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# Effects of elective cesarean section on outcomes in the first year of life: a cohort study

## *Efeitos da cesárea eletiva sobre desfechos no primeiro ano de vida: estudo de coorte*

## *Efectos de la cesárea electiva sobre los resultados en el primer año de vida: un estudio de cohort*

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## Abstract

**Objective**: to verify the effect of elective cesarean section compared to vaginal delivery, on the outcomes of the child's first year of life. **Methods**: cohort study with 499 mothers and their babies. Sociodemographic data were collected, related to the gestational history, birth and delivery, and about the baby's first year of life, in an interview carried out at the neonatal screening unit, from the maternity records and in home interviews. The associations of interest were evaluated with Cox regression analyses adjusted for the identified covariates, considering results of bivariate analyses that presented statistical significance at a p<0.20 level. In the adjusted analyses, associations were considered significant if p<0.05, having as effect measure the relative risk. **Results**: elective cesarean sections were not associated with the outcomes studied (interruption of breastfeeding, respiratory infections, atopies and overweight/obesity). **Conclusion and implications for practice**: the absence of association of elective cesarean sections and first year outcomes may be confirmed in future investigations. Based on the findings, it is suggested that the health team should support mothers in order to increase their confidence and commitment to breastfeeding, a practice that may have a positive impact on the other outcomes studied.

**Keywords:** Childbirth; Cesarean section; Elective Surgical Procedures; Morbidity; Infant.

## Resumo

**Objetivo**: verificar o efeito da cesárea eletiva, em comparação ao parto vaginal, sobre os desfechos no primeiro ano de vida da criança. **Método**: estudo de coorte com 499 mães e seus bebês. Foram coletados dados sociodemográficos, relativos à história gestacional, ao parto e nascimento e sobre o primeiro ano de vida do bebê, em entrevista realizada na unidade de triagem neonatal, do registro do prontuário da maternidade e em entrevistas no domicílio. Avaliaram-se as associações de interesse mediante análises de regressão de Cox, ajustadas para as covariáveis identificadas, considerando-se resultados de análises bivariadas que apresentaram significância estatística em nível de p<0,20. Nas análises ajustadas, consideraram-se as relações significativas se p<0,05, tendo como medida de efeito o risco relativo. **Resultados**: as cesáreas eletivas não se associaram aos desfechos estudados (interrupção do aleitamento materno, infecções respiratórias, atopias e sobrepeso/obesidade). **Conclusão e implicações para a prática**: a ausência de associação da cesárea eletiva e os desfechos do primeiro ano de vida poderão ser confirmados em investigações futuras. Pelos achados, sugere-se que a equipe de saúde apoie as mães, com o intuito de aumentar sua confiança e empenho em relação à amamentação, prática que pode repercutir positivamente nos demais desfechos estudados.

**Palavras-chave:** Parto; Cesárea; Procedimentos Cirúrgicos Eletivos; Morbidade; Lactente.

## Resumen

**Objetivo**: verificar el efecto de cesárea electiva, comparándolo con el producido por parto vaginal, en los resultados del primer año de vida del niño. **Métodos**: estudio de cohorte en 499 madres y sus bebés. Fueron recogidos datos sociodemográficos relacionados a la historia gestacional, al parto, al nacimiento y al primer año de vida del bebé; los datos fueron obtenidos en entrevista realizada en la unidad de selección neonatal, en la ficha médica de la maternidad y en entrevistas en el domicilio. Las asociaciones fueron evaluadas con el análisis de regresión Cox, ajustadas para las covariables identificadas, considerando los resultados del análisis bivariado que presentaron significación estadística con un nivel de p<0,20. En los análisis ajustados, las relaciones fueron consideradas significativas si p<0,05, teniendo como medida de efecto el riesgo relativo. **Resultados**: las cesáreas electivas no se asociaron con los resultados estudiados (interrupción del amamantamiento materno, infecciones respiratorias, atopias y exceso de peso/obesidad). **Conclusión e implicaciones para la práctica**: la ausencia de asociación de la cesárea electiva con los resultados del primer año de vida podrá ser confirmada en investigaciones futuras. De acuerdo con los resultados, se sugiere que el equipo de salud apoye a las madres con la finalidad de aumentar su confianza y empeño para realizar el amamantamiento; esta práctica puede repercutir positivamente en los demás resultados estudiados.

