Trends and factors associated with cesarean sections in Brazil and its States between 2001 and 2015

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Abstract

This study aimed to analyze the trends and socioeconomic factors associated with cesarean sections that occurred in Brazil and its states from 2001 to 2015. As hypotheses, it was suspected that there would be an increasing trend in the proportion of cesarean sections and an association with a higher socioeconomic status of women. This was an ecological and cross-sectional study with data collected from the Live Birth Information System and the National Household Sample Survey. The proportions and trends of cesarean sections in relation to normal births were calculated for three years. The temporal trend was calculated by simple linear regression models and the correlation between the proportion of cesarean sections and socioeconomic factors were by the Spearman correlation coefficient, with a significance level of 5%. From the 2010-2012 triennium, all states had caesarean sections greater than 30%. The largest proportions of cesarean sections were observed in the last three years analyzed from 2013 to 2015; the lowest being 34.9% and the highest 66.8%. Between 2007 and 2015 in all states of the Midwest, Southeast and Southern Regions the amount exceeded 50%. All states showed a significant tendency for cesarean sections to increase over time. There was a positive and significant correlation between the number of cesarean sections and per capita income, households with garbage collection and the Human Development Index, and there was a negative correlation for the percentage of the population with incomes below half one minimum wage. The high rate of cesarean sections in Brazil indicates the need for specific interventions through public policies aimed at maternal and child health.

Keywords: Childbirth. Cesarean section. Maternal and child health.

INTRODUCTION

Childbirth has always been considered a sociocultural milestone in women's lives, surrounded by mysteries and magic. Being a physiological and strictly female phenomenon, for a long time the situations found in labor were resolved by the most experienced women, assisted by midwives[1].

Over time, cesarean section has been considered a stage of evolution of human beings in the form of giving birth and proper normal delivery in modern times[2]. However, the increase in cesarean section numbers also caused an increase in female-related morbidity. In a global prospective cohort study on maternal and perinatal health conducted by the World Health Organization (WHO), cesarean section independently reduced overall risk in pelvic presentations and intrapartum fetal death in cephalic presentations, but increased risk of severe maternal and neonatal morbidity and mortality in cephalic presentations[3]. Other authors have also addressed the maternal and infant risks of morbidity and mortality due to cesarean section when compared to normal

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delivery[4,5]. In addition, caesarean sections represent a much higher expense than normal delivery where no complications occur[6].

In recent years, cesarean rates have increased so significantly that currently one in five women in the world gives birth by the abdominal route[7]. Cesarean sections above the recommended levels were observed in Brazil, but with regional differences[8]. In addition, there are reports that the proportion of cesarean sections in certain locations in Brazil have increased steadily[9,10].

Given this reality, there are several factors involved that may influence the choice of performing a cesarean section, which may be considered numerous and complex[11], among which are the socioeconomic characteristics. Studies indicate that women who belong to higher social strata, with higher education, higher income and are attended in private services are the ones who opt for this surgical procedure[9,12].

Considering that the increase in the number of cesarean sections became a public health problem, with risks of compromising maternal and child health[4,13,14] and the small number of national publications on the subject, this study aimed to analyze the temporal trend and socioeconomic factors associated with cesarean sections, which occurred in Brazil and its states (UFs) from 2001 to 2015. As the hypotheses of this study, there would be an increasing tendency in the proportion of cesarean sections and association with a higher socioeconomic level of women undergoing this type of delivery.

METHODOLOGY

This was a temporal series (2001-2015) with an ecological mixed design and a cross-sectional study for correlation with socioeconomic variables (2013-2015). Data were collected from the Live Birth Information System of the Department of Informatics of the Unified Health System (DATASUS). The proportions of cesarean sections in relation to normal births for Brazil and UFs (including the Federal District) between 2001 and 2015 were calculated by three-year periods (from 2001 to 2003, 2004 to 2006, 2007 to 2009, 2010 to 2012 and 2013 to 2015) to minimize any fluctuations in results. Cesarean section proportions were calculated using the equation: number of live births per cesarean section in mothers who resided in the area during the three-year period divided by the number of live births of mothers residing in the same area during the three-year period, multiplied by 100. The births recorded as ignored were not considered.

