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Congenital Zika Syndrome: Prevalence of low birth weight and associated factors. Bahia, 2015–2017

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ABSTRACT

Objective: The clinical manifestations of Congenital Zika Syndrome (CZS) are not fully known, for example its effect on birth weight. This study estimated the prevalence of low birth weight (LBW) among children with CZS, and identified associated factors.
Methods: Cross-sectional study involving 393 children with CZS living in Bahia, Brazil, in 2015–2017. Official Information Systems were the data sources. We calculated LBW prevalence and applied Logistic Regression to assess associated factors.
Results: Prevalence of LBW among children with CZS was 37.2%. Excluding pre-term births the proportion was 29.9%. This prevalence was 81.0% and 28.0% among children born pre-term and term/post term, respectively. There was a higher proportion (53.2%) in female children, and in those delivered by cesarean section (51.4%). Most mothers were single/separated (62.1%) and had a low level of schooling (70.0%). In the model adjusted for type of delivery, preterm births presented a 10.8 times greater chance of presenting LBW than term/post-term ones. However, the Confidence Interval was very wide. Adjusting for gestation duration, children born by cesarean section had a 1.63 higher probability of presenting LBW than those born by vaginal delivery (OR = 1,63; $CI_{95\%}$ 1.01, 2.63).
Conclusions: The prevalence of LBW among children with CZS was very elevated, both preterm and term/post-term live births. This can contribute to increasing their risk for morbimortality. The association of LBW with prematurity and cesarean deliveries is known, but in children with CZS, it has not been clarified whether or not this is related to pathological conditions caused by fetal infection by the Zika virus.

Introduction

Congenital Zika Syndrome (CZS) is a new morbid condition caused by vertical transmission of the Zika virus (ZIKV). It was detected in 2015 due to the significant increase of births of children with microcephaly, which occurred a few months after the introduction of this infectious agent in Brazil. This event represented one of the most relevant public health problems to emerge in the 21st century, and led the World Health Organization to declare a Public Health Emergency of International Interest, due to the seriousness and risk of dissemination to other countries infested by *Aedes aegypti*, the main transmitter of the ZIKV (Teixeira et al., 2016).

In the period prior to the introduction of this infectious agent (Kindhauser et al., 2016), Brazil registered an average of 164 new cases of microcephaly per year (Marinho et al., 2016), and a prevalence of 5.4/10,000 live births (Orioli et al., 2017). Thus, considering that there was space-time correlation of this epidemic with Zika epidemic, the hypothesis that the increase in frequency of these cases could be related to ZIKV congenital infection was immediately raised. Subsequently, several evidences of the existence of this association were demonstrated (Costello et al., 2016). In addition to microcephaly, new findings such as spasticity, convulsions, irritability, brain stem dysfunction, dysphagia, ocular and auditory abnormalities and abnormalities in the genitourinary, cardiac and digestive systems were related to intrauterine infection by ZIKV. This picture represents a spectrum of manifestations that has come to be called Congenital Zika Syndrome (CZS) (Moore et al., 2017).

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Since the appearance of the first cases of microcephaly/CZS, up until January 4, 2018, 720 CZS cases in 26 countries of the Americas (Anon., 2017) had been confirmed by the Pan American Health Organization (PAHO) and the World Health Organization (WHO) (Marinho et al., 2016)

In Brazil, from November 2015 to July 2018, the Ministry of Health (Ministério da Saúde – MS) confirmed 3,226 cases of microcephaly and/or neurological changes related to ZIKV in fetuses and children.

Although several studies describe the epidemiological, environmental, clinical and social characteristics of CZS (Costello et al., 2016; Diniz, 2016; França et al., 2016), much remains to be elucidated. One of the aspects that needs clarification is the possible effect of ZIKV congenital infection on birth weight, a factor recognized by the WHO as the most important predictor of survival in the first year of life (World Health Organization WHO, 1980).

A child weighing less than 2,500 g at birth is considered as having "low birth weight" (LBW), a condition that predisposes him or her to greater morbidity and mortality in childhood and adulthood (McCormick, 1985; Kramer, 1987; Godfrey and Barker, 2000). It is known that LBW is a marker of poor fetal nutrition. In order to survive, the fetus suffering from intrauterine malnutrition undergoes endocrine and metabolic adaptations. These may result in harmful late effects such as obesity, diabetes, metabolic syndrome, hypertension and coronary diseases (Godfrey and Barker, 2000; Bismarck-Nasr et al., 2008). Some authors suggest that LBW is also associated with deficits in cognitive development in children, adolescents and adults (Dammann et al., 1996), and dental conditions of teeth enamel hypoplasia, palate deformation and malocclusion, as well as a greater predisposition to caries (Diniz et al., 2011).

