section reduction in extreme south of Brazil: a reality only in the public sector?

Tendências recentes de redução das cesarianas no extremo sul do Brasil: uma realidade apenas no setor público?

Luana Patrícia Marmitt (<https://orcid.org/0000-0003-0526-7954>)¹

Adriana Kramer Fiala Machado (<https://orcid.org/0000-0002-6800-1064>)²

Juraci Almeida Cesar (<https://orcid.org/0000-0003-0864-0486>)³

Abstract *This study aimed to describe changes in cesarean section (C-section) prevalence from 2007 to 2019, in public and private sectors, according to maternal characteristics. We included all puerperal women who gave birth in Rio Grande, Rio Grande do Sul, Brazil, at years 2007, 2010, 2013, 2016 and 2019. A questionnaire was applied up to 48 hours after delivery. We assessed C-section rates over time and described the prevalence according to independent variables. Poisson regression was used. A total of 12.415 puerperal women were included. The prevalence of C-section increased between 2007-2013 (from 51.2% to 61.2%) and decreased between 2013-2019 (48.9% in 2019). This decrease was observed only in the public sector and was higher among the youngest (-10.0 percentual points) and high educated women (-10.3 percentual points). While in the private sector C-section occurrence increased even more (95.7% in 2019). In the public sector, women that were older, with a partner, primiparous, who performed prenatal care in the private system and with adequate prenatal assistance presented higher prevalence of C-section. In the private sector the prevalence was high independently of the maternal characteristics. In order to reduce C-section rates, efficient delivery care policies mainly focused on the private sector are necessary.*

Key words *Cesarean Section, Parturition, Trends*

Resumo *O objetivo deste estudo foi descrever tendências na ocorrência de cesariana entre 2007 a 2019, nos setores público e privado, segundo características maternas. Foram incluídas todas as puérperas de Rio Grande, Rio Grande do Sul, Brasil, com parto nos anos de 2007, 2010, 2013, 2016 e 2019. Um questionário foi aplicado em até 48 horas após o parto. Foram descritas as taxas de cesariana ao longo do tempo de acordo com variáveis independentes. Utilizou-se regressão de Poisson. Foram incluídas 12.415 puérperas. A prevalência de cesariana aumentou entre 2007-2013 (de 51,2% para 61,2%) e diminuiu entre 2013-2019 (48,9% em 2019). Essa diminuição foi observada apenas no setor público, sendo maior entre mulheres mais jovens (-10,0 pontos percentuais) e com maior escolaridade (-10,3 pontos percentuais). Enquanto no setor privado a prevalência de cesariana aumentou ainda mais (95,7% em 2019). No setor público, mulheres mais velhas, com companheiro, primíparas, que realizavam pré-natal na rede privada e com assistência pré-natal adequada apresentaram maiores prevalências de cesariana. No setor privado, a prevalência foi elevada independentemente das características maternas. Para reduzir as taxas de cesariana são necessárias políticas eficientes de assistência ao parto com foco principalmente no setor privado.*

Palavras-chave *Cesárea, Parto, Tendências*

¹ Programa de Pós-Graduação em Biociências e Saúde, Universidade do Oeste de Santa Catarina. R. Getúlio Vargas 2125, Bairro Flor da Serra. 89600-000 Joaçaba SC Brasil. luanamarmitt@gmail.com

² Programa de Pós-Graduação em Epidemiologia, Universidade Federal de Pelotas. Pelotas RS Brasil.

³ Programa de Pós-Graduação em Saúde Pública, Universidade Federal de Rio Grande. Rio Grande RS Brasil.

Introduction

A cesarean section can prevent maternal and perinatal mortality and morbidity when medically justified. However, according to the World Health Organization, there is no evidence that an occurrence higher than 15% could benefit both mothers and newborns^{1,2}. In addition to exceeding this percentage, C-sections have steadily increased over the past three decades^{3,4}.

Considerable variations in cesarean rates are found worldwide, the lowest in Africa (7.3%) and the highest in Latin America and the Caribbean (40.5%)⁵. Brazil is one of the countries with the highest prevalence of C-sections globally. In the 1970s, the country exceeded the 15% published by WHO, reaching 55.0% in 2016; it has become about four times higher than the justifiable limit⁶.

Social inequalities are observed in C-section rates. Higher rates are more frequent in women from higher socioeconomic status, who had more prenatal consultations, primiparous, had a previous cesarean section, delivered the child with a doctor after a prenatal period, and had low gestational risk⁷⁻⁹. However, the main inequality seems to be the funding of childbirth care. According to data from the Brazilian National Supplementary Health Agency (ANS), 85% of births in the private sector were performed by C-section in 2018, while in the public sector (SUS - Unified Health System), this rate was 43% in 2018¹⁰.

Frequent monitoring of this rate is essential to understand the effectiveness of implemented policies and guide new ones. Nevertheless, population-based studies assessing birth trends over time with a short periodicity between evaluations are scarce. This study aims to describe changes in C-section prevalence from 2007 to 2019, in public and private sectors, according to maternal characteristics in Rio Grande, Brazil, to learn the trends of C-sections over 12 years in the south of Brazil and the relative contribution of each sector (public and private).

Methods

Five cross-sectional surveys were conducted every three years in Rio Grande, a municipality with approximately 210,000 inhabitants located in the extreme south of the state of Rio Grande do Sul, Brazil. These studies, known as “*Estudos Perinatais*”, were conducted between January 1st and December 31st in 2007, 2010, 2013, 2016, and 2019 at the only two local maternities. At both

places, deliveries are performed by physicians, anesthesia is available, and the use of forceps was not different at any of the locations.

These studies included all puerperal women living in urban or rural areas of the municipality whose newborns weighed at least 500 g or reached 20 weeks of gestational age. These women were interviewed within 48 hours following delivery after signing the informed consent form authorizing their participation in the study. We excluded multiple births from the analysis.

The survey questionnaire was applied by trained interviewers who looked for puerperal women daily in the maternities. Each survey had at least three interviewers to apply the questionnaire to the puerperal women. This questionnaire investigated demographic, occupational and socioeconomic characteristics, reproductive history, habits of life and behavior, pattern of morbidity, and use of health services during pregnancy. All information contained in the pregnant women's card used in prenatal consultations was also collected, as well as the newborn's medical records.