**Palabras clave:** Parto; Cesárea; Procedimientos Quirúrgicos Electivos; Morbilidad. Lactante.

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## INTRODUCTION

In addition to the possible adverse outcomes observed in childbirth,[1-4] the scientific literature has pointed out the deleterious effects of cesarean operations in early childhood, including early weaning, respiratory tract infections, atopies, and obesity.[5,6] With regard to weaning and respiratory infections, there is a distinction between elective and indicated cesarean sections,[7,8] which does not occur when allergy and obesity are considered.

A systematic review with a meta-analysis published in 2012 showed that the rate of early breastfeeding was lower among women undergoing cesarean section compared to vaginal delivery, and this reduction was even more significant in the case of elective cesarean section.[9] In a prospective study conducted in Calgary, Canada, with follow-up until the fourth month of life of the infants, after controlling the socio-demographic characteristics and the delivery, an association was found between elective cesarean section and early weaning. This association is explained by the fact that the cesarean section, when performed before the beginning of labor, interferes in the release of oxytocin and, consequently, in lacto-genesis, making it difficult to start and maintain breastfeeding. Thus, the adverse outcome occurs both among women who had cesarean sections indicated and in the case of cesarean sections as elective surgical procedures, when both occur before the beginning of labor.[7]

With respect to respiratory tract infections, a randomized clinical trial developed by researchers in the United States indicates that birth by cesarean section results in high morbidity from these infections in childhood.[10] Specifically on the occurrence of asthma at this stage of life, the scientific literature presents still divergent results: in a cohort study conducted in Denmark, an association between cesarean section and asthma was found in children over six years of age, and this association was stronger in cases of cesarean section before membrane rupture.[11] However, a study with the same design developed in Braga, Portugal, with children at two years of age, showed no association between asthma and elective cesarean section, when compared to those born through vaginal delivery.[8]

The relationship between atopy and cesarean section was investigated in a cohort study conducted in Greece, which found an increased risk of developing food allergy in childhood in children born from cesarean sections, but not associated with atopic dermatitis.[12] By being deprived of the passage through the birth canal and consequently of exposure to maternal microbiota, the newborn suffers immunity impairment, which explains both the greater predisposition to atopy and to respiratory infections.[8,10]

Similarly, a cohort study in Canada found that intestinal microbiota in infants born by vaginal delivery is more adequate, and decreases the risk of overweight and obesity in childhood.[13] A cohort study in Copenhagen, Denmark, found that, at six months of age, babies born by caesarean section had a faster rate of weight gain than those born through vaginal delivery, but this difference did not persist in childhood.[5] In Brazil, two cross-sectional studies conducted in the northeastern region found an association between excess weight in childhood[14] or preschool age[15] and cesarean section, but in the southern region of the country, a cohort study that evaluated body mass index, weight and height for age, concluded that being born by cesarean section did not lead to an increase in the risk of childhood obesity.[16]

Considering the gap in the literature regarding the deleterious effects of elective cesarean section in childhood, the scarcity of studies on these effects specifically in the first year of life, and the divergences between existing studies, this study presents the hypothesis: the effect of elective cesarean section is detrimental to the child in the first year of life when compared to the effect of vaginal delivery when considering selected outcomes.

Thus, the objective of this study is to verify the effect of elective cesarean section, when compared to vaginal delivery, on the outcomes of the first year of life of the child.

## METHOD

This is a cohort study, which integrates the CLaB (Botucatu Infant Cohort) study, a broad research project funded by the Foundation for Research Support of the State of São Paulo - FAPESP (Process 2015/03256-1) entitled "Health of the child in the first year of life: a prospective cohort study in the interior of São Paulo". The municipality of Botucatu is located in the State of São Paulo, center-south region, with an estimated population of 144,820 inhabitants for the year 2018 and is part of the Regional Health Department VI (DRS VI), Bauru, with other 67 municipalities.[17,18]

