

THE IDENTIFICATION OF THE RISK FACTORS FOR CESAREAN SECTIONS IN PREGNANT WOMEN

IDENTIFICAÇÃO DOS FATORES DE RISCO PARA PARTO CESÁRIO EM GESTANTES

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ABSTRACT

This study aimed to understand the results of cesarean sections performed in a Teaching Hospital that receives most high-complexity cases, to identify the risk factors related to the choice of this type of childbirth. Binary logistic regression models were built to estimate the odds ratio, with the support of SPSS software. We analyzed 4726 medical records of pregnant women from 2017 to 2018, and 2020 to 2021, with a prevalence of 51.0% and 57.4%, respectively, of cesarean sections. The multiple models found that women over 35 years who have had previous cesarean deliveries, diabetes, polyhydramnios, oligohydramnios, and twin pregnancies were more likely to have a c-section than women who have had multigestational pregnancies. This comprehension enables a more thorough and informed analysis in decision-making, particularly to guarantee the relevance and necessity of cesarean birth.

Keywords: cesarean section; pregnant woman; odds ratio; prevalence.

RESUMO

Neste estudo, foram abordados os desfechos de partos cesáreos realizados em um Hospital Escola que recebe a maioria dos casos de alta complexidade, com o objetivo de identificar os fatores de risco relacionados à escolha desta via de nascimento. Foram construídos modelos de regressão logística binária para estimar o Odds Ratio, com suporte do software SPSS. Foram analisados 4726 prontuários de gestantes nos anos 2017 e 2018, 2020 e 2021, sendo a prevalência de 51,0% e 57,4%, respectivamente, de partos cesáreos. No modelo múltiplo, a idade da gestante ≥ 35 anos, o descolamento da placenta, as cesárias prévias, a diabetes, o HIV, a hipertensão, o polidrâmnio, o oligodrâmnio e a gestação gemelar foram associados à maior chance da ocorrência de parto cesáreo, enquanto a mulher ser multigesta foi associada à menor chance. Essa compreensão permite uma análise mais criteriosa e fundamentada na tomada de decisão, especialmente no sentido de assegurar a pertinência e a necessidade do parto cesáreo.

Palavras-chave: parto cesáreo; gestante; odds ratio; prevalência.

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INTRODUCTION

In Brazil, the number of cesarean deliveries surpassed vaginal deliveries for the first time in 2009 (Domingues *et al.*, 2014) reaching 55.1% in 2022 (Dias *et al.*, 2022). Among the 85 countries with more than 95% of births in health facilities, Brazil was second regarding cesarean section (c-section) rate, behind only the Dominican Republic (Boerma *et al.*, 2018).

The recommended c-section rate by the World Health Organization is 10% to 15% and should be performed only when indicated for medical reasons (WORLD HEALTH ORGANIZATION - WHO, 2015). The optimal rate of c-sections should maximize the best maternal and neonatal outcomes. According to the Clinical Protocol of Therapeutic Guidelines for Caesarean Section (Brazil, 2015), the main recommendations for cesarean deliveries are: to prevent vertical transmission of HIV; for women with three or more previous c-sections and with longitudinal uterine scar from anterior c-section; or in women who have had primary infection of the Herpes simplex virus during the third trimester of pregnancy.

Maternal death by cesarean birth, according to Rossetto *et al.* (2020), is three times higher compared to vaginal delivery, because cesarean delivery increases the risk of prematurity, respiratory difficulties of the newborn, hemorrhages, complications of anesthesia and postpartum infection, the last being noted in places with little infrastructure or precariousness in care. The theme has been gaining prominence due to the advancement of social movements and the struggle against the violation of the rights of the parturient.

The lack of knowledge and adequate preparation of professionals to deal with pregnant women, when associated with the rumors and myths related to it, generate lower adherence to vaginal delivery, and, consequently, a greater possibility of exposure to birth-related diseases. WHO has been conducting campaigns to address this problem, launching manuals that encourage vaginal delivery and show its benefits to pregnant women, as it has become a public health issue in developing countries. Studies in this area are important to raise awareness and help pregnant women to opt for vaginal delivery. Women need knowledge, information, and power to decide on the delivery type (Nascimento *et al.*, 2015).

According to Souza *et al.* (2018), the health of women is impacted by the factors that lead to cesarean deliveries in public health services, which needs to be studied. The understanding of these factors, according to Panda *et al.* (2021), has the potential to identify possible explanations for the trend of increasing c-sections among first-time mothers, reduce their inappropriate occurrences, and avoid repetitions in future pregnancies.