The outcome of interest in this study was C-section occurrence. The analyzed independent variables were: i) sociodemographic: maternal age (11-19, 20-24, 25-29, 30-37 years), self-reported skin color (white, mixed, black), living with a partner (yes or no), completed years of schooling (0-8 years, 9-11 years, 12 years or more), monthly family income in minimum wages (in quartiles); ii) past obstetric history: parity (primiparous, multiparous); iii) maternal morbidity during pregnancy: hypertension (yes or no), diabetes (yes or no), depression (yes or no) and anemia (yes or no); iv) current obstetric history: prenatal care (public or private), adequacy of prenatal (adequate or inadequate). Prenatal care was considered adequate when pregnant women attended six or more appointments starting before the fifth month of pregnancy, performed two or more qualitative tests of urine and two or more diagnostic tests of HIV and syphilis.

After consistency errors, data were analyzed using Stata 16.1 software¹¹. First, we presented the total births and C-section (CS) occurrence according to maternal characteristics and perinatal surveys. Secondly, we graphically presented the total number of births and the prevalence of cesarean section, according to childbirth care financing – private or public healthcare (SUS - Unified Health System). Due to expressive differences between public and private C-section prevalence, the following analyses were stratified

according to childbirth care financing. Thirdly, we presented the adjusted prevalence of cesarean and the respective 95% confidence interval (95%CI), according to maternal characteristics stratified by childbirth care financing. We then performed a multivariate analysis using Poisson regression with robust confidence intervals, followed by the “margins” post estimation command. Three hierarchical levels were considered according to a conceptual framework. At the first level, family income and maternal sociodemographic variables (age, skin color, schooling, and living with a partner) were included. At the second level, parity, adequacy of prenatal care, and public or private prenatal care were included. At the third level, we included hypertension, diabetes, depression, and anemia during pregnancy. All these variables were inserted into the model using backward selection, each level at a time, excluding those with $p < 0.20$.

Lastly, we present a summary of the main changes in the occurrence of C-sections over the study years using the linear trend test. Percentage points (pp) were calculated for the public and private sectors considering the difference between the cesarean rate at the end (2019) and the beginning (2007) of the study period. A p-value lower than 0.05 for a two-tail test was specified for these analyses.

Each research protocol was submitted and approved by the Health Research Ethics Committee of the Federal University of Rio Grande in the respective years 2007 (process 05369/2006), 2010 (process 06258/2009), 2013 (process 02623/2012), 2016 (process 0030-2015) and 2019 (process 23116.010992/2018-19).

Results

A total of 12,645 puerperal women were interviewed, with a response rate of around 98,0% in all study years. After multiple births exclusions ($n=230$), 12,415 women were included in the analysis (Figure 1). Table 1 shows the sample description and the occurrence of C-sections according to the year. The prevalence of C-section increased from 51.2% in 2007 to 61.2% in 2013, while from 2016 to 2019 this occurrence decreased (from 54.0% to 48.9%, respectively). We observed an increase in C-sections from 2007 to 2013 among all maternal characteristics. However, we found a decrease from 2013 to 2019, except in the private sector, which increased overall. Although the total number of deliveries decreased

in the private sector in 2016 and 2019, the prevalence of C-section increased, reaching 95.7% in 2019. On the other hand, this prevalence decreased from 2013 to 2019 in the public sector (from 46.5% to 39.8%, respectively) (Figure 2).

Table 2 presents the adjusted prevalence of C-section according to independent variables and study year in the public and private sectors. Among those who gave birth in the public sector, older women, those who have a partner, primiparous, performed prenatal care in the private sector, with adequate prenatal assistance, and those women who have hypertension or diabetes presented higher C-section occurrence. While among women who gave birth in hospitals from the private sector, the occurrence of C-section presented little variation according to maternal characteristics and, in general, it was higher than 80%.

Table 3 summarizes of the changes in C-section prevalence in public and private sectors from 2007 to 2019 according to the characteristics presenting more variation. We observed a decrease in global C-section prevalence due to a decrease in this procedure in the public sector. In this sector, the decline was higher among women with higher education (-10.3pp) and the youngest (-10.0pp). The increase in C-section rates in the public sector were among older women (3.0pp), with hypertension (3.6pp) and diabetes (0.7pp). Despite this reduction in global and public C-section rates, there was an increase in almost all variables in the private sector. This increase in C-sections was more expressive among women with adequate prenatal care (15.0pp) and diabetes (10.6pp).

Discussion

Our findings show that C-section prevalence increased from 2007 to 2013 and decreased from 2013 to 2019. Moreover, this recent decrease occurred unevenly between public and private health services. A real drop in the cesarean section rate was seen only in the public sector, which concentrates more births, while in the private sector, the prevalence increased even more during this period. In addition, C-section rates were higher among older women in the public sector, with a partner, primiparous, who performed prenatal care in the private system, and with adequate prenatal assistance. However, C-section prevalence was high independently of maternal characteristics in the private sector.