Regarding childbirth care in the Unified Health System (UHS), during the data collection period, the municipality relied on a Teaching Hospital and, for assistance to pregnant women and private individuals, a Private Hospital.[18] For care in the first week of life, in addition to traditional Basic Health Units and the Family Health Strategy, there is a neonatal primary care unit in the municipality, with the purpose of assisting all children born in both public and private services, and which has a high level of coverage, above 90% of births

The initial research sample consisted of all the mother/baby binomials that underwent medical or nursing consultation at the neonatal screening unit, the place of intake for the cohort, during the period defined for recruitment (July 2015 to February 2016). The inclusion criteria were: to be born in one of the two maternity hospitals in Botucatu, to have a maximum of 30 days of birth, to live in the urban area of the municipality, and the mother to be available to receive the interviewers at home for data collection. The project was presented to the mothers who took their children to the first clinical care after birth.

The follow-up of the babies took place from July 2015 until February 2017, when the last baby recruited for the study completed one year of life. In total, 656 babies (650 mothers) were recruited for the cohort and 585 were followed until the 12th month of life (10.8% loss of follow-up). The losses and refusals were higher in the home interview at six months of the baby (20 losses and six refusals). Losses were considered when there was no success after three attempts, at different times, of

home contact. The refusal was due to maternal manifestation in interrupting participation in the study.

All the newborns were included in the elective cesarean section group without reference to any indication of surgical delivery in the hospital records. The following situations were considered indications for cesarean section: pelvic presentation, placenta praevia, low-lying or accrete placenta, HIV-infected mother depending on viral load, iterativity, and genital herpes with active lesion.[19]

Six cases of twins (12 babies), 43 born by indicated cesarean section, and 31 cases with incomplete data (missing data) were excluded from this study. Thus, 499 babies composed the sample. For the overweight/obesity analysis related to the type of delivery, however, we considered a sample of 418 children (216 born by vaginal delivery and 202 by elective cesarean section), since it was opted to include only those classified as eutrophic at birth.

The data collection was performed in seven assessments, by a properly trained team, compensated, and supervised by the first author of this paper.

To meet the goal of this study, data collected from the first to the seventh moment of interaction with the binomial was used. The following is a list of the information collected at each stage of the follow-up:

Assessment 1 - data identifying the binomial and referring to the current gestational history (collected by means of an interview, at the time of recruitment); the birth, and the newborn (collected from the maternity ward records).

Assessments 2 and 4 - Data on breastfeeding was collected by telephone interview in the second and fourth month of life of the child, respectively.

Assessments 3 and 5 to 7 - Data was collected on breastfeeding, respiratory infection and/or atopies diagnosed and growth (weight and length) by home interview in the third, sixth, ninth and 12th month of the child's life.

In order to ensure the internal consistency of the study, properly trained and supervised interviewers and typists composed the data collection and typing team. The team included a general field supervisor, a data collection supervisor and consistency reviewers, with a total of 22 people involved in the research, which also had technical and logistical assistance from the Research Unit of the Botucatu Medical School, specialized in supporting epidemiological studies.

The instruments for data collection and recording were built by the researchers and tested by a pilot study, in order to adjust the questions that might present any difficulty. The masks for typing the data were built in Epi Info software version 7.0 ® and were also previously tested. It should be noted that the 12 binomials participating in the pilot study did not make up the sample for this study, as adjustments to the data collection instrument were necessary for the research to be effectively initiated.

The variables (co-variables) of characterization of the binomial were: maternal age under 20 years (yes/no); maternal education under eight years (yes/no); per capita income less than or equal to a minimum wage (yes/no); maternal color not white (yes/no); mother does not live with a partner (yes/no); mother does not exercise paid work (yes/no); pregnancy not performed in the Unified Health System (yes/no); gestational age at delivery equal to or less than 38 weeks (yes/no).

Regarding the outcomes, the following were investigated: interruption of exclusive breastfeeding (EBF) before the sixth month of life (yes/no); respiratory infection: asthma, bronchitis, bronchiolitis, pneumonia and/or other respiratory infections in the first year of life (yes/no); atopies: rhinitis, rhino-conjunctivitis, conjunctivitis, dermatitis, food allergy and/or other atopies in the first year of life (yes/no); body mass index (BMI) by age: overweight and obesity in the 12th month of life (yes/no).