Some of the risk factors associated with c-section were increased maternal age (Panda *et al.*, 2021; Nedberg *et al.*, 2020; Taye *et al.*, 2021), multiple pregnancies, (Panda *et al.*, 2021) fetal pelvic (Panda *et al.*, 2021), previous c-section (Oliveira *et al.*, 2016; Moreira *et al.*, 2021; Taye *et al.*, 2021),

the desire for cesarean birth at the beginning of pregnancy (Oliveira *et al.*, 2016) and overweight/obesity (Oliveira *et al.*, 2016; Nedberg *et al.*, 2020). In addition, the public and private systems reveal differences in the prevalence of cesarean delivery, being higher in the private model (Oliveira *et al.*, 2016; Guimarães *et al.*, 2017; Dias *et al.*, 2022; Silva *et al.*, 2020). The COVID-19 pandemic was also a factor contributing to the increase in c-section. Significant increases in c-section rates in the pandemic compared to before the pandemic were reported by Silva, Guida, and Costa (2023) and Gharacheh *et al.* (2023).

The motivation for this study emerged from the need to enhance the understanding of the factors that influence the choice and indication of cesarean birth, especially in a Teaching Hospital that serves high-complexity cases. Understanding these factors is important to develop strategies to reduce unnecessary c-sections and ensure that this intervention is performed only when indicated, thus promoting better maternal and neonatal outcomes.

Given the above, establishing the factors associated with complications during cesarean delivery is necessary for its main causes to be determined and for actions to reduce their fees to be implemented. Therefore, this study aims to determine the risk factors associated with cesarean delivery in parturients at a Teaching School. The rates of c-sections performed at the Hospital Escola will be determined and the variables related to pregnant women and concepts associated with cesarean birth will be analyzed.

MATERIALS AND METHODS

This study is retrospective observational and based on the medical records of pregnant women. The analyzed data are part of a project approved by the Research Ethics Committee (CAAE: 1 59366116.5.0000.5346). The hospital provides medical care 100% supported by the Unified Health System (SUS), developing teaching activities, research, and extension through health care to the population.

All patients who gave birth at the hospital were included in the study. Patients with incomplete medical records and those who did not give birth at the Teaching Hospital were excluded. There was no data collection in 2019, as the city hospital that received high-risk pregnant women had discontinued care. In this way, these patients were referred to the Teaching Hospital, impacting the service due to the greater number of hospitalizations, which made data collection impossible. Data from the 2017-2018 biennium correspond to the pre-pandemic period, while those from the 2020-2021 biennium refer to the pandemic period.

The covariates assessed were related to the parturients: maternal age (in years), level of education (up to primary education, incomplete and complete secondary education, incomplete and complete higher education), number of pregnancies, number of previous cesarean sections, diabetes (yes or no), HIV (yes or no), hypertension (yes or no) and newborns: twin (yes or no), polyhydramnios

(yes or no), oligohydramnios (yes or no), placenta previa (yes or no), placental abruption (yes or no), fetal malformation (yes or no). Data were stored, processed, and analyzed using the SPSS software.

A binary logistic regression was conducted to calculate the Odds Ratio (OR) and their respective 95% confidence intervals (95%CI). The logistic regression model was determined using the Enter Method, in which all covariates were entered into the model at once. Only variables with a p-value ≤ 0.25 in the univariate analysis were included in the logistic regression analysis. In the final model, those with a p-value < 0.05 remained, and the categories chosen as reference were those with the lowest risk for c-section.

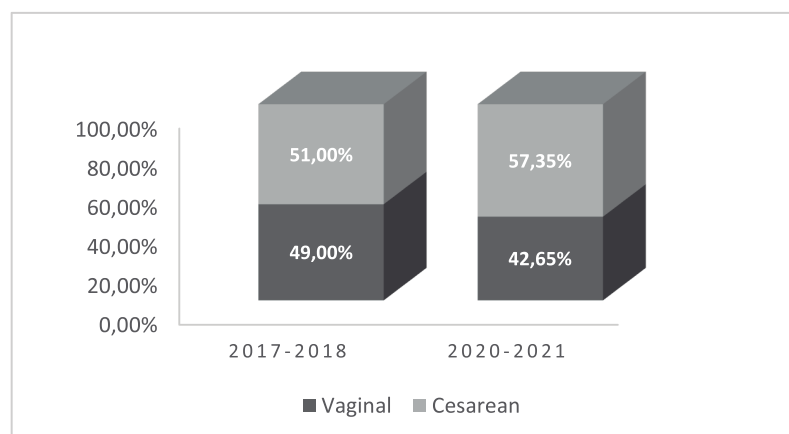
The Hosmer-Lemeshow test was used to confirm if the adjusted logistic model was suitable. Field (2009) concluded that the model fits the observed data adequately and could provide precise predictions even when the test result was insignificant.