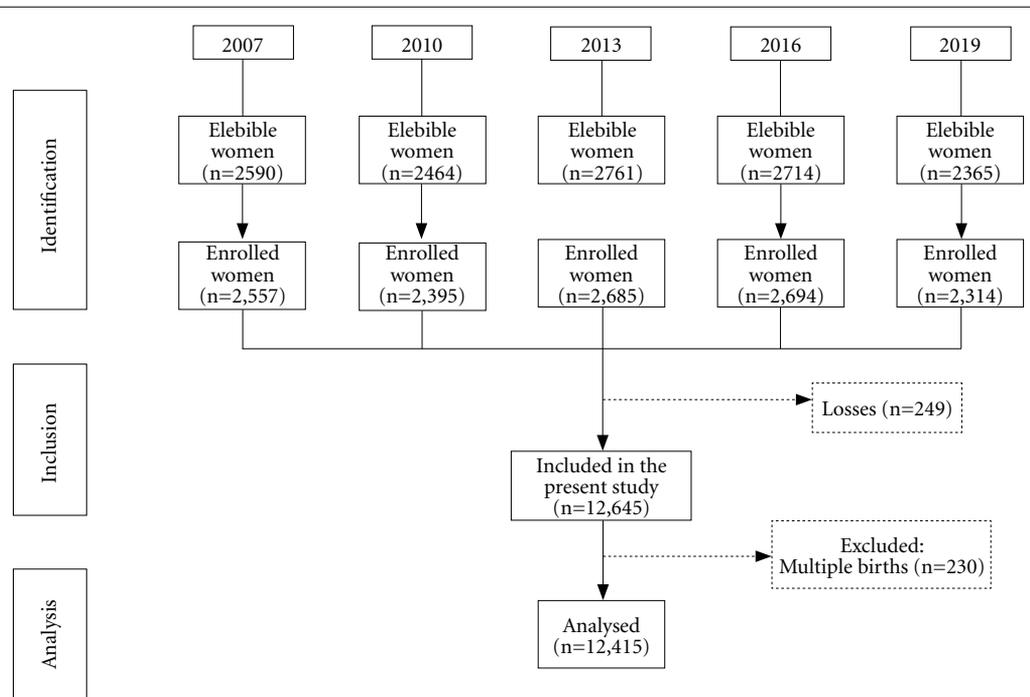


Figure 1. Puerperal women inclusion flowchart.

Source: Authors.

Table 1. Total births and c-section (CS) according to maternal characteristics in each perinatal survey. Rio Grande-RS, Brazil, 2007-2016 (n=12,415).

	2007		2010		2013		2016		2019		Total sample	
	All births % (n)	CS % (n)										
Total	20.3 (2,523)	51.2 (1,291)	19.0 (2,355)	56.2 (1,324)	21.1 (2,619)	61.2 (1,602)	21.3 (2,648)	54.0 (1,430)	18.3 (2,270)	48.9 (1,111)	100.0 (12,415)	54.4 (6,758)
Maternal age												
11-19	20.4 (515)	40.2 (207)	18.7 (441)	41.5 (183)	17.4 (456)	49.6 (226)	16.9 (448)	35.9 (161)	13.2 (299)	30.4 (91)	17.4 (2,159)	40.2 (868)
20-24	28.3 (714)	46.5 (332)	26.8 (630)	53.5 (337)	26.6 (697)	59.5 (415)	26.1 (691)	48.9 (338)	27.4 (622)	42.3 (263)	27.0 (3,354)	50.2 (1,685)
25-29	24.3 (614)	59.3 (364)	25.9 (609)	60.8 (370)	23.9 (627)	63.0 (395)	23.8 (631)	56.7 (358)	23.1 (525)	53.9 (283)	24.2 (3,006)	58.9 (1,770)
30-47	27.0 (680)	57.0 (388)	28.7 (675)	64.3 (434)	32.0 (839)	67.5 (566)	33.2 (878)	65.3 (573)	36.3 (824)	57.5 (474)	31.4 (3,896)	62.5 (2,435)
Skin color												
White	69.8 (1760)	54.9 (967)	69.6 (1639)	59.1 (968)	66.0 (1728)	64.8 (1120)	67.2 (1780)	56.4 (1004)	76.4 (1735)	50.8 (881)	69.6 (8,642)	57.2 (4,940)
Mixed	18.3 (462)	43.1 (199)	20.6 (486)	51.4 (250)	22.4 (586)	54.6 (320)	22.6 (598)	49.7 (297)	15.2 (345)	43.8 (151)	20.0 (2,477)	49.1 (1,217)
Black	11.9 (301)	41.5 (125)	9.8 (230)	46.1 (106)	11.6 (305)	53.1 (162)	10.2 (270)	47.8 (129)	8.4 (190)	41.6 (79)	10.4 (1,296)	46.4 (601)

it continues

Table 1. Total births and c-section (CS) according to maternal characteristics in each perinatal survey. Rio Grande-RS, Brazil, 2007-2016 (n=12,415).

	2007		2010		2013		2016		2019		Total sample	
	All births % (n)	CS % (n)	All births % (n)	CS % (n)	All births % (n)	CS % (n)						
Have a partner												
No	17.4 (438)	39.0 (171)	16.8 (395)	43.0 (170)	14.3 (374)	45.4 (170)	16.3 (432)	40.7 (176)	14.9 (337)	37.4 (126)	15.9 (1,976)	41.1 (813)
Yes	82.6 (2085)	53.7 (1120)	83.2 (1960)	58.9 (1154)	85.7 (2245)	63.8 (1432)	83.7 (2216)	56.6 (1254)	85.1 (1933)	51.0 (985)	84.1 (10,439)	56.9 (5,945)
Schooling (full years)												
0-8	48.8 (1231)	39.2 (483)	45.2 (1065)	44.4 (473)	39.9 (1044)	47.2 (493)	36.7 (972)	39.2 (381)	31.2 (709)	36.8 (261)	40.4 (5,021)	41.6 (2,901)
9-11	41.8 (1055)	58.8 (632)	44.5 (1048)	63.1 (661)	44.7 (1171)	66.4 (777)	39.7 (1051)	57.8 (607)	47.2 (1071)	49.8 (533)	43.5 (5,396)	59.3 (3,198)
12 or more	9.4 (237)	79.3 (188)	10.3 (242)	78.5 (190)	15.4 (404)	82.2 (332)	23.6 (625)	70.7 (442)	21.6 (490)	64.7 (317)	16.1 (1,998)	73.5 (1,469)
Familiar income ^a												
0-0.9	12.3 (302)	35.4 (107)	9.8 (209)	39.2 (82)	3.5 (89)	38.2 (34)	5.8 (143)	33.6 (48)	9.6 (213)	36.2 (77)	8.1 (956)	36.4 (348)
1-1.9	33.5 (821)	42.4 (348)	37.2 (794)	48.0 (381)	29.2 (748)	48.8 (365)	31.6 (786)	43.0 (338)	34.6 (765)	40.5 (310)	33.0 (3,914)	44.5 (1,742)
2-3.9	34.6 (849)	54.9 (466)	34.2 (729)	58.0 (422)	40.6 (1041)	61.0 (635)	40.5 (1006)	56.3 (566)	40.3 (891)	51.5 (459)	38.1 (4,516)	56.4 (2,548)
4 or more	19.6 (482)	71.4 (344)	18.9 (403)	75.9 (306)	26.8 (686)	79.5 (545)	22.1 (550)	71.3 (392)	15.5 (342)	69.9 (239)	20.8 (2,463)	74.1 (1,826)
Parity												
Primiparous	39.5 (997)	54.6 (544)	43.4 (1023)	62.0 (634)	47.2 (1237)	67.5 (835)	43.3 (1146)	55.2 (633)	37.8 (859)	50.8 (436)	42.6 (5,262)	58.6 (3,082)
Multiparous	60.5 (1526)	49.0 (747)	56.6 (1332)	51.8 (690)	52.8 (1382)	55.5 (767)	56.7 (1502)	53.1 (797)	62.2 (1411)	47.8 (675)	57.6 (7,153)	51.4 (3,676)
Prenatal care												
Public	61.1 (1476)	42.0 (620)	58.0 (1303)	45.2 (589)	52.1 (1329)	46.4 (617)	56.8 (1482)	41.2 (610)	63.6 (1395)	39.0 (544)	58.1 (6,985)	42.7 (2,980)
Private	38.9 (941)	69.7 (656)	42.0 (945)	75.6 (714)	47.9 (1221)	79.7 (973)	43.2 (1125)	72.4 (813)	36.4 (800)	68.5 (548)	41.9 (5,032)	73.6 (3,704)
Adequacy of prenatal care ^b												
Inadequate	83.8 (2115)	50.7 (1072)	61.4 (1447)	49.7 (719)	49.4 (1294)	53.4 (691)	62.5 (1656)	52.75 (870)	36.7 (833)	40.2 (335)	59.2 (7,345)	50.2 (3,687)
Adequate	16.2 (408)	53.7 (219)	38.6 (908)	66.6 (605)	50.6 (1325)	68.8 (911)	37.5 (992)	56.5 (560)	63.3 (1437)	54.0 (776)	40.8 (5,070)	60.6 (3,071)
Childbirth care financing												
Public sector	79.2 (1997)	42.0 (839)	75.9 (1788)	46.0 (823)	65.3 (1711)	46.5 (795)	75.9 (2011)	42.9 (863)	83.7 (1900)	39.8 (757)	75.8 (9,407)	43.3 (4,077)
Private sector	20.9 (526)	85.9 (452)	24.1 (567)	88.4 (501)	34.7 (908)	88.9 (807)	24.1 (637)	89.0 (567)	16.3 (370)	95.7 (354)	24.2 (3,008)	89.1 (2,681)