The exposure variable was type of delivery (vaginal delivery and elective cesarean section).

To identify the family income *per capita*, the family income in *reais* was surveyed and divided by the number of people dependent on this income; then, considering the value of the minimum wage at the time of data collection (R$788.00), the family income per capita was classified in minimum wages.

The nutritional status was classified according to the BMI, according to age. To calculate the BMI and subsequent classification of the z score, the weight and height data of the babies were submitted to BMI/age consistency analysis using the AnthroPlus® software. The cut-off points for the baby's BMI classification followed the recommendations of the World Health Organization: Severely underweight (< Score-z -3), underweight (> Score-z -3 and < Score-z -2), eutrophy (> Score-z -2 and < Score-z +1), risk of overweight (> Score-z +1 and < Score-z +2), overweight (> Score-z +2 and < Score-z +3) and obesity (> Score-z +3).[20]

The association between the type of delivery with early interruption of EBF, respiratory infection and atopies in the first year of life and overweight/obesity at 12 months was analyzed, adjusting Cox' semi-parametric multiple regression models. The variables that, in bivariate exploration, showed statistical association with $p < 0.20$ were included in the deterministic component of these models. The Statistical Package for the Social Sciences (SPSS) software version 21.0 was used for the analysis.

The integrity of the interviews was verified in a random sample of 5% of the participants, by means of re-interviews made by telephone by the field supervisor. The databases were checked, inconsistencies verified in the questionnaires and then corrections were made in the databases whenever pertinent.

This project was submitted to the local Research Ethics Committee and approved for implementation (opinion number 893,396). The women who agreed to participate in the study signed a Free and Informed Consent Form.

## RESULTS

From the total of 499 mothers/babies that participated in this study, 260 mothers (52.1%) had vaginal delivery and 239 (47.9%) were submitted to elective cesarean section.

Table 1 shows the sociodemographic and gestational characteristics of the women and the occurrence of the outcomes under study.

On the maternal characteristics according to the type of delivery, a higher prevalence of elective cesarean section is observed among women whose pregnancy was planned and with delivery not performed in the UHS. As for babies, they more often had gestational age at birth equal to or below 38 weeks (Table 1).

The proportion of infants who received EBF by the sixth month of life was higher among those who were born through vaginal delivery. For those who had respiratory infection, atopy, and growth change (overweight/obesity) in the first year of life, the occurrence was similar between the two groups (Table 1).

The following analyses are presented to verify the effect of elective cesarean section and the influence of covariates on selected outcomes in the first year of life.

Table 2 deals with the early interruption of EBF.

The final model was adjusted for the covariates: no paid work and no UHS childbirth ($p< 0.20$). After adjustment, interruption of EBF before the sixth month of life was not associated with elective cesarean section: p-value = 0.473; RR = 1.09; 95% CI = 0.86-1.39 (Table 2).

Table 3 deals with the occurrence of respiratory infection in the population studied.

After adjusting the model for the covariates: schooling, not living with partner, and unplanned pregnancy ($p< 0.20$), respiratory infection in the first year of life was not associated with elective cesarean section: p value= 0.930; RR= 1.01; 95% CI= 0.73-1.41 (Table 3).

Table 4 is related to the occurrence of overweight/obesity in the 12th month of life.

When investigating the association between overweight/obesity in the 12th month of life and elective cesarean section, after adjusting covariates: age under or equal to 19 years, not living with partner, income less than or equal to a minimum wage, and delivery not performed in the UHS ($p< 0.20$), overweight/obesity was not associated with elective cesarean section: p-value = 0.564; RR = 1.15; 95% CI = 0.71-1.84 (Table 4).

Regarding atopy in the first year of life, no significant association was found (data not shown in table).

## DISCUSSION

This study specifically verified the effect of the elective cesarean section on the outcomes of the first year of life. This is a relevant aspect, considering that the scientific literature, in general, does not differentiate between elective and indicated cesarean sections. Of the outcomes studied, there was no association with the type of delivery. Thus, being born by elective cesarean section, compared to vaginal delivery, did not influence, in this study, the variables: interruption of EBF before the sixth month of life, respiratory infection and atopy in the first year, and overweight/obesity in the 12th month of life.