The temporal trend of cesarean section proportions over time was calculated using simple linear regression models. In the regression analysis, the dependent variable (y) corresponded to cesarean section proportions and the independent variable (x) to the three-year period studied. The linear model was defined as $y = b0 + b1x$, where b0 corresponds to the mean coefficient for the period and b1 the increment (increase or decrease) for each period analyzed.

Two thematic maps were prepared representing the cesarean section proportions for each UF considering the first three years (2001 to 2003) and the last three years (2013 to 2015) analyzed. The spatial analysis units used were the UFs, and the proportions of cesarean sections were distributed in four groups and graded on color scales, where the darkest tones refer to the largest proportions and the lighter tones to the lowest proportions of cesarean sections.

The proportions of cesarean sections of the UFs for the three-year period 2013-2015 were also correlated with the socioeconomic factors according to the 2014 National Household Sample Survey[15]. The socioeconomic factors analyzed for each UF were: percentage of illiterate people, average years of schooling, average household income per capita, percentage of population with income less than half a minimum wage per capita, percentage of households with sewage, percentage of households with garbage collection and the Human Development Index (HDI). For correlations, the Spearman correlation coefficient was used. Correlations were considered according to the result as follows: negligible ($r<0.3$), weak ($0.3<r<0.5$), moderate ($0.5<r<0.7$), strong ($0.7<r<0.9$) or too strong ($r>0.9$).

Data were processed in the Excel 2010 database and for the calculations we used the statistical program Statistical Package for Social Sciences (IBM SSPS Statistics), version 15.0. The normality of the variables was assessed by the Shapiro-Wilk test and the significance level adopted was 5%.

In compliance with Resolution 466/2012 of the National Health Council, which provides for the Guidelines and Regulatory Standards for Research involving Humans, the project was submitted and approved by the Research Ethics Committee (COEP) of Ponta Grossa State University, under protocol 1.844.195 and CAAE 61671616.0.0000.5694.

RESULTS

In Brazil, between 2001 and 2015, there were 44,408,865 live births, 51.9% vaginal births and 48.1% caesarean sections. Table 1 presents the proportions of cesarean sections in relation to the total vaginal deliveries and the temporal trend, for each UF and Brazil, for three years.

The highest proportions of cesarean sections were observed in the last three years analyzed, from 2013 to 2015. Only the state of Alagoas presented the highest proportion of cesarean sections from 2010 to 2012 (55.1%) and Espírito Santo proportions for these three-year periods 2010-2012 and 2013-2015 (64.1%).

Considering the proportions of cesarean sections in all three years, the lowest was for the State of Amapá in the three-year period from 2001 to 2003 (18.6%), and the largest was for Goiás between 2013 and 2015 (66.8%). In addition, in the three-year periods between 2010 and 2015, all UFs had a caesarean section greater than 30%, and between 2007 and 2015 throughout Central West, Southeast and Southern UFs, the proportion of cesarean sections exceeded 50%.

In the triennium from 2013 to 2015, all regions except the Northeast had at least one UF with a cesarean section greater than 60%, totaling ten. These ten UFs were, in ascending order of cesarean sections: Santa Catarina, Mato Grosso, Sao Paulo, Mato Grosso do Sul, Rio de Janeiro, Rio Grande do Sul, Paraná, Espirito Santo, Rondonia and Goiás; with a variation of 60.0 to 66.8%.

56.4% of cesarean sections for the triennium from 2013 to 2015 were observed in Brazil. Considering this proportion, among the 26 UFs, 14 (51.8%) demosntrated larger cesarean section proportion than the whole of Brazil, for the same three-year period. It is important to highlight that all the UFs of the Midwest, Southeast and Southern regions displayed larger cesarean section proportions than Brazil, in all five triennium periods analyzed.