^aMonthly household income in minimum wages; ^bConsidered adequate when pregnant women attended six or more appointments began prenatal care before the fifth month of pregnancy and did two or more qualitative tests of urine, two or more tests diagnosis of HIV and syphilis.

Source: Authors.

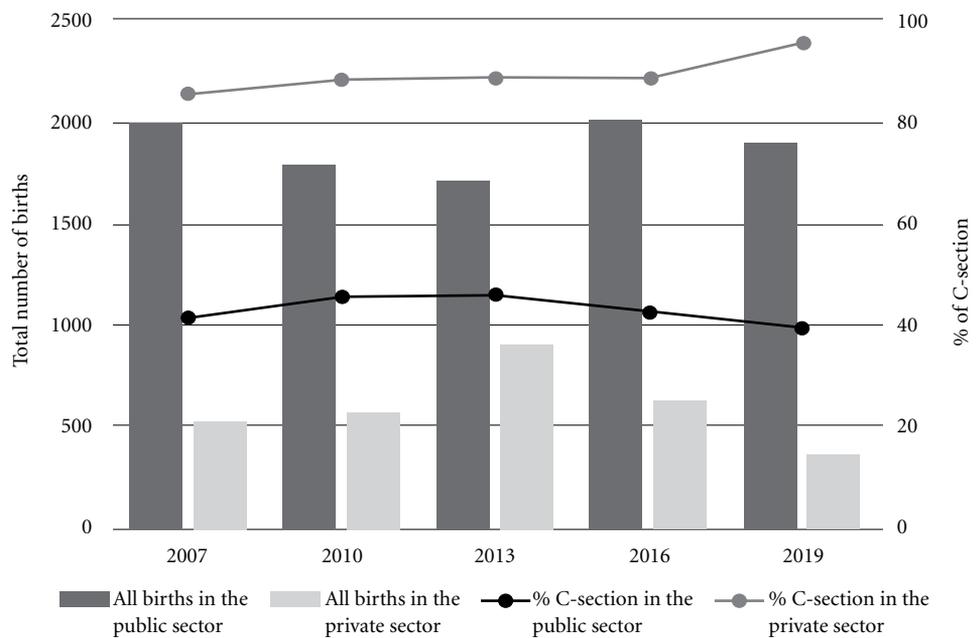


Figure 2. Total number of births and C-section prevalence according to childbirth care financing and study year.

Source: Authors.

Caesarean section can save women's and infants' lives and should be universally accessible¹². Nevertheless, its overuse has been a serious problem worldwide. Data from 169 countries estimated that between 2010 and 2015, the number of babies born by C-section almost doubled (from 12% to 21% of all births)¹³. This occurrence was even higher in Latin America and the Caribbean in 2015 (about 44% of all births). Brazil was the second country with the highest number of C-sections; rates increased considerably between 2000 and 2011 (from 37.7% to 53.9%)⁷, reaching 57.0% in 2014 and presenting a slight decrease in 2016 (55.0%)¹⁴. This reduction in the C-section rates has been the first one since the 1970s and has possibly demonstrated the beginning of a change in childbirth care practice¹⁵.

In the present study, we observed a decrease of 2.3pp in C-section rates over the years of study. This decrease was 12.3pp when we considered the period from 2013 to 2019. Possible explanations include improvements in the Unified Health System (SUS) and implementation of protection measures for vaginal delivery, such as the presence of a companion in the delivery room, inclusion of an obstetric nurse, and the need for parturient authorization for procedures

such as C-section and episiotomy. These efforts may have encouraged women to have a vaginal delivery and could have inhibited the medical team from performing unnecessary cesarean sections, especially in the public sector. Moreover, an obstetric regulation focused on reducing not clinically recommended cesareans was implemented by ANS (National Agency of Supplemental Health). However, given the increase in cesareans trends in the private sector, this norm does not seem to be efficient¹⁶.