The performance of the chosen model was evaluated using two measures that were similar to the R² of linear regression. The Cox-Snell R² measure ranged between 0 and 1, with higher values indicating greater model fit. However, this measure is limited considering that it cannot reach a maximum value of 1, so Nagelkerke proposed a modification that had the domain from 0 to 1. The number of variations explained by the logistic model is represented by these two additional measures, with 1.0 being the perfect fit (HAIR *et al.*, 2009).

RESULTS

A total of 4,726 patients who gave birth at the Teaching Hospital were analyzed, of which 3,150 parturients were attended from January 2017 to June 2018 and 1,576 from January 2020 to January 2021. It was possible to observe an increase in the prevalence of c-sections, which in 2017 and 2018 was 51.0%, and in 2020 and 2021 it rose to 57.4%.

Figure 1 - Distribution of Vaginal and Cesarean Births at the Teaching Hospital, from 2017-2018 and 2020-2021.



Source: Made by the authors.

Table 2 presents the covariates associated with pregnant women who delivered in a reference hospital for high-risk pregnancy. The highest prevalence of cesarean birth was observed in pregnant women aged 35 years or more, who presented 1.6 times more chances (OR=1.6; CI:1.4-1.9), to perform cesarean deliveries in comparison with pregnant women from 19 to 34 years of age.

The degree of education in this study did not show to be a factor associated with the increase in the c-section rate. The comorbidities of the parturients that presented significant results for the increase in cesarean birth rates were diabetes (OR= 1.8; IC: 1.5-2.1), HIV (OR= 4.4; IC: 2.5-7.8) and hypertension (OR: 1.8; IC: 1.6-2.2). In addition, the covariates number of pregnancies (OR = 1.6; CI: 1.4-1.6), and number of previous c-sections (OR = 86.8; CI: 50.9-148.1) were also significant.

Table 2 - Covariables related to the parturients attended in the hospital, from 2017-2018 and 2020-2021.

Covariables	Total		Cesarean section		p	Odds ratio (CI95%*)
	n	%	n	%		
Age (years)						
19-34	3442	72.9	1815	52.7		1.0
≥ 35	789	16.7	509	64.5	< 0.001	1.6 (1.4 - 1.9)
< 19	489	10.3	183	37.4	< 0.001	0.5 (0.4 - 0.7)
Degree of education						
Higher education (Complete and incomplete)	501	11.0	271	51.4		1.0
High school (Complete and incomplete)	2089	45.8	1146	54.9	0.281	0.9 (0.7 - 1.1)
Middle school (complete)	1969	43.2	1012	54.1	0.757	1.0 (0.8 - 1.2)
Number of pregnancies						
One	1520	32.2	684	45.0		1.0
More than one	3196	67.8	1821	57.0	< 0.001	1.6 (1.4 - 1.8)
Number of previous cesarean sections						
0	3021	64.0	1074	35.6		1.0
1	1013	21.4	761	75.1	< 0.001	5.5 (4.6 - 6.4)
2 or more	688	14.6	671	98.0	< 0.001	86.8(50.9-148.1)
Diabetes						
No	3805	80.5	1916	50.4		1.0
Yes	921	19.5	591	64.3	< 0.001	1.8 (1.5 - 2.1)
HIV						
No	4636	98.3	2438	52.6		1.0
Yes	82	1.7	68	82.9	< 0.001	4.4 (2.5 - 7.8)
Hipertension						
No	3940	83.4	1993	50.6		1.0
Yes	786	16,6	514	65,5	< 0.001	1,8 (1,6 - 2,2)

Subtitle: * CI95% = Confidence Interval of 95%.

Source: Made by the authors

Table 3 shows the associations between the outcome and the covariates related to the concept. A significant association was found for the following covariates: twin pregnancy (OR= 7.6; CI: 3.6-15.8), polyhydramnios (OR= 6.2; CI: 2.2-17.8), oligohydramnios (OR= 2.2; CI: 1.3-13.5), placenta previa (OR= 3.8; CI: 1.1-13.5), placental abruption (OR= 6.0; CI: 2.5-14.1) and fetal malformation (OR= 0.3; CI: 0.03-2.5).