In the trend analysis of cesarean section proportions, it was observed that there was a growing pattern in the estimation curves for all UFs, as well as for Brazil (all values $p \leq 0.01$ or $p \leq 0.001$; except for Roraima, $p = 0.03$).

In the analysis of the spatial distribution of cesarean section proportions in relation to normal births in the first triennium, from 2001 to 2003 (Figure 1), it was observed that the largest proportions were concentrated in the UFs of the Midwest, Southeast and Southern regions. The largest proportion was São Paulo and the smallest was mainly in the North and some UFs in the Northeast of the country. In the last three-year period (2013-2015), cesarean sections were higher than in the first three years and were concentrated in the Midwest, Southeast (except Minas Gerais) and Southern regions, and the lowest was in the North and Northeast of the country (Figure 2).

Table 2 shows the correlations between the proportion of cesarean sections in the triennium 2013-2015 and the socioeconomic indicators of the 2014 Brazilian National Household Sample Survey (according to state). It was observed that higher average household income *per capita*, higher percentage of households with garbage collection and higher HDI had a significant and moderate correlation ($r = 0.57$, 0.49 and 0.54, respectively) with higher proportion of cesarean sections. Higher percentage of the population with income below half a minimum wage *per capita* had a significant and moderate correlation ($r = -0.63$) with a lower proportion of cesarean sections. The percentage of illiterate people, the average years of schooling and the percentage of households with sewage did not correlate with the proportion of cesarean sections.

Table 1 – Proportion of cesarean sections and temporal trend for states and Brazil for trienniums, 2001 to 2015. Ponta Grossa - 2015

Region	State	Trienniums					R^2 (%)	p	Tendency
		2001-2003	2004-2006	2007-2009	2010-2012	2013-2015			
North	Acre (AC)	23.7	27.7	29.9	31.8	38.3	95.0	<0.01	Increase
	Amapá (AP)	18.6	23.8	27.4	30.8	34.8	99.4	<0.001	Increase
	Amazonas (AM)	23.9	30.0	34.7	37.7	37.8	90.2	0.01	Increase
	Pará (PA)	28.3	31.3	37.2	45.0	49.6	98.2	0.001	Increase
	Rondônia (RO)	47.4	53.6	59.0	64.5	66.5	97.6	<0.01	Increase
	Roraima (RR)	23.7	23.0	32.9	33.3	35.0	81.6	0.03	Increase
	Tocantins (TO)	29.2	33.6	39.8	44.7	51.9	99.4	<0.001	Increase
Northeast	Alagoas (AL)	26.0	33.9	42.9	55.1	54.7	94.5	<0.01	Increase
	Bahia (BA)	23.3	27.9	34.1	40.4	43.5	99.0	<0.001	Increase
	Ceará (CE)	30.3	35.7	42.4	52.3	57.2	98.8	0.001	Increase
	Maranhão (MA)	23.0	26.2	30.9	36.6	42.4	98.8	0.001	Increase
	Paraíba (PB)	33.5	39.8	47.0	53.7	56.9	98.6	0.01	Increase
	Pernambuco (PE)	31.6	36.2	44.2	51.1	53.2	97.3	<0.01	Increase
	Piauí (PI)	29.9	36.9	41.8	48.2	52.9	99.6	<0.001	Increase
	Rio Grande do Norte(RN)	29.0	36.6	44.0	53.4	59.2	99.6	<0.001	Increase
	Sergipe (SE)	23.0	26.9	31.3	38.3	43.4	98.9	<0.001	Increase
Mid-West	Distrito Federal (DF)	42.9	47.5	51.8	52.9	54.9	93.6	<0.01	Increase
	Goiás (GO)	45.3	49.9	56.9	63.7	66.8	98.6	0.001	Increase
	Mato Grosso (MT)	46.0	49.6	52.9	58.1	60.8	99.2	<0.001	Increase
	Mato Grosso do Sul(MS)	44.3	49.1	53.4	57.9	61.4	99.7	<0.001	Increase
									Increase
Southeast	Espírito Santo (ES)	44.7	48.3	56.5	64.1	64.1	93.9	<0.01	Increase
	Minas Gerais (MG)	41.9	46.4	50.5	55.9	57.7	98.3	0.001	Increase
	Rio de Janeiro (FJ)	49.5	52.9	56.9	61.3	61.6	95.6	<0.01	Increase
	São Paulo (SP)	50.5	53.9	57.2	60.0	60.9	96.7	<0.01	Increase
South	Paraná (PR)	45.6	50.3	55.1	60.3	62.7	98.8	0.001	Increase
	Santa Catarina (SC)	44.1	50.1	54.5	59.2	60.0	95.2	<0.01	Increase
	Rio Grande do Sul (RS)	43.4	48.9	53.8	60.2	62.2	98.1	0.001	Increase
BRASIL		39.0	43.4	48.4	54.0	56.4	98.8	0.001	Increase