Although the existence of a relationship between congenital infection by ZIKV and birth weight has not yet been established, several case series studies indicate a higher proportion of LBW in these children than in the general population (França et al., 2016; del Campo et al., 2017). Considering that Bahia was one of the states most affected by CZS in Brazil (DIVEP/SUVISA/SESAB, 2017; Anon., 2019), and given the importance of BW as an indicator of child survival, health and quality of life (Godfrey and Barker, 2000), this study aimed to estimate the prevalence of LBW in children with CZS and identify associated factors, in the state of Bahia, Brazil.

Methods

A cross-sectional study was performed on children with CZS, whose mothers lived in the state of Bahia. Cases reported from November 2015 to May 2017 were included. The sources of data were the state Live Birth Information System database (Sistema de Informação de Nascidos Vivos – SINASC) and the Public Health Event Record (Registro de Eventos em Saúde Pública – RESP). RESP is an online form created by the Brazilian Ministry of Health (MS) for the recording of unusual events in public health occurring in the country. It must be filled out by all public and private health services. This instrument was adapted to meet the needs for the notification of births, stillbirths and fetuses suspected of congenital infection by Zika. Each notification requires a clinical-epidemiological investigation, aiming to rule out or confirm the suspicion of a congenital syndrome, with etiological identification whenever possible, according to the guidelines defined by the MS (Brasil Ministério da Saúde et al., 2017).

Considering the information recorded in the RESP, the following criteria were adopted for inclusion of participants in this study: being a live birth whose mother lives in Bahia, and presenting a laboratory-confirmed CZS diagnosis or being a presumed case. Confirmed cases must have a serological test or RT polymerase chain reaction positive for ZIKV. Presumed cases must present congenital malformations compatible with CZS, and negative laboratory tests for syphilis, toxoplasmosis, rubella, cytomegalovirus, herpes and other etiologies.

The variables used in this study referring to the neonate were gender (male or female) and low birth weight (yes or no). Those referring to the mother were: Race/color; age group; marital status; schooling; type of delivery; type of pregnancy; duration of gestation; and number of live children.

For purposes of comparison, we analyzed these same variables for a representative sample of the 204,874 live births (LB) registered in the SINASC of Bahia in 2013, the year in which the ZIKV still did not circulate in Brazil – that is, no child born in this year had CZS. To be strongly related to LBW, the mother's schooling was the variable chosen as reference to estimate the sample size, using the following parameters: expected prevalence of 55% for mothers (of newborns in 2013) with incomplete and/or complete primary education, and of 45% for those who attended high school and/or higher; significance level of 5%; 90% power; and relative risk of 1.5. Thus, a sample of 1,085 LB was obtained, of which 651 (60%) were LB whose mother had incomplete and/or complete primary education and 434 (40%) those whose mother had higher education than elementary school. The selection of sample participants was random, using STATA® software version 12.0, also used in statistical analyses.

After distribution of the absolute and relative frequencies of the strata of each variable, possible differences were verified for children with and without CZS, using the Chi-Square test and Fisher's Exact test, considering $p < 0.20$. Bivariate logistic regression was used to evaluate the association between LBW and other covariates, with estimated odds ratios and their respective 95% confidence intervals.

In addition, bivariate logistic regression was applied for children born with CZS and without CZS, stratified according to the duration of gestation (<37 weeks and ≥37 weeks). Even variables with a value of $p > 0.20$ were included in the multivariate model, provided that they were pointed out in the literature as important associated with LBW. The variable twin pregnancy could not be included in this model due to low frequency of children in one of its categories.

The distribution of the same variables was verified for suspected CZS cases that had been reported in the RESP but were still in the process of undergoing diagnostic investigation to determine if the birth weight and other variables in these cases resembled those already confirmed as CZS. The Chi Square Test was applied in order to verify differences among them.

The Research Ethics Committee of the Institute of Public Health of the Federal University of Bahia approved the design of this study, under number 2.102.890.