C-sections in the private sector presented the highest increase between 2016 and 2019 (about 6.7pp), reaching 95.7% of all births, and this finding agrees with the literature^{9,17}. This increase is indeed not explained by clinical necessity alone. Pregnant women assisted in the private sector have greater power to decide on the type of delivery. The private sector allows the scheduling of C-sections on request based on the professional's choice, the team, and even the health establishment¹⁸. In a study conducted in the state of Parana (Brazil), the high occurrence of C-sections in the private sector (93.8%) was mainly determined by the women's desire for this type of delivery in early pregnancy (OR=18.3)¹⁷. Another argument explaining high C-section rates in the

Table 2. Adjusted prevalence of cesarean section according to independent variables and study year in the public and private sector.

Maternal Characteristics	Study years									
	2007		2010		2013		2016		2019	
	Public	Private								
Maternal age										
11-19	39.1 (34.4-43.9)	88.4 (78.2-98.6)	39.4 (34.0-44.8)	85.8 (74.7-96.9)	43.7 (38.3-49.1)	98.3 (92.6-104)	34.4 (29.0-39.8)	99.4 (89.1-110)	29.1 (23.4-34.7)	89.7 (72.0-107)
20-24	40.2 (36.3-44.1)	79.6 (72.0-87.2)	44.1 (39.6-48.5)	89.6 (84.1-93.3)	47.2 (42.8-51.6)	88.6 (84.1-93.1)	41.4 (37.1-45.6)	85.8 (79.5-92.2)	35.4 (30.3-38.6)	97.0 (93.9-101)
25-29	47.1 (42.6-51.6)	86.2 (81.2-91.3)	48.6 (43.8-53.3)	88.9 (84.1-93.8)	46.9 (42.0-51.7)	84.9 (80.5-89.4)	42.7 (38.2-47.3)	87.8 (83.0-92.6)	44.8 (40.1-49.6)	92.9 (87.9-98.0)
30-47	42.2 (37.8-46.6)	88.4 (84.1-92.8)	51.5 (46.6-56.3)	87.6 (83.4-91.8)	47.4 (42.9-51.9)	89.8 (86.7-92.9)	49.4 (45.2-53.5)	90.0 (86.5-93.4)	45.2 (41.3-49.2)	96.7 (94.2-99.2)
Maternal skin color										
White	43.7 (41.0-46.3)	88.3 (85.2-91.3)	46.3 (43.4-49.2)	89.4 (87.1-91.7)	48.1 (45.2-51.1)	89.4 (87.1-91.7)	42.8 (40.0-45.5)	89.6 (86.9-92.3)	40.2 (37.6-42.8)	95.4 (93.1-97.7)
Mixed	38.5 (33.7-43.3)	75.8 (65.5-86.1)	47.1 (42.0-52.2)	80.6 (72.0-89.2)	38.9 (38.9-48.3)	87.2 (82.0-92.4)	42.6 (38.0-47.2)	89.5 (83.4-95.7)	30.9 (34.3-45.5)	96.6 (88.9-103)
Black	38.6 (32.8-44.5)	75.4 (60.5-90.2)	42.4 (35.1-49.6)	95.4 (87.5-103)	43.6 (36.9-50.3)	88.0 (80.2-95.8)	45.1 (37.9-52.3)	80.1 (67.3-92.9)	36.6 (29.1-44.0)	99.6 (98.5-101)
Have a partner										
No	36.0 (31.2-40.9)	80.0 (68.1-92.0)	40.1 (34.4-45.8)	83.6 (72.6-94.6)	39.9 (34.1-45.7)	81.9 (72.8-91.0)	38.0 (32.3-43.7)	81.9 (71.1-92.6)	36.5 (30.6-42.3)	95.4 (88.0-103)
Yes	43.4 (41.0-45.9)	86.4 (83.4-89.4)	47.3 (44.7-50.0)	88.7 (86.1-91.4)	47.8 (45.2-50.4)	89.4 (87.3-91.5)	43.9 (41.5-46.3)	89.6 (87.2-92.1)	40.4 (38.0-42.8)	95.7 (93.6-97.8)
Schooling (years)										
0-8	37.9 (35.0-40.8)	74.4 (64.3-84.6)	41.9 (38.5-45.3)	88.2 (80.4-95.9)	42.8 (39.5-46.2)	86.3 (80.4-92.3)	37.9 (34.4-41.5)	84.0 (75.3-92.8)	37.7 (33.7-41.7)	94.1 (84.5-104)
9-11	47.5 (43.9-51.1)	87.7 (83.7-91.5)	50.8 (46.9-54.7)	87.9 (84.4-91.5)	49.2 (45.8-53.0)	88.6 (85.8-91.4)	46.1 (42.6-49.6)	88.4 (84.6-92.1)	41.1 (37.8-44.4)	95.2 (92.0-98.5)
≥12	48.3 (36.7-60.0)	86.5 (82.6-92.4)	50.9 (40.2-61.6)	88.3 (84.6-94.0)	56.7 (48.0-65.4)	90.5 (86.9-94.1)	47.1 (41.7-52.4)	91.0 (87.5-94.4)	40.5 (34.9-46.0)	96.2 (93.5-98.9)
Family income (quartiles)*										
1 (poorest)	42.8 (36.6-48.9)	87.7 (70.8-105)	45.8 (38.5-53.0)	75.0 (58.0-92.0)	42.7 (34.8-50.5)	87.2 (74.9-99.4)	38.1 (31.6-44.5)	92.5 (79.7-105)	38.6 (32.1-45.1)	100 (96.0-104)
2	39.9 (35.6-44.2)	88.1 (77.9-98.3)	47.9 (42.5-53.3)	91.5 (84.0-99.0)	47.4 (42.3-52.5)	87.8 (81.6-93.9)	44.1 (39.4-48.8)	92.7 (86.1-99.3)	39.5 (34.5-44.4)	97.1 (92.9-101)
3	39.8 (33.7-45.8)	81.9 (74.9-88.9)	46.2 (38.8-53.6)	83.8 (77.2-90.4)	47.0 (40.8-53.1)	91.0 (87.1-94.9)	42.2 (36.4-47.9)	83.9 (78.2-89.7)	40.7 (34.1-47.3)	94.0 (90.0-98.0)
4	52.0 (41.1-62.9)	86.8 (83.1-90.5)	42.8 (31.5-54.2)	90.2 (86.7-93.8)	50.2 (40.0-60.2)	88.3 (85.5-91.2)	49.0 (39.0-59.0)	89.8 (86.4-93.3)	41.9 (26.4-57.5)	95.9 (92.8-99.0)
Parity										
Primiparous	46.4 (42.3-50.5)	88.1 (84.0-92.2)	50.9 (46.5-55.3)	93.1 (90.0-96.1)	52.8 (48.6-57.0)	91.3 (88.7-93.8)	46.4 (42.5-50.3)	89.1 (85.6-92.7)	44.4 (39.9-48.9)	95.1 (91.8-98.4)
Multiparous	41.9 (39.0-44.9)	84.1 (79.8-88.4)	45.1 (41.8-48.4)	82.4 (77.6-87.3)	44.0 (40.6-47.3)	85.8 (82.3-89.3)	41.5 (38.6-44.5)	88.9 (85.5-92.3)	38.4 (35.5-41.3)	96.2 (93.5-98.8)