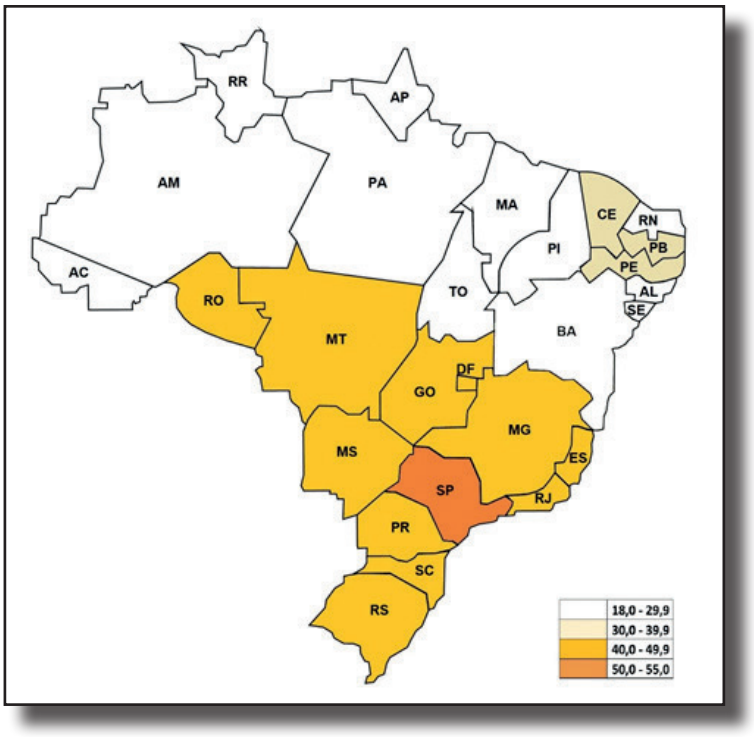

Figure 1 – Spatial distribution of cesarean sections in relation to normal deliveries, in percentage, among the states, triennium 2001 to 2003. Ponta Grossa – 2015.
Source: the authors (2018).

