Original article

Profile of congenital anomalies among live births in the municipality of Tangará da Serra, Mato Grosso, Brazil, 2006-2016*

doi: 10.5123/S1679-49742018000300017

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Abstract

Objective: to describe congenital anomalies (CA) among live births of mothers resident in Tangará da Serra, MT, Brazil, during the period 2006-2016. **Methods**: this was a descriptive study, using Brazilian Live Birth Information System (SINASC) data. **Results**: out of 15,689 births, 77 were registered with CA (prevalence of 4.9/1,000); there was an 80.7% increase of recorded CA in 2016, accounting for 10.3/1,000 live births, including five cases of microcephaly; CA prevalence was higher among children born to women aged over 35 years (prevalence ratio [PR] =1.91; confidence interval [95%CI] 1.01;3.60), preterm (PR=2.22; 95%CI 1.26;3.92) and low birth weight infants (PR=3.21; 95%CI 1.86;5.54). **Conclusion**: low CA prevalence was found, possibly related to under-recording at birth; the increase observed in 2016 may be related to the Zika epidemic causing microcephaly, as well as greater attention by health professionals in relation to CA during this public health emergency.

Keywords: Congenital Anomalies; Live Birth; Information Systems; Public Health Surveillance; Zika Virus Infection; Microcephaly.

*The study was funded by the Brazilian Health Ministry's National Health Fund, Process No. 25000.162050/2016-86

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Introduction

Congenital anomalies (CA) are developmental disorders of prenatal origin present at birth, and may be structural (physical deformities), functional (neuromotor alterations) or metabolic (for example, inborn errors of metabolism, phenylketonuria, among other). Their causes may be genetic, environmental, or multifactorial.[1,2] In most cases, their etiology remains unknown and environmental causes (teratogens) are still little studied, especially in developing countries like Brazil.[1,3] It is estimated that congenital anomalies are present in 2 to 3% of live births, and can reach 5% if alterations diagnosed later, such as cardiac, renal and pulmonary anomalies, are taken into account.[2] Between 1980 and 2007, there was a large proportional reduction of secondary infant deaths due to infectious and respiratory causes, while CA remained stable, these being the second cause of infant mortality in Brazil.[1,4] A similar phenomenon was described in another Latin American country, Chile, between 2001 and 2010.[5]

With effect from 1999, a field was included on the SLB form for registering CA. This makes SINASC an important instrument for CA monitoring in Brazil.

The Brazilian Live Birth Information System (SINASC) was established in 1990 by the Brazilian Ministry of Health with the goal of providing data on live births retrieved from Statements of Live Birth (SLB).[6,7] With effect from 1999, a field was included on the SLB form for registering CA and coded according to the 10th revision of International Statistical Classification of Diseases and Related Health Problems (ICD-10).[3] This makes SINASC an important instrument for CA monitoring in Brazil.[8]

With the national emergency caused by the Zika virus and its association with microcephaly,[9] the epidemiological surveillance service of the municipality of Tangará da Serra, Mato Grosso, Brazil, realized the importance of recording live birth head circumference and length at birth (data until then absent from the SLB form) and made it compulsory for all local maternity hospitals to record this information manually with effect from 2016. In 2017, the initiative was extended throughout the national territory in response to a Ministry of Health recommendation.

In seeking to understand the behavior of congenital anomalies in Tangará da Serra over the last ten years (2006-2016), both prior to the emergence of congenital Zika virus syndrome (CZS) as well as during the occurrence of CZS with continuous virus transmission, the objective of this study was to describe congenital anomalies (CA) among live births to mothers resident in Tangará da Serra, MT, Brazil, during the period 2006-2016.

Methods

This was a descriptive study, using SLB and SINASC data referring to the period between 1 January 2006 and 31 December 2016, consulted in the second half of 2017. We included all live births resident in the municipality of Tangará da Serra, located in the Southwestern region of Mato Grosso state, 240km from Cuiabá, the state capital. In 2017, Tangará da Serrra had a population of 98,828 inhabitants, with an annual average of 1,445 live births. Tangará da Serra is the main city of its microregion and the sixth largest city in Mato Grosso state, accounting for approximately 3% of the state's population.[10] The city has a total of 211 public and private health establishments registered on the National Database of Health Care Facilities (CNES). These establishments include four hospitals with three maternity units.[11]