it continues

Table 2. Adjusted prevalence of cesarean section according to independent variables and study year in the public and private sector.

Maternal Characteristics	Study years									
	2007		2010		2013		2016		2019	
	Public	Private								
Prenatal care										
Public	42.1 (39.5-44.7)	89.9 (63.0-117)	45.3 (42.4-48.2)	78.7 (52.1-105)	45.7 (42.8-48.5)	86.1 (69.7-103)	42.2 (39.4-44.9)	83.8 (59.1-109)	40.1 (37.4-42.9)	69.4 (15.4-123)
Private	47.9 (43.3-52.6)	87.8 (74.9-101)	53.2 (48.2-58.3)	83.6 (69.6-97.6)	53.7 (48.5-59.0)	87.5 (79.3-95.8)	46.4 (41.8-50.9)	86.4 (73.7-99.1)	41.2 (36.3-46.0)	81.5 (49.8-113)
Adequacy of prenatal care										
Adequate	44.3 (39.0-49.5)	80.4 (72.2-88.5)	52.0 (47.9-56.1)	88.1 (84.5-91.6)	49.9 (46.4-53.4)	91.0 (88.6-93.3)	44.8 (41.2-48.3)	87.8 (83.8-91.9)	42.9 (40.1-45.8)	95.4 (92.9-97.8)
Inadequate	43.5 (41.0-45.9)	87.0 (84.0-90.1)	44.7 (41.6-47.8)	88.7 (84.9-92.6)	45.6 (42.2-48.9)	85.4 (81.7-89.2)	42.6 (39.7-45.4)	89.8 (86.8-92.8)	36.7 (32.0-39.5)	96.8 (92.6-101)
Hypertension										
No	41.6 (39.2-44.1)	84.1 (80.8-87.4)	43.4 (40.7-46.2)	87.1 (84.1-90.1)	44.4 (41.8-47.1)	88.4 (86.1-90.6)	39.9 (37.4-42.3)	88.0 (85.3-90.7)	37.9 (35.5-40.2)	95.7 (93.5-97.9)
Yes	52.1 (47.0-57.2)	96.5 (91.8-101)	62.3 (57.0-67.7)	93.9 (89.7-98.1)	59.5 (54.4-64.6)	91.4 (87.2-95.7)	57.6 (52.4-62.8)	94.9 (90.1-100)	55.7 (49.6-61.8)	95.6 (89.7-101)
Diabetes										
No	43.3 (41.1-45.6)	85.9 (83.0-88.8)	47.3 (44.9-49.8)	87.9 (85.2-90.6)	46.7 (44.2-49.1)	88.7 (86.6-90.8)	43.0 (40.7-45.2)	88.5 (86.0-91.0)	39.1 (36.7-41.4)	95.5 (93.3-97.7)
Yes	50.8 (39.2-62.5)	86.4 (72.4-100)	48.7 (37.3-60.3)	99.1 (95.4-103)	66.7 (56.5-77.1)	91.6 (84.7-98.5)	51.8 (42.4-61.2)	98.2 (95.6-101)	51.5 (44.5-58.5)	97.0 (91.8-102)
Anemia										
No	40.0 (36.9-43.1)	84.8 (80.7-88.8)	45.6 (42.6-48.6)	88.9 (85.8-92.1)	46.3 (43.4-49.2)	88.1 (85.5-90.8)	43.1 (40.6-45.6)	88.3 (85.2-91.3)	39.0 (36.2-41.8)	95.7 (93.1-98.3)
Yes	43.8 (40.9-46.8)	87.3 (83.3-91.4)	46.5 (43.1-49.9)	87.1 (82.3-91.9)	46.7 (42.8-50.6)	90.0 (86.8-93.2)	42.5 (38.6-46.5)	90.4 (86.5-94.3)	41.2 (37.7-44.6)	95.7 (92.3-99.0)
Depression										
No	42.6 (40.2-44.9)	85.7 (82.6-88.7)	45.4 (43.0-47.8)	88.2 (85.5-91.0)	46.7 (44.3-49.2)	89.4 (87.4-91.4)	43.1 (40.9-45.2)	89.1 (86.6-91.5)	39.7 (37.6-41.9)	95.6 (93.5-97.7)
Yes	39.7 (34.8-44.6)	88.4 (79.8-97.0)	50.8 (44.0-57.6)	89.7 (80.4-99.0)	44.4 (37.5-51.3)	80.0 (68.9-91.0)	39.0 (28.8-49.3)	84.2 (69.1-99.3)	44.8 (30.5-59.2)	99.6 (97.1-102)

*Minimum wage. Adjustments per level: Equation I: Maternal age, living with a partner, schooling, income (1st level); Equation II: Equation I + parity, prenatal care public or private, adequacy of prenatal care (2nd level); Equation III: Equation I + Equation II + hypertension and diabetes during pregnancy (3rd level).

Source: Authors.

Table 3. Main changes in the prevalence of cesarean section in public and private sectors from 2007 to 2019. Perinatal surveys, Rio Grande-RS, Brazil.