Results

From 11/2015 to 05/2017 were recorded into the RESP 1,637 cases of congenital infection by ZIKV, for residents of Bahia. Of these, 71 referred to abortions, fetuses with changes in imaging tests and stillbirths; 24 were of other etiologies, not ZIKV; 558 had suspected congenital syndrome discarded after medical evaluation; and 567 were still under investigation or unclassified. The remaining 417 reports of live births met the inclusion criteria adopted for this study. However, when looking for the variables of interest in the SINASC, we excluded 24 (5.8%) participants because they did not have the data of their live birth declarations. Thus, 393 participants constituted the population of "children with CZS from the state of Bahia" included in this study.

Of the 393 children with CZS (CZS Group), 53.2% were female and 37.2% presented LBW. Regarding maternal characteristics,

72.8% were mixed 18.3% were adolescents, 62.0% were single or separated, 70.0% had schooling through elementary school and 51.4% had a cesarean section birth. Only 1.3% of pregnancies were twins, 16.3% had preterm births and 11.2% of mothers had 3 or more children. With respect to the 1085 live births without CZS (LB group 2013), 50.9%% were male and 8.6% had low birth weight. Maternal characteristics were: race/color: mixed (78.4%); adolescents (23.3%); single or separated (42.6%); had an elementary education (60.0%); had cesarean delivery (39.4%); twin pregnancies (2.3%); preterm deliveries (12.4%); and 15.4% had 3 or more children (Table 1).

According data not shown in table, when we excluded the preterm births (58) of the total of LB with CZS (393), the prevalence of LBW was 29.9%. Considering only those births preterm with this syndrome, the prevalence of LBW was 81.0% and it was 28.0% for term/post term births. Among the 1085 LB without this syndrome (LB2013), about 11.2% were preterm, and for them the prevalence of LBW was 32.0%, whereas for term/post-term births was 5.0%. The proportion of preterm births with CZS that were born from cesarean delivery was 62.1%, whereas for preterm births without this syndrome (LB2013) it was 40.6%. This difference was statistically significant ($p < 0.001$).

As shown in Table 2, comparing the LB according to birth weight (with and without LBW), the descriptive analysis bivariate showed a statistically significant difference for delivery type ($p = 0.01$), pregnancy type ($p < 0.01$) and duration of gestation ($p < 0.001$) for children with Zika; for those without Zika (LB2013 group), a difference was observed for maternal education ($p = 0.01$), pregnancy type and duration of gestation ($p < 0.001$).

In modeling bivariate by logistic regression (Table 3), we observed for all children with SCZ that were associated with LBW: cesarean delivery with an OR of 1.74 (95% CI 1.15–2.63) and duration of gestation <37 weeks with an OR of 11.02 (95% CI 5.45–22.27). For those without CZS, this association was with mother's elementary education with OR = 1.91 (95% CI 1.19–3.07) and duration of gestation <37 weeks with OR of 8.90 (95% CI 5.46–14.52).

In Table 4, the multivariate analysis (saturated model) shows that for children with CZS, those with cesarean deliveries presented OR of 1.90 (95% CI 1.11–3.24) and preterm births with OR of 15.75 (95% CI 6.74–36.80) were associated to LBW, while in the group without CZS the variables associated to LBW were mother's elementary education with OR of 2.08 (**95% CI** 1.15–3.76) and preterm births with OR of 9,20 (**95% CI** 5.50–15.42). The final model for the CZS group, adjusted for type of delivery, indicated OR of 10.76 (**95% CI** 5.30–21.83) for preterm pregnancy and, when adjusted for gestation duration the OR was 1.63 (**95% CI** 1.01–2.63) for cesarean delivery. In the group without CZS, the model adjusted for maternal schooling showed for preterm an OR of 8.40 (**95% CI 5**.13–13.74), and when adjusted for gestation duration, mothers with elementary education presented an OR of 1.80 (**95% CI** 1.05–3.07).

Data shown in the table indicate that, considering gestational duration, none of the maternal and child characteristics analyzed in this study had a statistically significant association with preterm birth weight for both CZS-born and non-CZS born. Among term/post-term, cesarean birth was associated to that outcome among births with CZS with OR of 1.90 (95% CI 1.13–3.20), and fundamental schooling showed an OR of 3.43 (95% CI 1.57–7.48) among births without CZS.

