ABSTRACT

Background and aim: The cesarean births have increased, just like observed for obesity and overweight in childhood. This study aims to report the association between cesarean birth and the nutritional development status of 6/7-year-old. Materials and methods: As part of the Coorte Brasil Sul, the study involved 475 randomly selected children from the city of Palhoça, Brazil, born in 2009. Demographic, pregnancy and birth characteristics and children nutritional status were obtained. Measures of weight and height were converted to age and sex-adjusted z-scores of height-for-age (HFAz), weight-for-age (WFAz) and BMI-for-age (BMIz). Results: Among these children, 196 (41.3%) were born by cesarean section and 279 (58.7%) were born by vaginal birth. No differences were found between the means of the BMIz, WFAz and HFAz according to the mode of delivery, as well as the average treatment effect. Conclusion: Cesarean birth was not associated with the nutritional development status of 6/7-year-old in the studied population.

Key words: Obesity. Delivery Obstetric. Cesarean Section. Child.

RESUMO

Cesariana e o estado nutricional na infância: resultados de uma coorte no sul do Brasil

Introdução e objetivo: A incidência de cesariana tem aumentado, bem como o observado para a obesidade e o sobrepeso na infância. Este estudo tem como objetivo reportar a possível associação entre o parto ocorrido por cesariana e o status de desenvolvimento nutricional aos 6/7 anos de idade. Material e métodos: Como parte da Coorte Brasil Sul, o estudo envolveu 475 crianças selecionadas randomicamente na cidade de Palhoça, Brasil, nascidas em 2009. Foram identificadas as características demográficas, gestacionais e relativas ao nascimento, bem como o status no desenvolvimento nutricionais destas crianças. Foram realizadas as aferições de peso e altura e convertidos para os escores Z ajustados por idade e sexo para altura-por-idade (HFA2z), peso-por-idade (WFA2z) e IMC-por-idade (BMIz). Resultados: Entre estas crianças, 196 (41,3%) foram nascidas por cesariana e 279 (58,7%) por parto vaginal. Não foram identificadas diferenças entre as medias de BMIz, WFAz e HFAz ajustados pela via de parto, bem como quando realizado o efeito médio de tratamento dos dados. Conclusão: O nascimento por cesariana não esteve associado ao desenvolvimento nutricional aos 6/7 de idade na população estudada.


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INTRODUCTION

Obesity is considered a public health problem in several countries and the World Health Organization (WHO) has considered obesity an epidemic due to its increase in prevalence (WHO, 2000). Economically, it has raised financial costs and reduced productivity in certain populations over the last three decades, despite its stabilization in some developed and developing Western countries for the last years (Kelly and colaborators, 2008; Weng and colaborators, 2013).

Overweight and obesity in childhood have been identified as predictors of obesity in adulthood, with consequent increase in the risks of clinical conditions, such as cardiovascular diseases, diabetes mellitus, pulmonary diseases and musculoskeletal complications, aggravating the morbidity and mortality in middle age individuals (O’Dea, Hueiwen and Peralta, 2013; Widen and colaborators, 2017).

In this way, educational programs and public policies have contributed to achieving a stabilization of the incidence of obesity in children and adolescents in some developed countries (Aeberli and colaborators, 2010; Andersen, Baker and Sorensen, 2012; De Jong and colaborators, 2011; Stamatakis, Wardle and Cole, 2010). However, these results were not achieved among some different population subgroups, indicating the existence of certain genetic or environmental characteristics that contribute to the occurrence of childhood obesity (Olds and colaborators, 2011; Martinez-Vizcaíno and colaborators, 2015; Paz and colaborators, 2017).

The possibility that these environmental factors are not limited to late childhood, but also associated with the perinatal period, including prenatal care, the conditions of birth and the mode of delivery should be considered (Møller and colaborators, 2014; Santos and colaborators, 2017; Sorensen and colaborators, 2016).

Over the last three decades, the cesarean births have also increased, just like observed for obesity and overweight, stabilizing in the last few years. Several outcomes have been associated to the cesarean, such as postpartum hemorrhage, injury to urinary tract, neonatal respiratory morbidity, abnormal placentation, and uterine rupture in future pregnancies, as well as breastfeeding difficulties (Kankoon and colaborators, 2018).

Some authors Vinding and colaborators (2017) and Weng and colaborators (2013) have attributed obesity and overweight in childhood to the operatory birth. In Brazil, a continental country with great cultural miscegenation, the high rates of obesity and cesarean section have not been well explained as they were in other developing countries.

However, the Brazilian southern region presents socioeconomic, cultural and genetic characteristics different from the rest of the country and very alike to those found in the European continent, due to its colonization.

Thus, population studies in this region may contribute to elucidate which perinatal factors and genetic conditions might be effectively associated with the onset of obesity in childhood. They also may contribute to the development of educational measures to prevent this condition in the adult population, such as other several cohorts around the world (Leonard and colaborators, 2017; Massion and colaborators, 2016; Mastroeni and colaborators, 2017; Mueller and colaborators, 2017; Smithers and colaborators, 2017).