The association between weaning and cesarean section has been evidenced. A prospective study in Canada found that

**Table 1.** Description of maternal sociodemographic and gestational characteristics by type of delivery and outcomes investigated. Botucatu, 2015-2017.

| Variables | Vaginal delivery (n=260) | | Cesarean section (n=239) | |
|---|---|---|---|---|
| | n | % | n | % |
| **Age (years)** | | | | |
| ≤ 19 | 49 | 18.8 | 28 | 11.7 |
| ≥ 20 | 211 | 81.2 | 211 | 88.3 |
| **Schooling (approved years)** | | | | |
| ≤ 7 | 32 | 12.3 | 13 | 5.4 |
| ≥ 8 | 288 | 87.7 | 266 | 94.6 |
| **Skin color** | | | | |
| Not white | 106 | 40.7 | 80 | 33.4 |
| White | 154 | 59.3 | 159 | 66.6 |
| **Lives with partner** | | | | |
| Yes | 219 | 84.2 | 219 | 91.6 |
| No | 41 | 15.8 | 20 | 8.4 |
| **Paid work** | | | | |
| Yes | 132 | 50.7 | 162 | 67.8 |
| No | 128 | 49.3 | 77 | 32.2 |
| **Family income *per capita*** | | | | |
| ≤ minimum wage | 239 | 91.9 | 155 | 64.8 |
| > minimum wage | 21 | 8.1 | 84 | 35.2 |
| **Planned pregnancy** | | | | |
| Yes | 111 | 42.7 | 133 | 55.6 |
| No | 149 | 57.3 | 106 | 44.4 |
| **Birth outside of UHS** | | | | |
| Yes | 23 | 8.8 | 142 | 59.4 |
| No | 237 | 91.2 | 97 | 40.6 |
| **Gestational age at birth** | | | | |
| ≤ 38 weeks | 78 | 30.0 | 122 | 51.0 |
| ≥ 39 weeks | 182 | 70.0 | 117 | 49.0 |
| **Exclusive breastfeeding in the sixth month of life** | | | | |
| Yes | 78 | 30.0 | 47 | 19.7 |
| No | 182 | 70.0 | 192 | 80.3 |
| **Respiratory infection in the first year of life** | | | | |
| Yes | 80 | 30.8 | 69 | 28.9 |
| No | 180 | 69.2 | 170 | 71.1 |
| **Atopy in the first year of life** | | | | |
| Yes | 65 | 25.0 | 58 | 24.3 |
| No | 195 | 75.0 | 181 | 75.7 |
| **Overweight/Obesity in 12th month of life (n=418)** | | | | |
| Yes | 32 | 14.8 | 30 | 14.9 |
| No | 184 | 85.2 | 172 | 85.1 |

**Table 2.** Association between elective cesarean section and early interruption of exclusive breastfeeding, based on gross and adjusted Cox regression. Botucatu, 2015-2017.

| Variable | Gross Analysis | | | pvalue | Adjusted Analysis | | |
|---|---|---|---|---|---|---|---|
| | RR* | CI95%** | | | RR* | CI95% | pvalue |
| Age ≤ 19 years old | 0.94 | 0.71 | 1.26 | 0.698 | | | |
| Color not white | 1.09 | 0.88 | 1.34 | 0.417 | | | |
| Does not live with partner | 1.13 | 0.84 | 1.52 | 0.405 | | | |
| Does not perform paid work | 0.81 | 0.65 | 1.00 | 0.050 | 0.83 | 0.66-1.04 | 0.105 |
| Schooling ≤ 7 years | 0.88 | 0.60 | 1.28 | 0.501 | | | |
| Per capita income ≤ 1 minimum wage | 0.96 | 0.75 | 1.23 | 0.770 | | | |
| Unplanned pregnancy | 0.98 | 0.80 | 1.19 | 0.826 | | | |
| Birth not performed in the UHS | 1.15 | 0.93 | 1.43 | 0.176 | 1.03 | 0.80-1.34 | 0.786 |
| Gestational age at birth ≤ 38 weeks | 1.02 | 0.83 | 1.26 | 0.825 | | | |
| Elective Caesarean | 1.15 | 0.93 | 1.40 | 0.183 | 1.09 | 0.86-1.39 | 0.473 |