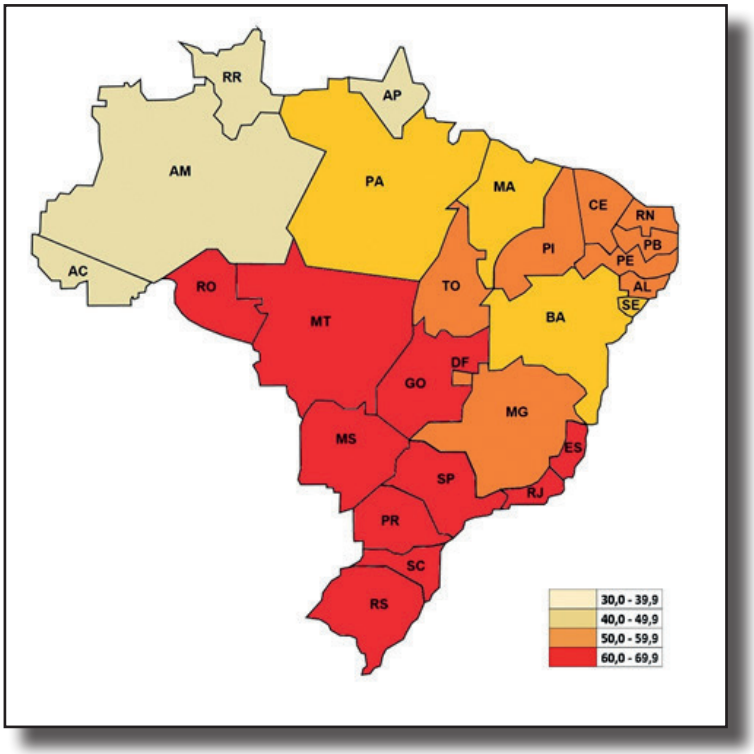

Figure 2 – Spatial distribution of cesarean sections in relation to normal deliveries, in percentage, among the states, triennium 2013 to 2015. Ponta Grossa – 2015
Source: the authors (2018).

Table 2 – Correlations between the proportions of cesarean sections in the 2013-2015 triennium and the socioeconomic indicators of the Brazilian National Household Sample Survey (according to state). Ponta Grossa – 2015

Socioeconomic indicator	Correlação	p*
Illiterate Percentage **	-0.34	0.08
Average years of schooling	0.24	0.23
Average household income per capita	0.57	<0.01
Percentage of population earning less than half the minimum wage per capita **	-0.63	<0.001
Percentage of households with sewage system	0.16	0.41
Percentage of households with garbage collection	0.49	<0.01
Human Development Index (HDI)	0.54	<0.01

*Spearman correlation test was used
** The lower the indicator value, the better the social or economic condition.
Source: the authors, 2018

DISCUSSION

This study evaluated the proportions and temporal trends of cesarean sections in the UFs and the whole of Brazil between 2013 and 2015, as well as possible correlations with socioeconomic indicators.

As several factors may influence the cesarean section rate, WHO has recently developed an evaluation tool that takes into account the characteristics of the obstetric population and which ones could influence the rates of these procedures in each region. Forty-three countries, including Brazil, participated to develope and validate the tool with more than 10 million births. For the Brazilian population, due to its specific characteristics, a caesarean section ratio of around 25 to 30% was recommended as reference[11].

Even considering the maximum reference value of 30%, all UFs exceeded this value in the 2010-2012 and 2013-2015 trienniums. In addition, in the 2007-2009, 2010-2012 and 2013-2015 trienniums of all UFs in the Midwest, Southeast and Southern regions, cesarean sections exceeded 50%; reaching 66.8% in Goiás in the last three-years period. The results found in this study are worrisome, given that in recent years there has been a change in the pattern of births, with cesarean section being the most frequent type of procedure in the female population.

Worldwide, there was an absolute increase in cesarean section rates of 12.4% between 1990 and 2014. This increase was seen across all continents, setting a true global epidemic. Rates ranged from 6% to 27.2% in the less developed and more developed continents, respectively. The largest variation occurred for developing countries (20.9% to 56.4%). The Latin America and the Caribbean region had the highest cesarean section rates (40.5%), followed by Northern America (32.3%), Oceania (31.1%), Europe (25%), Asia (19.2%) and Africa (7.3%)[7].

In fact, caesarean sections have become very common in many countries of the world, both developed and developing. For example, high cesarean rates were found in Chile (44.7% in 2015)[16], Singapore (37.4% in 2014)[17], Paraguay (37.3% in 2008)[18] and the United States (31.9% in 2016)[19]. However, smaller proportions have been reported in the

United Kingdom (22.0% in 2008)6, Denmark (20.7% 2009 to 2011)20, Japan (17.4% in 2008), India (8.5% in 2008) and Morocco (5.4% in 2008)[6].

Analyzing the temporal trend of cesarean section proportions in the study period, an increasing pattern was observed for all UFs in Brazil, as in the state of Piauí, where an analysis of hospital births of primiparous women registered at SINASC showed an increasing trend in the proportions of cesarean sections between 2000 and 2011, 34.4% and 52.1%, respectively10. In the municipality of Maringá, State of Paraná, among the 48,220 births that occurred between 2002 and 2012, 77.1% of cesarean sections were verified, with an increasing tendency, regardless of the type of financing. Cesarean section rates were higher than 90.0% for non-SUS (Unified Health System) vaginal deliveries, higher than cesarean section rates in SUS[9].