Table 3 - Covariates related to the Concept born at the Teaching Hospital, from 2017-2018 and 2020-2021.

Covariables	Total		Cesarean		P	Odds ratio (CI95%*)
	n	%	n	%		
Twins						
No	4651	98.4	2440	52.5		1.0
Yes	75	1.6	67	89.3	< 0.001	7.6 (3.6 -15.8)
Polyhydramnios						
No	4694	99.3	2479	52.9		1.0
Yes	32	0.7	28	87.5	0.001	6.2 (2.2 - 17.8)
Oligohydramnios						
No	4657	98.5	2458	52.8		1.0
Yes	69	1.5	49	71.0	0.003	2.2 (1.3 - 3.7)
Placenta Previa						
No	4710	99.7	2494	53.0		1.0
Yes	16	0.3	13	81.3	0.036	3.8 (1.1 - 13.5)
Premature Placenta Detachment						
No	4680	99.0	2467	52.8		1.0
Yes	46	1.0	40	87.0	< 0.001	6.0 (2.5 -14.1)
Fetal malformation						
No	4721	99.9	2503	53.1		1.0
Yes	5	0.1	4	80.0	0.259	0.3 (0.03 - 2.5)

Subtitle: * CI95% = Confidence Interval of 95%.

Source: Made by the authors.

In the multiple model, it was found that the covariates pregnant woman's age ≥ 35 years, placental abruption, previous c-sections, diabetes, HIV, hypertension, polyhydramnios, oligohydramnios, twin pregnancy, and being a multigravida remained statistically significant after adjustment. Previous c-sections increase the likelihood of having a new one by 159.8 times.

After defining the model, the Hosmer-Lemeshow goodness-of-fit statistic was evaluated, resulting in a value of 6.3, with a p-value of 0.51. Nagelkerke's R^2 was 0.413 and Cox -Snell's R^2 was 0.309. In other words, the adjusted model can explain or account for 41.3% of the variation in the dependent variable (cesarean delivery). This indicates a moderate model fit.

Among the variables found in the final model, we found that women under the age of 19 were 30% less likely to have a c-section (OR: 0.7; CI: 0.5-0.9) compared to the reference age group. Another variable that proved to be a protective factor was pregnant women who had two or more pregnancies; in other words, multigravidas were 70% less likely to have a cesarean delivery (OR: 0.3; CI: 0.2-0.4).

Table 4 - Multiple logistic regression analysis of significant covariates in the univariate analysis.

Covariáveis	p-value	Odds ratio (CI95%*)
Age (Years)		
19-34		1.0
≥ 35	< 0.001	1.4 (1.1 - 1.7)
< 19	< 0.001	0.7 (0.5- 0.9)
Number of pregnancies		
One		1.0
Multiple	< 0.001	0.3 (0.2 - 0.4)
Premature Placenta Detachment		
No		1.0
Yes	< 0.001	8.8(3.5 -21.74)
Number of previous cesarean sections		
0		1.0
1	< 0.001	9.7 (8.0 - 11.7)
2 or more	< 0.001	159.8(92.6-275.8)
Diabetes		
No		1.0
Yes	< 0.001	1.8 (1.5 - 2.2)
HIV		
No		1.0
Yes	< 0.001	4.9 (2.5 - 9.6)
Hipertension		
No		1.0
Yes	< 0.001	2.3 (1.9 - 2.7)
Twins		
No		1.0
Yes	< 0.001	14.1 (6.5- 30.4)
Polyhydramnios		
No		1.0
Yes	< 0.001	7.1 (2.2 - 22.8)
Oligohydramnios		
No		1.0
Yes	< 0.001	2.7 (1.4 - 4.9)

Subtitle: * CI95% = Confidence Interval of 95%.

Source: Made by the author.

DISCUSSION

The prevalence of cesarean deliveries in our study increased from 51.0% in 2017 and 2018 to 57.4% in 2020 and 2021. The studies by Costa, Lopes, Oliveira (2022), and Martínez Pérez (2020) observed that COVID-19 infection increased the number of c-sections and mortality among pregnant women, associated with comorbidities and advanced age. Health protocols that extended to the post-partum period and beyond were created.