According to Table 5, of the 567 live births reported in the RESP which were still under epidemiological investigation, 60.4% were female. Their mothers were mixed (79.2%), single or separated (58.5%), and had not completed high school (91.0%). In addition, 24.9% were adolescents, 2.9% had a twin pregnancy and 89.6% had up to 2 children. Compared to the group of children with confirmed CZS, there was no statistically significant difference in the strata of the following variables: birth weight ($p = 0.143$), maternal marital status ($p = 0.292$), pregnancy type ($p = 0.11$), gestation duration ($p = 0.135$) and number of children (0.755).

Among the 535 cases under investigation that had data about birth weight, 174 (32.5%) weighed less than 2500 g, distributed in the following manner: 2 (0.3%) lower than 1000 g, 7 (1.3%) from 1000 g to 1499 g and 165 (30.9%) from 1500 g to 2499 g.

Table 1
Number and percentage[a] of live births with and without Congenital Zika Syndrome (CZS) according to sociodemographic and health characteristics of the children and mothers. State of Bahia, Brazil. 2013[b]–2017.[c]

Characteristics	With CZS (n = 393)		Without CZS (n = 1085)	
	N.	%	N.	%
Children				
Sex	393	100.0	1085	100.0
Female	209	53.2	533	49.1
Male	184	46.8	552	50.9
Low birth weight	393	100.0	1085	100.0
No	247	62.8	992	91.4
Yes	146	37.2	93	8.6
Mothers				
Race/Color	371	100.0	989	100.0
White	28	7.5	91	9.2
Black	73	19.7	123	12.4
Mixed	270	72.8	775	78.4
Age Group (years)	393	100.0	1085	100.0
Adolescent (≤19)	72	18.3	253	23.3
Adult (≥20)	321	81.7	832	76.7
Marital status	387	100.0	1056	100.0
Single or separate	240	62.0	450	42.6
Stable union/married	147	38.0	606	57.4
Education	383	100.0	1085	100.0
Elementary	268	70.0	651	60.0
High school or more	115	30.0	434	40.0
Type of delivery	391	100.0	1082	100.0
Vaginal	190	48.6	656	60.6
Cesarean	201	51.4	426	39.4
Pregnancy type	393	100.0	1080	100.0
Only	388	98.7	1055	97.7
Twin/Multiple	5	1.3	25	2.3
Pregnancy time (weeks)	355	100.0	980	100.0
Term/Post-term (≥37)	297	83.7	858	87.6
Preterm (<37)	58	16.3	122	12.4
N° living children	303	100.0	879	100.0
Until 2	269	88.8	745	84.8
3 or more	34	11.2	134	15.2

[a] Re 1 Refers to live births with information recorded on each variable.
[b] Live births without CZS — period: January to December 2013
[c] Live births with CZS — period: November 2015 to May 2017.

Discussion

The results of this study showed that the prevalence of LBW among children with CZS is very high, regardless of the duration of gestation. Prematurity and cesarean delivery were associated with its outcome. When the live births were stratified by gestation duration, LBW was associated to cesarean birth among CZS born infants and elementary education among those born without Zika, both for term/post-term births. For preterm births, either with or without CZS, none of the analyzed variables was associated with LBW. Most of the children with this syndrome were female, had a mother of mixed color, were single or separated and had low schooling levels.

Prevalence of LBW in children with CZS was more than four times higher than that observed in those without the syndrome, when compared to the value found in the sample of live births in 2013 in Bahia, as well as to values found in studies carried out in other regions of Brazil (Victora et al., 2013). Corroborating this

Table 2
Number and percentage[a] of live births with and without Congenital Zika Syndrome (CZS) according to presence of low birth weight, the child's sex and maternal sociodemographic and health characteristics. State of Bahia, Brazil. 2013[b]–2017.[c]