It seems that the upward trend in cesarean rates is a worldwide problem. International studies[7,17,18,21] have shown the increasing trend in cesarean sections, as observed in this study.

As an example, in a large survey that accounted for 98.0% of all live births worldwide, using data from 159 countries, cesarean section rates increased between 2000 and 2012 for most countries. The overall average rate increased to 15.5%, with a range between 1.4% in Niger and 55.6% in Brazil. In less developed countries, cesarean sections increased slightly to an average rate of 5.2%. In all developed countries the rate was over 15%, except for Bosnia and Herzegovina (13.9%) and Finland (14.7%)[21]. Other research has evaluated cesarean section rates and trends across continents and subcontinents over 24 years (1990-2014), with data from 121 countries. The overall average cesarean section rate increased by 12.4% (from 6.7% to 19.1%). Caribbean and Latin America had the highest absolute growth rate (19.4%), followed by Asia with an increase of 15.1% over the years. Asia and North America were the regions with the highest and lowest average annual rates of increase (6.4% and 1.6%, respectively)[7].

Even in countries that do not have high cesarean rates, these rates have increased over the years. A retrospective, population-based survey looked at all 3,398,586 births that occurred between 2000 and 2011 in Denmark, Finland, Iceland, Norway, and Sweden. Cesarean section rates increased in Denmark (16.4% to 20.7%), Norway (14.4% to 16.5%) and Sweden (15.5% to 17.1%). However, Finland and Iceland decreased by 16.5% to 16.2% and 17.5% to 15.3%, respectively[20].

On the other hand, cesarean sections in the United States, after increasing each year since 1996 and peaking in 2009 (32.9%), declined for the fourth consecutive year to 31.9% in 2016, which is the lowest rate since 2007[19]. It appears that China has been following this trend, as surveyed between 2008 and 2014 in all 2,865 municipalities in the 31 provinces of Mainland China, with 100,873,051 live births. Although there was an overall increase in cesarean sections (28.8% in 2008 to 34.9% in 2014), cesarean rates in 14 of the country's 17 major urban areas had declined from 4.1 to 17.5 percentage points from peak values. Moreover, in 4 large urban areas there were the largest decreases, with no increase in maternal or perinatal mortality[22].

Cesarean sections under ideal conditions can be considered safe and with little chance of serious complications and are effective in reducing maternal and perinatal mortality if indicated for medical reasons. However, this procedure has been widely used unnecessarily, without adequate indications justifying the high rates observed in Brazil[11]. Although severe cesarean section-related maternal complications are relatively rare, thousands of births worldwide occur every year through this route, with exposure to unnecessary risks, including serious surgical complications[13].

The causes that lead to excessive cesarean sections are complex and are related to maternal characteristics, obstetric practices,

institutional factors, health care level and economic factors[23]. Among the obstetric causes, an important factor that influences the increased choice of this procedure is if the user already had a previous cesarean section20. In addition, current medical training, which emphasizes technology and medical unpreparedness for caring for obstetric maneuvers, also help to favor cesarean sections[24].

Another factor linked to the greater chance of cesarean sections and is discussed in some studies, is the higher socioeconomic status of the parturient woman[10,12,18]. In this study, the information found referred to the same pattern, that is, a higher average household income per capita, a higher percentage of households with garbage collection and a higher HDI had a significant correlation with a higher proportion of cesarean sections. On the other hand, a higher percentage of the population with income below half a minimum wage per capita had a significant correlation with a lower proportion of this procedure.

Women with a higher educational level, higher income, higher social status, and those treated in private healthcare services were those who opted for cesarean sections[9,12,18]. In fact, worldwide cesarean rates are higher in more developed regions (27.2%) when compared to the neediest regions (6%)[7].