The age group with the highest prevalence of cesarean births was those aged 35 and over. It is important to highlight that the 20- to 29-year-old group is considered the ideal age group for pregnancy, as mentioned by Martins and Menezes (2022).

The results that demonstrate an increase in cesarean delivery rates in the presence of maternal comorbidities (including diabetes, hypertension, and HIV) are in line with findings in the literature. Koivunen *et al.* (2020) and Barros *et al.* (2021) observed that, regardless of the diagnostic criteria, women with gestational diabetes had a higher risk of undergoing c-sections than controls. Also, in pregnant women living with HIV, there is an increase in the indication for elective cesarean birth, since, in the absence of effective antiretroviral therapy, planned termination of pregnancy can protect against childhood HIV infection. However, if the mother is undergoing treatment and shows viral suppression, this benefit is not observed. In these cases, the procedure can bring unnecessary risks associated with elective c-section, both for mothers and newborns. (Kennedy *et al.*, 2017).

In our research, we found RR of 2.3 and 14.1, respectively for hypertensive pregnant women and twin pregnancies. Analyzing the factors and subgroups associated with high cesarean delivery rates, Harrison *et al.*, 2020, observed that hypertensive women had an RR of 1.6 for c-section. This risk was also greater when the maternal age was greater than 35 years of age, in the presence of antepartum hemorrhage (usually caused by placenta previa and placental abruption), in multiple pregnancies, and in the abnormal course of labor. Rasador and Abegg (2019) reinforce that there is a strong association between a previous c-section and the occurrence of a cesarean delivery in the next birth, as there is a fear of other complications such as rupture of the uterus and other comorbidities.

Multiple or twin pregnancies are often terminated by c-section, as they are associated with greater fetal and maternal risk compared to a single pregnancy (Federação Brasileira das Associações de Ginecologia e Obstetrícia - FEBRASGO, 2021). In some places, fetal malformation is not considered a public health priority, and with this diagnosis (80.0%), deliveries are planned as cesarean sections to improve both maternal and fetal outcomes (Gonçalves *et al.*, 2021).

Oligohydramnios and polyhydramnios are also associated with cesarean delivery since they can be related to maternal and fetal complications that lead to early termination of birth. Oligohydramnios consists of a low level of amniotic fluid for the gestational period, and its diagnosis is obtained through serial ultrasound monitoring. Polyhydramnios, unlike oligohydramnios, consist of excess amniotic fluid (Huri, Di Tommaso, Seravalli, 2023).

The biggest risk factor found was having a previous history of cesarean birth, which increases the chance of having another c-section by 159.8 times, a figure much higher than that found by Moreira *et al.* (2021). In addition, if the pregnant woman is under 19, this is a protective factor for cesarean delivery. This result was similar to that found by Nedberg *et al.* (2020) who found that women aged 13 to 19 were 34% less likely to have a c-section.

As in the studies by Taye *et al.* (2021) and Moreira *et al.* (2021), we also found that mothers with a previous history of c-section were more likely to undergo cesarean delivery than those who had not. We found no studies that evaluated the other covariates that were included in the final model.

CONCLUSION

We achieved our objectives by demonstrating that the factors of maternal age, first-time pregnant women, twin pregnancy, diabetes, HIV, hypertension, polyhydramnios, and oligohydramnios were all significantly linked to a higher occurrence of cesarean sections. However, the main factor associated with cesarean birth was that the pregnant women had performed two or more previous c-sections. The prevalence of cesarean deliveries was high in the analyzed Teaching Hospital, which can be justified by being the only regional institution for high-risk cases.

Our study differs from previously published articles because it focuses on a specific population and analyzes data from extended trends and variations over time. In addition, by using binary logistic regression models, we were able to identify specific factors associated with the increase in the probability of c-section, such as advanced maternal age, specific medical conditions (such as hypertension, diabetes, and HIV), and obstetric history (such as previous c-sections). The detailed analysis of these factors contributes to a deeper and more grounded understanding of indications for c-sections in a high-complexity context.

The importance of this study lies in its ability to provide knowledge that can guide more informed and thorough obstetric policies and practices. By identifying and understanding the risk factors associated with cesarean delivery, it is possible to develop targeted interventions to reduce the prevalence of unnecessary c-sections, improving the quality of mother and child healthcare.

Regarding the limitations of this work, it is important to highlight the use of secondary data sources, which are open to errors in form filling and lack of information on certain variables. Also, we emphasize that the hospital serves pregnant women at high risk, which may have influenced the value of cesarean birth rates.

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