Variables	Main changes in the occurrence of cesarean sections (2007-2019)*		
	Total	Public	Private
Youngest (11-19 years)	↓ -12.7	↓ -10.0	↑ 1.3
Oldest (30-47 years)	↑ 0.9	↑ 3.0	↑ 8.3
White skin color	↓ -3.5	↓ -3.5	↑ 7.1
Live with partner	↓ -2.8	↓ -3.0	↑ 9.3
Higher education	↓ -8.4	↓ -7.8	↑ 9.7
Higher income	↓ -3.5	↓ -10.3	↑ 9.1
Primiparous	↓ -3.3	↓ -2.0	↑ 7.0
Private prenatal care	↓ -1.5	↓ -6.7	↓ -6.3
Adequate prenatal care	↓ -8.4	↓ -1.4	↑ 15.0
With hypertension	↑ 2.2	↑ 3.6	↓ -0.9
With diabetes	↑ 2.2	↑ 0.7	↑ 10.6
With anemia	↓ -3.1	↓ -2.6	↑ 8.4

*Difference in percentage points (pp) at the end and at the beginning of the period, linear trend p-value <0,05.

Source: Authors.

private sector is that providers generally receive a higher payment for C-sections than for vaginal births¹⁹. Physician practice styles and familiarity with high-tech procedures may be more prominent in private hospitals, influencing recurrent C-section practice²⁰.

Despite this increase in C-section rates in the private sector, it is important to note that the total proportion of births in this sector decreased by 4.6pp over time. Furthermore, deliveries were even more concentrated in the public sector (about 80.0%). These differences in the proportion of births would explain why the global C-section rate in the municipality has decreased, despite the increase observed in the private sector. In addition, in our study, C-section rates were high even in cases that do not depend on maternal clinical characteristics and which commonly characterize groups with lower obstetric risk, such as women who performed adequate

prenatal assistance, those with prenatal care in the private sector, and who lived with a partner. This scenario was seen in both private and public sectors, but more markedly in the latter. Likewise, a study performed in Brazil concluded that C-sections were more common among women at low risk of maternal or fetal death, suggesting, once again, that the option for this type of delivery was mostly elective⁷. A previous publication also using data from the “Estudos perinatais” observed that C-section occurrence by request of pregnant women doubled, from 11% in 2007 to 22% in 2016²¹. Only these percentages of caesarean sections alone already exceed the justifiable limit published by WHO.

Another important result observed in this study was the higher occurrence of C-section in primiparous women in public and private sectors. This may be related to medical convenience because the progression of labor tends to take

longer among primiparous women²². In addition, fear of childbirth and concerns related to vaginal trauma can influence primiparous women to request a C-section even before labor²³. This is alarming, once a previous cesarean section could increase the risk of a repeat surgical delivery²⁴. A more careful evaluation of indications for primary cesarean is essential.

The literature has shown the presence of social inequalities in C-section occurrence^{7,25,26}. In Brazil, family income and maternal schooling are the main determinants of this occurrence. Studies performed in the south of the country in 1982, 1993, 2004, and 2015 observed that the richest and the most educated women presented the highest cesarean section occurrence⁹. Our data agree with this, showing the same pattern in the public and private sectors. This finding could be explained by the higher purchasing power of these families, the empowerment of women with respect to the right to choose, the freedom to arbitrate about their health, and the access to new technologies, in addition, for some women, a cesarean section implies better health care²⁶⁻²⁹.

When interpreting the results, we need to consider that most of the information comes

from the pregnant women's reports obtained through a single approach and may have been affected by the recall bias. However, we sought to minimize this bias through the interview in the first 48 hours after delivery. Besides, the clinical indications for C-sections were not verified, which could better explain our results. As a strength, it is noteworthy that this study represents a census with a large sample size, a low percentage of losses (1.9%), carried out periodically since 2007, enabling the temporal evaluation of delivery indicators.

Conclusions

Our results showed a decrease in cesarean section rates between 2013 and 2019, which could result from public policies implemented in the Unified Health System (SUS). Nevertheless, in the private system, this occurrence is almost universal. It is essential to point out that this rate remained extremely high, even in the public sector, and improvements are still needed. Future interventions focused mainly on the private sector may bring more effective results in reducing the overall occurrence of cesarean deliveries.

Collaborations

LP Marmitt: methodology, writing - original draft preparation, formal analysis. AKF Machado: writing - original draft preparation and formal analysis. JA Cesar: conceptualization, methodology and supervision.