We included all live births between 1 January 2006 and 31 December 2016, based on SINASC data retrieved on 1 September 2017. SINASC is organized on the basis of Statement of Live Birth (SLB) records filled in by healthcare professionals. For the purpose of our analysis, the following SLB variables were selected:

a) date of birth (day, month and year);
b) sex of live birth (male; female);
c) birth weight (in grams: equal or greater than to 2,500g; less than 2,500g);
d) maternal age (in years: less than 35; 35 or more);
e) maternal education level (in years of study: up to 7; 8 to 11; 12 or more);
f) number of previous pregnancies (none, one, two, three or more);
g) number of children born alive (none; one ; two; three or more);
h) number of fetal losses (none, one, two or more);

i) duration of pregnancy (in weeks: less than 36; 37 to 41; 42 or more);
j) type of pregnancy (single; double); and
k) presence of congenital anomalies.

Congenital anomalies are recorded in a special field on the SLB form. This field allows one or more congenital anomalies to be recorded. Each diagnosis should be informed both on the SLB form and on SINASC. Physicians are responsible for diagnosing defects and/or anomalies, as well as for informing the person who fills in and/or inputs the corresponding ICD-103 codes on the SLB Recording this information in hospitals can be hampered by inadequate workflow, especially when different people collect and fill in SLB data. For this reason it is recommended that the SLB form is filled in by just one person before the mother is discharged. In the case of congenital defects diagnosed after the issuance of the SLB, or when laboratory confirmation of diagnosis is late, it is possible to register the data as an exception and add the information to the SINASC database.

The statistical analysis was performed using Stata version13.0.12 Initially, the annual numbers of live births with any congenital anomaly (isolated or multiple) and their prevalence per 1,000 live births were analyzed. As such, we estimated CA prevalence (per 1,000 live births) by type, according to ICD-10, for the entire period from 2006 to 2016, whereby the numerator was the number of live births for each CA type/group and the denominator was the total number of live births in the period. Prevalence ratios (PR) and their respective 95% confidence intervals (95%CI), were calculated according to sociodemographic characteristics, child delivery characteristics and live birth characteristics.

The study was carried out within the scope of the Epidemiological Surveillance actions of the municipality of Tangará da Serra. Only secondary data were used, with no direct or indirect identification of people. As it followed the ethical standards set out in National Health Council (CNS) Resolution No. 466 of 12 December 2012 and Resolution No. 510, of 7 April 2016, the study project was not submitted to a Research Ethics Committee.

Results

15,689 live births to mothers resident in the municipality of Tangará da Serra between 2006 and 2016 were analyzed. Of these, 77 had some form of CA identified before hospital discharge, representing CA prevalence of 4.9/1,000 live births.

Figure 1 shows total CA prevalence between 2006 and 2016. It is noteworthy that in the decade between 2006 and 2015, the records remained stable, although there was an increase of 80.7% in CA prevalence between 2015 and 2016 (5.7/1,000) (10.3/1,000).

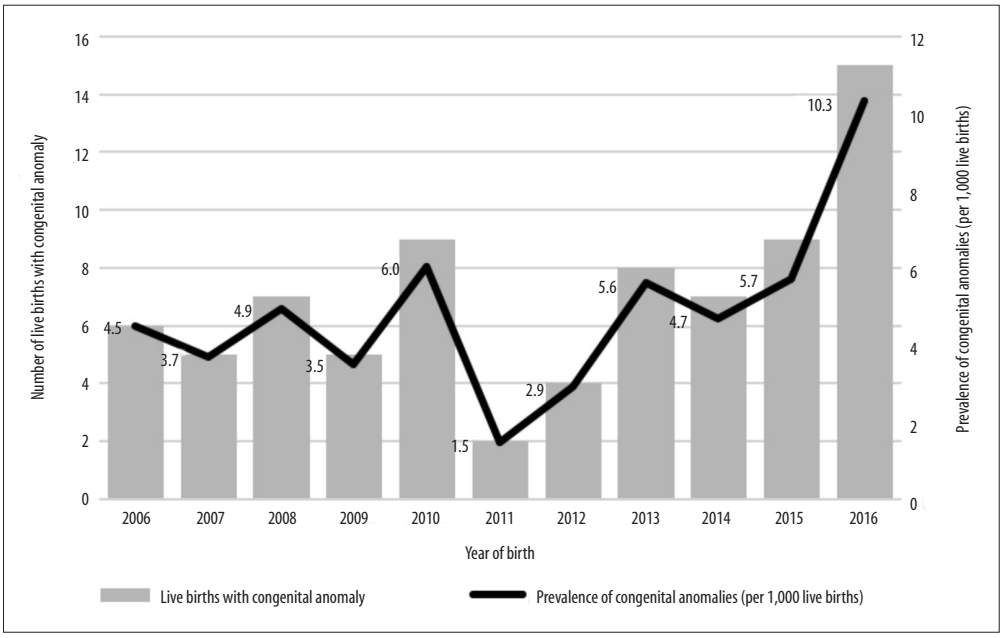
There were a total of 90 anomalies, since seven live births had more than one anomaly. Musculoskeletal system CA (27/90) were the most frequent, followed by nervous system CA (23/90), digestive system CA (12/90), cleft lip and palate CA (6/90) and chromosomal CA (4/90). Among musculoskeletal system CA, the most recorded diagnoses were 'clubfoot' (7/27) and polydactyly (5/27). Of the 23 records of nervous system CA, the most common diagnosis was microcephaly with six records - five of in the year 2016 alone, followed by hydrocephalus (5/23), anencephaly (3/23), spina bifida (2/23) and encephalocele (2/23) (Table 1).