The aim of this study is to report the association between cesarean birth and the nutritional development status of 6/7-year-old schoolchildren.

MATERIALS AND METHODS

This study was approved by the Ethics Committee on Human Research of the University of Southern Santa Catarina, Brazil. This study is part of the Coorte Brasil Sul, a broad population-based study involving children from the city of Palhoça, Brazil, born in 2009. Its objective is to understand the influence of the first thousand days of life on the schoolchildren’s health-related behaviors and health.

A sample size was calculated according to the following parameters: total of 1,903 schoolchildren born in 2009; an unknown outcome prevalence (overweight and obesity); a relative error of 5% and a confidence level of 95%. The minimum sample size was 475 schoolchildren.

Data regarding demographic, pregnancy and birth characteristics were obtained from interviews with children’s parents at home. Also, birth records were collected from the health portfolio. Children’s nutritional status was obtained from anthropometric measures performed at
The average treatment effect (ATE) was calculated. Statistical analysis was performed using SPSS version 18.0 and the level of significance was p < 0.05.

RESULTS

Data from 475 children and their mothers were included in this study. Among children, 196 (41.3%) were born by cesarean section and 279 (58.7%) were born by vaginal birth.

Table 1 - Characteristics of the study sample according to route of delivery.

<table>
<thead>
<tr>
<th></th>
<th>Cesarean</th>
<th>Vaginal</th>
<th>Mean difference ± SD or n (%)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother’s age</td>
<td>27.0 ± 6.6</td>
<td>25.6 ± 6.6</td>
<td>-1.6 (-2.8; -0.4)</td>
<td>0.010</td>
</tr>
<tr>
<td>Mother’s ethnicity</td>
<td></td>
<td></td>
<td></td>
<td>0.273</td>
</tr>
<tr>
<td>Caucasian</td>
<td>155 (79.5)</td>
<td>207 (74.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African-Brazilian</td>
<td>39 (20.0)</td>
<td>64 (23.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>1 (0.5)</td>
<td>7 (2.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother with partner</td>
<td>177 (92.7)</td>
<td>255 (93.1)</td>
<td></td>
<td>0.870</td>
</tr>
<tr>
<td>Planned pregnancy</td>
<td>87 (45.3)</td>
<td>106 (38.5)</td>
<td></td>
<td>0.144</td>
</tr>
<tr>
<td>Prenatal care</td>
<td>189 (98.4)</td>
<td>272 (98.2)</td>
<td></td>
<td>0.842</td>
</tr>
<tr>
<td>Appointments</td>
<td>9.3 ± 3.2</td>
<td>9.1 ± 3.2</td>
<td>-0.2 (-0.8; 0.4)</td>
<td>0.489</td>
</tr>
<tr>
<td>Mother’s weight gain</td>
<td>15.2 ± 8.6</td>
<td>12.8 ± 6.6</td>
<td>-2.4 (-4.0; -0.9)</td>
<td>0.002</td>
</tr>
<tr>
<td>Gestational age</td>
<td>38.8 ± 2.5</td>
<td>39.1 ± 3.1</td>
<td>0.3 (0.3; 0.8)</td>
<td>0.309</td>
</tr>
<tr>
<td>Breastfed</td>
<td>178 (91.8)</td>
<td>250 (90.3)</td>
<td></td>
<td>0.578</td>
</tr>
<tr>
<td>Breastfeeding (months)</td>
<td>18.7 ± 7.5</td>
<td>17.1 ± 4.9</td>
<td>1.6 (-1.2; 4.7)</td>
<td>0.322</td>
</tr>
<tr>
<td>Alcohol in pregnancy</td>
<td>9 (4.9)</td>
<td>19 (7.1)</td>
<td></td>
<td>0.346</td>
</tr>
<tr>
<td>Tobacco in pregnancy</td>
<td>25 (13.2)</td>
<td>47 (17.2)</td>
<td></td>
<td>0.245</td>
</tr>
<tr>
<td>Drugs in pregnancy</td>
<td>4 (2.1)</td>
<td>4 (1.5)</td>
<td></td>
<td>0.610</td>
</tr>
<tr>
<td>Child’s sex</td>
<td></td>
<td></td>
<td></td>
<td>0.117</td>
</tr>
<tr>
<td>Male</td>
<td>96 (49.0)</td>
<td>157 (56.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>100 (51.0)</td>
<td>122 (43.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apgar 1st minute</td>
<td>8.3 ± 1.1</td>
<td>8.1 ± 1.1</td>
<td>-0.2 (-0.4; 0.1)</td>
<td>0.164</td>
</tr>
<tr>
<td>Apgar 5th minute</td>
<td>9.0 ± 1.0</td>
<td>9.0 ± 1.0</td>
<td>0.1 (-0.2; 0.2)</td>
<td>0.719</td>
</tr>
</tbody>
</table>

Table 2 - Associations between cesarean compared to vaginal birth on z-scores of weight-for-age (WFAz), height-for-age (HFAz) and BMI for age (BFAz).