Acknowledgments

Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

References

- World Health Organization (WHO). Appropriate technology for birth. *Lancet* 1985; 326(8452):436-437.
- Betran AP, Torloni MR, Zhang JJ, Gülmezoglu AM, Aleem HA, Althabe F, Bergholt T, de Bernis L, Carroli G, Deneux-Tharaux C, Devlieger R, Debonnet S, Duan T, Hanson C, Hofmeyr J, Gonzalez Pérez R, de Jonge A, Khan K, Lansky S, Lazdane G, Lumbiganon P, Mackeen D, Mahaini R, Manyame S, Mathai M, Mikolajczyk R, Mori R, De Mucio B, Oladapo OT, Ortiz-Panozo E, Ouedraogo L, Parker C, Robson M, Serruya S, Souza JP, Spong CY, Stanton C, Stanton ME, Sullivan EA, Temmerman M, Tita A, Tunçalp Ö, Velebil P, Vogel JP, Weber M, Wojdyla D, Ye J, Yunis K, Zamora J, Zongo A. WHO Statement on Caesarean Section Rates. *BJOG* 2016; 123(5):667-670.
- Jun Z, Mikolajczyk R, Torloni MR, Gülmezoglu AM, Betran AP. Association between rates of caesarean section and maternal and neonatal mortality in the 21st century: a worldwide population-based ecological study with longitudinal data. *BJOG* 2016; 123(5):745-753.
- Vogel JP, Betrán AP, Vindevoghel N, Souza JP, Torloni MR, Zhang J, Tunçalp Ö, Mori R, Morisaki N, Ortiz-Panozo E, Hernandez B, Pérez-Cuevas R, Qureshi Z, Gülmezoglu AM, Temmerman M; WHO Multi-Country Survey on Maternal and Newborn Health Research Network. Use of the Robson classification to assess caesarean section trends in 21 countries: a secondary analysis of two WHO multicountry surveys. *Lancet Glob Health* 2015; 3(5):e260-e270.
- Betran AP, Torloni MR, Zhang J, Ye J, Mikolajczyk R, Deneux-tharaux C, Deneux-Tharaux C, Oladapo OT, Souza JP, Tunçalp Ö, Vogel JP, Gülmezoglu AM. What is the optimal rate of caesarean section at population level? A systematic review of ecological studies. *Reprod Health* 2015; 12:57.
- Brasil. Ministério da Saúde (MS). *TabNet: Proporção de partos cesáreos. Datasus* [Internet]. 2016 [acessado 2018 mar 31]. Disponível em: <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?idb2010/f08.def>.
- Barros FC, Matijasevich A, Maranhão AGK, Escalante JJ, Rabello Neto DL, Fernandes RM, Vilella ME, Matos AC, Albuquerque C, Léon RG, Victora CG. Caesarean sections in Brazil: will they ever stop increasing? *Rev Panam Salud Publica* 2015; 38(3):217-225.
- Barros FC, Vaughan JP, Victora CG. Why so many caesarean sections? The need for a further policy change in Brazil. *Health Policy Plan* 1986; 1(1):19-29.
- Barros AJD, Victora CG, Horta BL, Wehrmeister FC, Bassani D, Silveira F, Santos LP, Blumenberg C, Barros FC; Pelotas Cohorts Study Group. Antenatal care and caesarean sections: trends and inequalities in four population-based birth cohorts in Pelotas, Brazil, 1982-2015. *Int J Epidemiol* 2019; 48(Supl. 1):i37-i45.
- Brasil. Agência Nacional de Saúde Suplementar (ANS). *Painel de Indicadores de Atenção Materna e Neonatal*. Brasília: ANS; 2019.
- StataCorp. *Stata statistical software: release 13*. College Station: StataCorp LP; 2013.
- Countdown to 2030 Collaboration. Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health. *Lancet* 2018; 391(10129):1538-1548.
- Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L, Moller AB, Say L, Hosseinpoor AR, Yi M, de Lyra Rabello Neto D, Temmerman M. Global epidemiology of use of and disparities in caesarean sections. *Lancet* 2018; 392(10155):1341-1348.
- Brasil. Ministério da Saúde (MS). *DATASUS. Informações de Saúde, Sistema de Informações sobre Mortalidade* [Internet]. 2016 [acessado 2016 jun 14]. Disponível em: <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/inf10uf.def>.
- Leal MC, Bittencourt SA, Esteves-Pereira AP, Ayres BVS, Silva LBRAA, Thomaz EBAF, Lamy ZC, Nakamura-Pereira M, Torres JA, Gama SGND, Domingues RMSM, Vilela MEA. Progress in childbirth care in Brazil: preliminary results of two evaluation studies. *Cad Saude Publica* 2019; 35:e00223018.
- Brasil. Ministério da Saúde (MS). Agência Nacional de Saúde Suplementar (ANS). Resolução Normativa nº 368, de 6 de janeiro de 2015. Dispõe sobre o direito de acesso à informação das beneficiárias aos percentuais de cirurgias cesáreas e de partos normais, por operadora, por estabelecimento de saúde e por médico e sobre a utilização do partograma, do cartão da gestante e da carta de informação à gestante no âmbito da saúde suplementar. *Diário Oficial da União*; 2015.
- Oliveira RR, Melo EC, Novaes ES, Ferracioli PLRV, Mathias TAF. Factors associated to Caesarean delivery in public and private health care systems. *Rev Esc Enferm USP* 2016; 50(5):733-740.
- Nakano AR, Bonan C, Teixeira LA. A normalização da cesárea como modo de nascer: cultura material do parto em maternidades privadas no Sudeste do Brasil. *Physis* 2015; 25:885-904.
- Hoxha I, Syrogiannouli L, Luta X, Tal K, Goodman DC, Costa BR, Jüni P. Caesarean sections and for-profit status of hospitals: systematic review and meta-analysis. *BMJ Open* 2017; 7(2):e013670.
- Currie J, MacLeod WB. Diagnosing Expertise: Human Capital, Decision Making, and Performance among Physicians. *J Labor Econ* 2017; 35(1):18977.
- Carlotto K, Marmitt LP, Cesar JA, Carlotto K, Marmitt LP, Cesar JA. On-demand cesarean section: assessing trends and socioeconomic disparities. *Rev Saude Publica* 2020; 54:01.
- Nedberg IH, Rylander C, Skjeldestad FE, Blix E, Ugu-lava T, Anda EE. Factors Associated with Cesarean Section among Primiparous Women in Georgia: A Registry-based Study. *J Epidemiol Glob Health* 2020; 10(4):337-343.
- Liana P, Sima RM, Carp D, Alexândroaia C, Bălălu DO, Stănescu AD, Oлару OG. The psychosocial impact of vaginal delivery and cesarean section in primiparous women. *J Mind Med Sci* 2018; 5(1):70-74.
- Menacker F, Declercq E, Macdorman MF. Cesarean delivery: background, trends, and epidemiology. *Semin Perinatol* 2006; 30(5):235-241.
- Madeiro A, Rufino AC, Santos AO. Cesarean sections in Piauí State: trend and associated factors in the period 2000-2011, Brazil. *Epidemiol Serv Saude* 2017; 26(1):81-90.

26. Barros AJD, Santos IS, Matijasevich A, Domingues MR, Barros FC, Victora CG. Patterns of deliveries in a Brazilian birth cohort: almost universal cesarean sections for the better-off. *Rev Saude Publica* 2011; 45(4):635-643.
27. Béhague 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(7343):942-945.
28. Potter JE, Berquó E, Perpétuo IHO, Leal OF, Hopkins K, Souza MR, Formiga MC. Unwanted caesarean sections among public and private patients in Brazil: prospective study. *BMJ* 2001; 323(7322):1155-1158.
29. Mazzoni A, Althabe F, Liu NH, Bonotti AM, Gibbons L, Sánchez AJ, Belizán JM. Women's preference for caesarean section: a systematic review and meta-analysis of observational studies. *BJOG* 2011; 118(4):391-399.

Article submitted 12/12/2021

Approved 02/05/2022

Final version submitted 04/05/2022

Chief editors: Romeu Gomes, Antônio Augusto Moura da Silva