Low birth weight	With CZS			Without CZS		
	YES n (%)	NO n (%)	P	YES n (%)	NO n (%)	P
Child's Sex	n = 393			n = 1085		
Female	82 (56.2)	127 (51.4)	0.36*	43 (46.2)	490 (49.4)	0.56*
Male	64 (43.8)	120 (48.6)		50 (53.8)	502 (50.6)	
Mother's characteristics						
Race/Color	n = 371			n = 989		
White	13 (9.2)	15 (6.5)	0.62*	5 (5.9)	86 (9.5)	0.31*
Black	28 (19.9)	45 (19.6)		14 (16.5)	109 (12.1)	
Mixed	100 (70.9)	170 (73.9)		66 (77.6)	709 (78.4)	
Age group (years)	n = 393			n = 1085		
Adolescent (≤19)	118 (80.8)	203 (82.2)	0.73*	23 (24.7)	230 (23.2)	0.74*
Adult (≥20)	28 (19.2)	44 (17.8)		70 (75.3)	762 (76.8)	
Marital status	n = 387			n = 1056		
Single/separated	97 (66.4)	143 (59.3)	0.16*	41 (45.6)	409 (42.3)	0.56*
Stable union/married	49 (33.6)	98 (40.7)		49 (54.4)	557 (57.7)	
Education	n = 383			n = 1085		
Elementary	97 (67.8)	171 (71.5)	0.48*	68 (73.1)	583 (58.8)	0.01*
High school or more	46 (32.2)	68 (28.5)		25 (26.9)	409 (41.2)	
Delivery Type	n = 391			n = 1082		
Vaginal	58 (40.0)	132 (53.7)	0.01*	55 (59.1)	601 (60.8)	0.76*
Cesarean	87 (60.0)	114 (46.3)		38 (40.9)	388 (39.2)	
Pregnancy type	n = 393			n = 1080		
Only	141 (96.6)	247 (100.0)	0.01**	83 (89.2)	972 (98.5)	0.00**
Twin/Multiple	5 (3.4)	– (–)		10 (10.8)	15 (1.5)	
Pregnancy time (weeks)	n = 355			n = 980		
Term/Post-term (≥37)	83 (63.8)	214 (95.1)	0.00*	43 (52.4)	815 (90.8)	0.00*
Preterm (<37)	47 (36.2)	11 (4.9)		39 (47.6)	83 (9.2)	
N° living children	n = 297			n = 879		
Until 2	94 (85.5)	169 (90.4)	0.20*	66 (88.0)	679 (84.5)	0.41*
3 or more	16 (14.5)	18 (9.6)		9 (12.0)	125 (15.5)	

* Chi-Square Test.
** Fisher's Exact Test.
[a] Refers to live births with information recorded on each variable.
[b] Live born without CZS period: January to December 2013.
[c] Live births with CZS period: November 2015 to May 2017.

observation Baid and Agarwal (2017), report LBW as a common outcome of prenatal infection by ZIKV (Baid and Agarwal, 2017).

Among the possible explanations are: the placental damage, abnormal volume of amniotic fluid and altered flow of the umbilical artery caused by this viral infection (Marrs et al., 2016; Mysorekar and Diamond, 2016) result in intrauterine growth restriction, which may represent an important determinant for LBW. It is worth mentioning that in experimental models, it was possible to prove that ZIKV caused restriction of severe intrauterine growth (Cugola et al., 2016). A more direct factor that may favor lower birth weight among children with CZS is microcephaly, because reduced cranial volume and reduced cerebral weight may be influencing the child's total weight, although this is an element which is difficult to measure (del Campo et al., 2017).

More than half of the children with CZS were born by cesarean delivery, a factor that, along with prematurity, was associated with LBW in children with and without CZS, but with a greater intensity among the former. In our study, preterm births with CZS presented a 10.8 times greater chance of presenting LBW than full-term ones, and those born by cesarean section had a 1.63 higher probability of presenting LBW than those born by vaginal delivery. However, for prematurity the CI was very large. Possibly, the small number of cases in the different strata of the variables analyzed were responsible for the large CI of the associations observed with birth weight as well as the absence of this association in the analysis of preterm births.

The existence of the association between cesarean delivery and LBW and prematurity in the general population of live births is already known. There are situations in which this medical intervention can result in both effects (McCormick, 1985; Faúndes and Cecatti, 1991; da Silva, 2012). On the other hand, some authors argue that in Brazil there is still no consensus regarding the existence of this causal relationship, since the trends observed in cesarean deliveries do not explain regional variation or the trends of these outcomes over time (Victora et al., 2013).