Table 2 presents the distribution of live births with CA by type of anomaly and year of birth, including the ten most frequent CA in the period. From 2006 to 2015, only one case of microcephaly was recorded in the municipality, while the following year, 2016, no fewer than five cases were notified and all of them were severe cases.

Regarding maternal and live birth characteristics, CA prevalence ratios were greater among children born to women over the age of 35 years, in relation to those aged under 35 years (PR=1.91; 95% CI 1.01;3.60), as well as among preterm children, in comparison with those who were born at term (PR=2.22; 95% CI 1.26;3.92), and those with birth weight less than 2,500g (PR=3.21; 95% CI 1.86;5.54) (Table 3).

Discussion

Annual CA prevalence recorded on SINASC between 2006 and 2016 in a municipality in the state of Mato Grosso in the Brazilian Midwest was evaluated retrospectively. There was a Zika virus outbreak in this municipality at the end of 2015 and beginning of 2016. Zika virus (ZIKV) infection is known to be teratogenic in humans and the epidemic heightened the importance of establishing protocols for CA surveillance in developing countries. The World Health Organization



Source: Brazilian Live Birth Information System (SINASC); data retrieved on 9/1/2017.

Figure 1 – Number of live births with congenital anomaly and prevalence of congenital anomalies (per 1,000 live births), Tangará da Serra, Mato Grosso, 2006-2016

(WHO) recommends as responsibility of each country the establishment of protocols and regulations for CA surveillance.[13] CA are responsible for 276,000 early neonatal deaths from congenital anomaly worldwide each year.[14]

In Europe, the European Surveillance of Congenital Anomalies (EUROCAT) was created in 1979. It is a network of population records for epidemiological surveillance of CA with 23 member countries.[15]

In the Americas, there are records of CA in several countries such as Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Mexico and Uruguay, in addition to the Latin-American Collaborative Study of Congenital Malformations (ECLAMC), which involves hospitals in several countries in South America. In the United States, state-level tracking is mandatory and hospital services notify data on CA births and fetal deaths using a standardized form. The majority of these data are reported to higher authorities, such as the International Clearinghouse for Birth Defects and Monitoring Systems (ICBDMS), responsible for international surveillance.[16]

In Brazil, notification has been compulsory since 1999 and is done by filling out the SLB form. This data is available on SINASC and allows the tracking of CA.[6,7]

In Mato Grosso State, SINASC coverage between the years 2000 and 2012 was 94.9%. This was considered satisfactory and had an increasing trend[17] above the Brazilian average of 92%.[4]

CA frequency is estimated to be 2% to 3% of live births. ECLAMC registers 2.73% of CA live births in Latin America, while in European countries covered by the EUROCAT network, this average is 9.5/1,000 live births and 0.9/1,000 perinatal deaths. These differences between frequencies in Latin America and in Europe are due, to a large extent, to elective interruption of pregnancy (elective abortions) owing to fetal anomalies. When the records include these anomalies, the CA frequency reaches 2% in European countries.[2,14]