*RR= Relative Risk; **CI= Confidence Interval

**Table 3.** Association between elective cesarean section and respiratory infection in children up to one year of age, based on gross and adjusted Cox regression. Botucatu, 2015-2017.

| Variable | RR* | Gross Analysis | | | RR* | Adjusted Analysis | |
|---|---|---|---|---|---|---|---|
| | | CI** 95% | | pvalue | | CI**95% | pvalue |
| Age ≤ 19 years old | 0.85 | 0.53 | 1.36 | 0.498 | | | |
| Color not white | 1.16 | 0.84 | 1.61 | 0.355 | | | |
| Does not live with partner | 1.38 | 0.89 | 2.13 | 0.150 | 1.20 | 0.76-1.90 | 0.417 |
| Does not perform paid work | 0.84 | 0.60 | 1.17 | 0.302 | | | |
| Schooling ≤ 7 years | 1.56 | 0.97 | 2.50 | 0.063 | 1.44 | 0.88-2.33 | 0.140 |
| Per capita income ≤ 1 minimum wage | 1.42 | 0.82 | 1.92 | 0.283 | | | |
| Unplanned pregnancy | 1.38 | 0.99 | 1.91 | 0.053 | 1.31 | 0.93-1.83 | 0.116 |
| Birth not performed in the UHS | 1.08 | 0.77 | 1.52 | 0.634 | | | |
| Gestational age at birth ≤ 38 weeks | 1.06 | 0.77 | 1.47 | 0.703 | | | |
| Elective Caesarean | 0.94 | 0.68 | 1.29 | 0.698 | 1.01 | 0.73-1.41 | 0.930 |

*RR= Relative Risk; **CI= Confidence Interval

**Table 4.** Association between elective cesarean section and overweight/obesity on the 12th month of life, based on gross and adjusted Cox regression. Botucatu, 2015-2017.

| Variable | RR* | Gross Analysis | | | RR* | Adjusted Analysis | |
|---|---|---|---|---|---|---|---|
| | | CI** 95% | | pvalue | | CI**95% | pvalue |
| Age ≤ 19 years old | 0.59 | 0.30 | 1.15 | 0.124 | 0.60 | 0.31-1.53 | 0.126 |
| Color not white | 0.81 | 0.54 | 1.24 | 0.343 | | | |
| Does not live with partner | 1.74 | 0.97 | 3.13 | 0.063 | 1.69 | 0.96-1.98 | 0.068 |
| Does not perform paid work | 0.93 | 0.60 | 1.44 | 0.746 | | | |
| Schooling ≤ 7 years | 0.48 | 0.75 | 3.42 | 0.487 | | | |
| Per capita income ≤ 1 minimum wage | 1.54 | 0.87 | 2.71 | 0.136 | 1.48 | 0.87-2.53 | 0.144 |
| Unplanned pregnancy | 1.16 | 0.77 | 1.75 | 0.475 | | | |
| Birth not performed in the UHS | 0.56 | 0.88 | 2.75 | 0.121 | 1.55 | 0.94-2.58 | 0.086 |
| Gestational age at birth ≤ 38 weeks | 1.04 | 0.68 | 1.60 | 0.832 | | | |
| Elective Caesarean | 1.07 | 0.65 | 1.74 | 0.791 | 1.15 | 0.71-1.84 | 0.564 |

*RR= Relative Risk; **IC= Confidence Interval

women undergoing elective cesarean section are more likely to wean their babies in the first 12 weeks after delivery than women having a vaginal delivery (OR = 1.61; 95%CI = 1.14-2.26; p = 0.014). 7 A cohort conducted in China to determine the potential effects of cesarean section (without distinction between elective and indicated) on breastfeeding practice and duration also revealed that infants born by cesarean section were weaned earlier than babies born by vaginal delivery (OR=1.40; 95%CI=1.06-1.84; p<0.05).[21]

Such association was not observed in this study: babies born through elective cesarean section had no increased risk for interruption of EBF before the sixth month of life when compared to those born through vaginal delivery. One of the hypotheses that may justify the lack of association is related to the characteristics of the population studied, since in both groups more than 80% of the women were 20 years old or older, had eight years of schooling or more, and lived with a partner.