In the present study, a different distribution of cesarean section proportions in the states of the country was observed. In general, it was noted that the highest proportions were concentrated in the Midwest, Southeast and Southern regions (displaying higher cesarean sections than Brazil in all five analyzed trienniums), and the lowest were in the North and Northeast; the latter two have the worst socioeconomic indicators[15]. In the city of Campinas, São Paulo, a survey on the frequency and risk factors associated with cesarean sections reported that there was a 1.6 times greater chance of this procedure for women who worked, and 1.2 times more for women living in regions with the best Living Condition Indices[12].

The results of this study did not show significant correlations between the percentage of illiterate people and the average years of schooling with the proportion of cesarean sections. However, there are reports in the literature of the association of better education with higher cesarean section rates[10,12,18,24,25]. These differences in results in relation to the present study can be explained, in part, by the fact that research generally considers maternal education, and in this study the evaluation of schooling was used from average values of the population in general, composed by both genders and specific ages.

Concerning this topic, it is important to report a recent prospective cohort study in 10 public clinics in São Paulo that adopted standardized obstetric care protocols. Among 757 births, 215 (28.4%) were by cesarean section, and there was no association between cesarean section and socioeconomic indicators in the multivariate analysis. The authors concluded that in public hospitals that adopt standard obstetric protocols, the indicators of socioeconomic status are not associated with higher cesarean section rates, and the chance of women undergoing the procedure is determined by clinical and obstetric indications[26].

It should also be remembered that, as with any surgery, cesarean sections can entail risks and complications. A cohort study in Canada compared 46,766 healthy parturient women, who underwent their first cesarean section for pelvic presentation, with 2,292,420 others with similar characteristics, but were indicated for induction of labor. Parturient women who underwent cesarean sections had a higher risk of severe morbidity in general, such as hysterectomy, hemorrhage requiring hysterectomy, anesthetic complication, cardiorespiratory arrest, venous thromboembolism, severe puerperal infection, wall hematoma and prolonged hospitalization[4]. These results become even more worrisome if we consider

a survey conducted in 2008 in 137 countries, which found 6.2 million cesarean sections evaluated as unnecessary, with China and Brazil accounting for almost 50% of these procedures[6].

Care in childbirth should be based on well-established, pre-established studies and guidelines aimed at respecting the health and safety of birth for both mother and newborn. Variations inherent in the demographic and obstetric profile of the population and health services should be considered[11], as well as the adoption of educational practices, informing the advantages and disadvantages of various types of births, and the potential maternal and child risks and complications[24]. Recent research suggests strategies for adjusting the proportion of cesarean sections, such as the adoption of obstetric protocols[26] and the use of the Robson classification to stratify and implement a cesarean section monitoring program through local and international comparisons[20].

This study had limitations, such as the use of information from secondary databases, and the referrals for cesarean section and whether the care was provided by SUS or by Supplementary Health were not available.

CONCLUSION

Beginning from the 2010-2012 triennium, all the UFs had caesarean sections greater than 30%. The highest proportions were observed in the last three-year period analyzed from 2013 to 2015, which was the lowest for the state of Amapá (34.9%) and the highest for Goiás (66.8%). In the trienniums between 2007 and 2015, in all states of the Midwest, Southeast and South, the proportion of cesarean sections exceeded 50%. All UFs showed a significant tendency for cesarean sections to increase. There was a positive and significant correlation between the proportion of cesarean sections and per capita income, households with garbage collection and the Human Development Index, and negative for the percentage of the population with an income below half a minimum wage. Thus, the hypotheses of the study, that there would be an increasing trend in the proportion of cesarean sections and an association with a higher socioeconomic level of women undergoing this type of delivery were confirmed.

There is a need to evaluate cesarean section indications and to rethink the role of health services and staff in order to clarify the parturient women, their families and society in general, concerning the importance of the rational and safety of cesarean sections. The implementation of health policies directed at health and community services and professionals is fundamental for cesarean sections to be indicated when necessary, reducing expenses, curbing excesses and improving the quality of delivery care safely and with respect at birth.

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