Some 2.9 million live births are registered annually in Brazil and it is expected that approximately 90,000 have some kind of CA, taking estimated prevalence of 3% for the human species.[6] However, studies based on SINASC data for the municipalities of Rio de Janeiro and São Paulo showed live birth CA frequency of 1.7% and 1.6%, respectively, these rates being higher than those found in our study.[6,18] Maringá-PR and Vale do Paraíba-SP share similar data, having 0.7% and 0.76% live birth ACs, respectively, this being close to the findings of our study, 0.7.[19,20] The issue of CA underreporting on SLB

Table 1 – Distribution and prevalence of types of congenital malformations at birth according to 10th revision of International Statistical Classification of Diseases and Related Health Problems (ICD-10), Tangará da Serra, Mato Grosso, 2006-2016

Group of Diseases	Live births with congenital anomalies	Prevalence of congenital anomalies at birth (Per 1,000 live births)
	n	
Congenital malformations and deformations of the musculoskeletal system	27	1.72
'Clubfoot'	7	0.45
Polydactyly, unspecified	5	0.32
Other unspecified congenital malformations of limb(s)	3	0.19
Gastroschisis	3	0.19
Congenital malformation, unspecified	3	0.19
Congenital diaphragmatic hernia	1	0.06
Other congenital deformities of feet	1	0.06
Congenital absence of hand and finger(s)	1	0.06
Thanatophoric short stature	1	0.06
Other congenital deformities of skull and face bones	1	0.06
Syndactyly, unspecified	1	0.06
Congenital malformations of the nervous system	23	1.47
Microcephaly	6	0.38
Congenital malformation, unspecified	5	0.32
Anencephaly	3	0.19
Spina bifida, unspecified	2	0.13
Other congenital malformation syndromes with other skeletal changes	2	0.13
Encephalocele, unspecified	2	0.13
Holoprosencephaly	1	0.06
Arnold-Chiari Syndrome	1	0.06
Hypoplasia and dysplasia of spinal cord	1	0.06
Congenital malformations of the digestive system	12	0.76
Congenital malformations of the lips	5	0.32
Congenital absence, atresia and stenosis	2	0.13
Congenital malformation, unspecified	1	0.06
Other congenital malformations of the mouth	1	0.06
Absence, atresia and congenital stenosis	1	0.06
Congenital malformation, unspecified	1	0.06
Atresia of esophagus with tracheo-esophageal fistula	1	0.06
Cleft Lip And Cleft Palate	6	0.38
Cleft palate, unspecified	3	0.19
Cleft palate with cleft lip	3	0.19
Congenital malformations of the circulatory system	4	0.25
Congenital malformation of heart, unspecified	2	0.13
Cardiac chambers and connections	1	0.06
Hypoplastic left heart syndrome	1	0.06
Other congenital malformations	4	0.25
Multiple congenital malformations, not elsewhere classified	2	0.13
Congenital malformation syndromes predominantly affecting facial appearance	1	0.06
Other specified congenital malformations of the intestine	1	0.06

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Table 1 – Distribution and prevalence of types of congenital malformations at birth according to 10th revision of International Statistical Classification of Diseases and Related Health Problems (ICD-10), Tangará da Serra, Mato Grosso, 2006-2016

Group of Diseases	Live births with congenital anomalies	Prevalence of congenital anomalies at birth (Per 1,000 live births)
	n	
Chromosomal abnormalities, not elsewhere classified	4	0.25
Down syndrome, unspecified	4	0.25
Congenital malformations of the musculoskeletal system	4	0.25
Other congenital malformations of the musculoskeletal system	2	0.13
Congenital absence and hypoplasia of the umbilical artery	1	0.06
Congenital malformation, unspecified	1	0.06
Congenital malformations of the respiratory system	3	0.19
Congenital hypoplasia and dysplasia of lung	2	0.13
Fissured, notched and cleft nose	1	0.06
Congenital malformations of the urinary system	1	0.06
Renal agenesis, unspecified	1	0.06
Congenital malformations of the eye, ear, face and neck	1	0.06
Congenital malformation, unspecified	1	0.06
Congenital malformations of the genital organ	1	0.06
Penile hypospadias	1	0.06

Source: Brazilian Live Birth Information System (SINASC); data retrieved on 9/1/2017.

forms has been investigated by Luquetti and Koifmann[8] in eight hospitals in João Pessoa-PB, Salvador-BAa, São Paulo and Campinas-SP, Belo Horizonte-MG, and Florianópolis and Joinville-SC.[8] In their work, which used ECLAMC as its gold standard, the authors found that CA was underreported on SINASC in these hospitals by at least 40% in 2004 and 2007. Costa et al. (2008)[18] also performed a study comparing SINASC data with hospital records of live births in the state of Rio de Janeiro in 2004 and found variability of concordance between SINASC data and hospital records, depending on the type of CA, with the highest CA concordance rates being found for the musculoskeletal system.