<table>
<thead>
<tr>
<th></th>
<th>Cesarean</th>
<th>Vaginal</th>
<th>t-test</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFAz</td>
<td>-2.66</td>
<td>7.03</td>
<td></td>
<td>0.607</td>
</tr>
<tr>
<td>HFAz</td>
<td>-2.26</td>
<td>3.09</td>
<td></td>
<td>0.917</td>
</tr>
<tr>
<td>BFAz</td>
<td>-3.09</td>
<td>7.13</td>
<td></td>
<td>0.452</td>
</tr>
</tbody>
</table>

Legends: Children’s nutritional status was obtained from anthropometric measures performed at schools. Children’s weight and height were converted to age and sex-adjusted z-scores of height-for-age (HFAz), weight-for-age (WFAz) and BMI-for-age (BFAz). The t-test was used to evaluate the homogeneity between the way of birth and the anthropometric measures, according to the WHO parameters. To measure the difference in mean outcomes between both way of birth, the average treatment effect (ATE) was calculated. Statistical analysis was performed using SPSS version 18.0 and the level of significance was p < 0.05.

The characteristics of the studied sample are shown in Table 1 and some imbalances were found. Women of greater age at delivery had more children born from cesarean section (p=0.010). This happened also with mothers that presented a greater gain of weight during pregnancy (p=0.002). It is known that children born from women with a excessive weight gain during pregnancy tend to be heavier, the greater mother’s weight gain. This can be associated with heavier infant growth, but by age 6-7 years, the age at outcome measurement for this study, the differences may no longer be observable.

No differences were found between the means of the BMlz, WFAz and HFAz according to the route of delivery (Table 2). The mean effect (ATE) for cesarean birth compared to vaginal birth on the 6/7 year-old-
schoolchildren nutritional status in the studied population was also not different. Among the 428 children with anthropometric measurements, 55 (12.9%) were within the obesity range and 94 (22.0%) were in overweight.

**DISCUSSION**

In this study no evidence was found regarding the association between cesarean birth and anthropometric measures in childhood among 6/7 years-old-schoolchildren. Previously, cesarean delivery was associated with obesity rating from 15% (Chen and collaborators, 2017; Yuan and collaborators, 2016) to 46% (Mueller and collaborators, 2015).

However, other large population studies have shown that this association occurs in early childhood, but not in the age evaluated in this study (Vinding and collaborators, 2017; Pey and collaborators, 2014). The cohort studies present different analytical approaches, samples or definitions for the choice of birth, such as elective or emergency cesarean section and normal or instrumented vaginal delivery. Such methodological differences can interfere in the results.

This cohort still does not present the long-term follow-up. It is possible that future results show differences that have not yet been possible to evaluate. However, if the association between obesity and childbirth manifests at earlier ages and ceases to exist with the child’s growth, it might be tackled, since its main argument includes the difference in the colonization microbiota according to the way of childbirth (Dao and Clément, 2017).

In fact, it is difficult to explain such changes during children’s growth. The hypothesis that the intestinal flora of the child does not pass through the ideal colonization due to vaginal delivery, and that would contribute to the metabolism in childhood, cannot be the only way to explain obesity.

Several environmental and behavioral factors could have interfered with these results. In addition, modern surgical techniques and more precise indications, out of the risk of emergence during labor, can contribute to reduce the relationship between the surgical procedure and childhood obesity (Vinding and collaborators, 2017).

In this way, we must reflect on the real negative and positive repercussions of elective cesareans that seem to be being strengthened by medical entities and by the population.

A limitation of this study is on the non-differentiation between the two modes of childbirth, but this was not its initial goal.

Although further research is needed to elucidate the underlying mechanisms of overweight in childhood, the simple observation of a similar pattern of the increasing incidence of childhood obesity and cesarean section rates is not enough to explain this imbalance in child development.

Several metabolic complications have been associated with children born by surgery, such as neonatal hypoglycemia, immune disorders and allergic conditions in childhood (Leonard and collaborators, 2017; Vinding and collaborators, 2017).

**CONCLUSION**

Therefore, this study has not found association between cesarean birth and the nutritional development status of 6/7-year-old schoolchildren.

Other characteristics might contribute to childhood obesity and the follow-up of this children might also demonstrate different results.

**REFERENCES**


Disclosure Statement

This paper is based on the COORTE BRASIL SUL. The original project was sponsored by FAPESC/Brazil grant number 2016TR222. But all the authors declare no conflicts of interest once this funding aims to develop scientific data regarding the improvement of community health.

Informed Consent

All patients provided written consent to participate in this research.

Ethical Considerations

This study was approved by the Ethics Committee on Human Research of the University of Southern Santa Catarina, Brazil, under CAAE 38240114.0.0000.5369, in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 2008.

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