It is important to highlight the fact that the proportion of this feeding practice was higher in the group of babies born by vaginal delivery, when compared to those born by elective cesarean section. Also important is the clinical relevance related to the small number of children who were kept under EBF until the sixth month of life.

A cross-sectional study developed in a hospital accredited as a "Friend of the child" located in a capital city of the North region of Brazil, which sought to identify factors associated with EBF also found no significant association with type of delivery.[22] Data from the National Health Survey of 2013 indicate that the prevalence of exclusive breastfeeding until the sixth month of life was 36.6% in the country.[23] In the United States, the situation is even more unfavorable: according to the Center for Disease Control and Prevention, the prevalence of infants exclusively breastfed until the sixth month of life in the year 2016 was 25.4%.[24] Thus, it is clear that the rate of exclusive breastfeeding (25.1%) of the population studied is lower than the prevalence found nationwide and similar to the American result.

The World Health Organization, the Ministry of Health, and the Brazilian Society of Pediatrics recommend that this EBF practice should continue during the first six months of a child's life.[25] Complementary nutrition should be initiated after this period, together with breastfeeding, and should preferably be maintained until the second year of life, because it is important for the physical and psychic health of the binomial.[26]

It is clear from the above that there is a need for specific educational actions aimed at mothers, regardless of the type of delivery, in order to stimulate breastfeeding. These interventions must be present from prenatal care, addressing, among other issues, the birth plan of pregnant women and the consequences of these for the binomial.

The following explanatory hypotheses can be made about the absence of significant associations for the outcomes of respiratory infections and atopies: follow-up in the first year of life was not enough to identify these outcomes, since the studies that found such association investigated them in childhood and in children over six years of age.[10-12] The study aimed at verifying the association between cesarean section and asthma in two-year-old children ratifies this statement, since it highlights the difficulty of this type of diagnosis in children up to the age of two.[8] Another hypothesis is related to the non-identification, in this study, of whether the cesarean section occurred before or after the beginning of labor, since the literature reveals a stronger association between the development of asthma in children born from cesarean sections before the rupture of the amniotic membrane.[11]

Moreover, no association was found between elective cesarean section compared to vaginal delivery and the occurrence of overweight/obesity and, again, the explanation may be in the fact that the follow-up performed (one year), was insufficient to identify growth changes related to the types of delivery, since published studies bring this association in the medium and long term, especially in early childhood and adolescence.[14,15]

## CONCLUSION AND IMPLICATIONS TO THE PRACTICE

This study supports the conclusion that elective cesarean section, in the population studied, had no effect on the interruption of EBF before the sixth month of life, occurrence of respiratory infection, and atopy in the first year and overweight/obesity in the 12th month of life. Thus, we refute the hypothesis presented in this research.

As limitations of the study, the authors emphasize that the data reflect the socio-demographic and health conditions of the interior of São Paulo state. Therefore, generalization to other populations should consider the particularities of a medium-sized town. Some unexplored potential confounders may have an impact on the analyses, such as time to start breastfeeding or whether there was an incentive for early breastfeeding, the type and timing of food introduction, and the fact that the time when the elective cesarean section took place was not recorded, i.e., before or after labor started.

Based on the results found, it is suggested that the health team should give support to mothers, regardless of the type of delivery, from prenatal care, in order to increase their confidence and commitment to breastfeeding, thus seeking to prevent any deleterious events from happening. It is also suggested that new studies be conducted, with longer follow-up and identification of cases in which elective cesarean sections were performed after the beginning of labor, to better understand the relationships investigated in this study.

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## AUTHOR'S CONTRIBUTIONS

Study Design. Anna Paula Ferrari.

Data collection. Anna Paula Ferrari. Maria Cristina Heinzle da Silva Machado.

Data analysis. Anna Paula Ferrari. Maria Cristina Heinzle da Silva Machado. Vera Lúcia Pamplona Tonete. Cristina Maria Garcia de Lima Parada.

Interpretation of results. Anna Paula Ferrari. Vera Lúcia Pamplona Tonete. Cristina Maria Garcia de Lima Parada.

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