In Tangará da Serra underreporting can be attributed in particular to the lack of detection of CA in internal organs, such as congenital cardiopathies[21] or other CA the clinical characteristics of which are less visible at birth.[22] The predominance of congenital anomalies of the musculoskeletal system may be related to the inclusion of frequent anomalies, such as 'clubfoot' and polydactyly, in addition to the majority of musculoskeletal system anomalies being easily visible at birth.[2,6]

There was a sharp increase in CA in 2016, with the occurrence of five live births of children with microcephaly, compared to only one case recorded in all the previous years. This result could have arisen from more records being made following the incorporation of head circumference measurement on SLB. However, the five cases reported were severe microcephaly cases, which were clinically observable, even without the aid of a tape measure. Subsequently, these five cases were all evaluated and recorded as being compatible with congenital Zika syndrome. This assessment is concomitant with the occurrence of the ZIKV infection outbreak in the municipality, between the end of 2015 and the beginning of 2016. In Brazil, microcephaly cases remained stable from 2000 to 2014, with prevalence of 2/10,000 live births, changing significantly with effect from 2015, with 54.6/10,000 live births.[7] Part of this increase is attributed to the adoption of broader microcephaly inclusion criteria, such as head circumference of between -2 and -3 Z-Scores In addition, head circumference measurement is often subject to bias, either because of measurement errors, or because measurement is taken before the child completes 24 hours of life.[23] Notwithstanding such obliquities, the use of SINASC data was fundamental for the

Table 2 – Number of live births with congenital anomaly, by type of anomaly and year of birth (per 1,000 live births), Tangará da Serra, Mato Grosso, 2006-2016

Type of congenital anomaly	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
'Clubfoot'	–	–	1	–	1	1	–	2	1	–	1	7
Microcephaly	–	–	–	–	–	–	–	–	1	–	5	6
Deformation of the Lips	–	–	1	1	1	–	–	–	–	2	–	5
Polydactyly	2	–	–	–	–	–	–	–	1	–	2	5
Congenital Hydrocephalus	–	1	–	–	1	–	–	–	1	–	1	4
Malformations of member	–	–	1	–	–	–	1	–	–	1	1	4
Down Syndrome	–	1	–	2	–	–	–	1	–	–	–	4
Cleft palate	1	–	–	–	1	–	–	–	1	–	–	3
Anencephaly	–	–	–	–	–	–	–	1	1	1	–	3
Gastroschisis	1	1	1	–	–	–	–	–	–	–	–	3

Source: Brazilian Live Birth Information System (SINASC); data retrieved on 9/1/2017.
Note: The table includes the ten most frequent congenital anomalies in the period from 2006 to 2016.

confirmation of an abnormal and sudden increase in microcephaly cases in Northeast Brazil at the end of 2015.[7] In Mato Grosso state as a whole, between epidemiological weeks 45/2015 and 35/2017, the state registered 386 notifications of microcephaly cases, of which 19% were confirmed as cases of congenital Zika syndrome.[24]

In our study, CA prevalence was greater among live births to mothers aged more than 35 years old. This is an expected effect, since maternal age is the main risk factor for chromosomal abnormalities.[2,6,17] It is also important to note that three cases of gastroschisis were recorded, this being an anomaly more frequent in children of younger mothers. Moreover there appears to be a global time trend of increasing CA with effect from 1980 as confirmed in North American records.[25] Weighing less than 2,500g and prematurity were also factors associated with congenital anomalies. This was to be expected as congenital defects are frequently associated with these outcomes.[3,6,8]

As additional limitations of the present study, we highlight the incomplete filling in of the SLB form and the unavailability of complementary exams in prenatal care for early diagnosis of CA.

Considering the lack of studies about CA in Brazil, mainly in Midwest region, the results presented by this research can contribute to the planning of Public Health actions, as well as to directing and deepening discussions regarding the scaling up of actions as part of the public policies on CA and all actors involved in this process: family, friends, professionals and society in general. Standing out among these actions is the importance of training and raising the awareness of health professionals regarding the filling in of the SLB form, since the data they provide on CA, once they have been included on SINASC, constitute an important tool for the detection of alterations in temporal or spatial frequencies of congenital anomalies, such as the occurrence of microcephaly owing to maternal infection by the virus.

Acknowledgments

We thank the epidemiological surveillance team of the Municipal Health Department of Tangará da Serra: Zulema Salete Dengo Nuernberg, Maria Ozana Ferreira da Silva and Gisele Barbosa da Silva.

Authors' contributions

Silva JH and Terças ACP participated in the design of the study, data collection, analysis and interpretation and writing the manuscript. Pinheiro LCB, França GVA, Atanaka M and Schuler-Faccini L participated in the data analysis and interpretation and writing the manuscript. All the authors participated in the relevant critical review of the manuscript's intellectual content, approved the final version and declared themselves to be responsible for all aspects of the study, ensuring its accuracy and integrity.

Table 3 – Frequency of live births and the prevalence of congenital anomalies at birth, according to sociodemographic, child delivery and live births characteristics, Tangará da Serra, Mato Grosso, 2006-2016

Variables	Total number of live births (N= 15,689)	Live births with congenital anomalies		Prevalence of congenital anomalies at birth (Per 1,000 live births)		Prevalence Ratio		P-value
		n	%	Prevalence	(95% CI)[b]	PR[a]	(95% CI)[b]	
Age group (in years) (n= 15,689)								0.046
<35	14,429	66	85.7	4.6	3.6;5.8	1.00		
≥35	1,260	11	14.3	8.7	4.8;15.7	1.91	1.01;3.60	
Education level (in years of schooling) (n= 15,668)								0.456
≥7	3,609	18	24.0	5.0	3.1;7.9	1.00		
8-11	8,719	37	49.3	4.2	3.1;5.9	0.85	0.49;1.49	
≥12	3,340	20	26.7	6.0	3.9;9.3	1.20	0.64;2.27	
Number of previous pregnancies (n= 14,646)								0.775
None	5,270	28	36.3	5.3	3.7;7.7	1.00		
One	4,637	24	31.2	5.2	3.5;7.7	0.97	0.57;1.68	
Two	2,580	11	14.3	4.3	2.4;7.7	0.80	0.40;1.61	
Three or more	2,159	14	18.2	6.5	3.8;10.9	1.22	0.64;2.31	
Number of living children (n= 14,519)								0.354
None	5,836	36	46.7	6.2	4.5;8.5	1.00		
One	4,804	18	23.4	3.7	2.4;5.9	0.61	0.35;1.07	
Two	2,381	14	18.2	5.9	3.5;9.9	0.95	0.52;1.76	
Three or more	1,498	9	11.7	6.0	3.1;11.5	0.97	0.47;2.02	
Number of fetal loss (n= 13,526)								0.582
None	11,206	61	79.2	5.4	4.2;7.0	1.00		
One	1,907	14	18.2	7.3	4.4;12.4	1.35	0.76;2.41	
Two or more	413	2	2.6	4.8	1.2;19.2	0.89	0.22;3.63	
Duration of pregnancy (in weeks) (n= 15,667)								0.014
<37	1,621	15	20.0	9.3	5.6;15.3	2.22	1.26;3.92	
37-41	13,693	57	76.0	4.2	3.2;5.4	1.00		
≥42	353	3	4.0	8.5	2.7;26.1	2.04	0.64;6.49	
Type of pregnancy (n= 15,688)								0.238
Single	15,376	74	96.1	4.8	3.8;6.0	1.00		
Double	312	3	3.9	9.6	3.1;29.4	2.00	0.63;6.30	
Child's sex (n= 15,689)								0.648
Male	7,946	41	53.3	5.2	3.8;7.0	1.00		
Female	7,743	36	46.7	4.6	3.4;6.4	0.90	0.58;1.41	
Birth weight (n= 15,688)								<0.001
<2,500g	1,186	16	20.8	13.5	8.3;21.9	3.21	1.86;5.54	
≥2,500g	14,502	61	79.2	4.2	3.3;5.4	1.00		

a) PR: prevalence ratio.
b) 95%CI: 95% confidence interval.
Source: Brazilian Live Birth Information System (SINASC); data retrieved on 9/1/2017.

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Received on 31/01/2018
Approved on 04/05/2018