Independently of this controversy, it was observed in our study that the difference between the proportion of premature infants with CZS and premature infants without this syndrome was significant. This shows the need for new studies in order to elucidate that relationship and to verify if the higher frequency of these factors is due to pathological situations in which an early interruption of gestation was necessary, or to other factors. It is also important to mention that although the type of pregnancy (single or multiple fetus) is a relevant factor associated with LBW in the groups with and without CZS, it was not possible to include it in the multivariate logistic regression model, due to the small number of observations in the twin/multiple pregnancy category. The higher frequency of mothers with a low level of schooling in the CZS group may reflect increased exposure to ZIKV infection by poorer people living in poorer conditions of sanitation, with less access to information and resources for prevention. It should also be considered that women with a higher level of education and therefore with better living conditions may have opted to interrupt their pregnancies after a diagnosis of microcephaly in their concept or postponed a possible pregnancy during the Zika epidemic. Furthermore, it may be plausible to hypothesize that this finding is

Table 3
Odds Ratio (OR) obtained by bivariate logistic regression, for the association between low birth weight in children with and without Zika Congenital Syndrome (CZS) according to sociodemographic and health characteristics of the children and mothers. Bahia, Brazil 2013[a] and 2017.[b]

Variables	With CZS		Without CZS	
	OR	95% CI	OR	95% CI
Child's Sex				
Female	1	–	1	–
Male	0.83	0.55;1.25	0.13	0.74;1.74
Mother's characteristics				
Race/Color				
White	1	–	1	–
Black	0.72	0.30; 1.73	2.21	0.77; 6.37
Mixed	0.68	0.31; 1.48	1.60	0.63; 4.08
Age group (years)				
Adult (≥20)	1	–	1	–
Adolescent (≤19)	1.09	0.65; 1.85	1.09	0.66; 1.78
Marital status				
Single/separated	1	–	1	–
Stable union/married	1.36	0.88; 2.08	1.14	0.74; 1.76
Education				
High school or more	1	–	1	–
Elementary	0.85	0.54; 1.33	1.91	1.19; 3.07
Delivery Type				
Vaginal	1	–	1	
Cesarean	1.74	1.15; 2.63	1.07	0.69; 1.65
N° living children				
Until 2	1	–	1	–
3 or more	1.60	0.78; 3.28	0.74	0.36; 1.53
Pregnancy time (weeks)				
Term/Post-term (≥37)	1	–	1	–
Preterm (<37)	11.02	5.45; 22.27	8.90	5.46; 14.52

[a] Live born without CZS period: January to December 2013.
[b] Live births with CZS period: November 2015 to May 2017.

in line with the educational profile of the majority of the Brazilian population, that is, having low schooling (Instituto Brasileiro de Geografia e Estatística (IBGE) B, 2018).

Because this study was performed with secondary data, its results may be subject to the quality of records in the information systems, especially in less developed municipalities. However, it is worthy of note that the SINASC is well consolidated in the national territory, reaching 100% coverage in 2011 (Brasil, 2013), and is a system widely used in studies on birth weight. Failure to locate some data on live births happened in the case of only 5.8% of the participants, possibly due to the delay in updating the system, and should not have compromised the results of this study. Additionally, the small number of preterm births represented a limitation of the study.

Regarding the RESP, although the possibility of underreporting exists, this should have been minimal due to the health services awareness of the importance of reporting CZS cases, after a public health emergency of international interest (Brasil, 2013) was declared and the media provided ample coverage of the epidemic, in addition to the active search for CZS cases carried out by epidemiological surveillance teams. It should also be borne in mind that 567 reports of suspected CZS cases were still under epidemiological investigation due to the time required to complete clinical and epidemiological investigation from notification to classification. However, there does not appear to be any evidence that the behavior of birth weight can be differentiated between already confirmed cases and those still under investigation, since the distribution in both groups was very similar. Possibly, this means that most of the suspected cases still under investigation should be confirmed.

Despite these limitations, this is a relevant study for the field of public health, as it reveals a worrisome picture: in addition to the developmental impairment that has been observed in children with CZS, there is a negative repercussion of the high prevalence of LBW. According to the hypothesis of the fetal origin of diseases, LBW can contribute to the increase of mortality at all ages, and to future risk for metabolic syndrome, diabetes, hypertension, coronary disease and obesity (Godfrey and Barker, 2000; Bismarck-Nasr et al., 2008).

To date, there are no specific ZIKV vaccines or antivirals, so prevention of fetal damage caused by this virus is based on taking precautions against mosquito bites throughout pregnancy, through the use of repellents, mosquito nets, and adequate clothing, among others. Although it was not possible to evaluate other variables that could better clarify the differences observed

Table 4
Odds Ratio (OR) obtained by multivariate logistic regression, for the association between low birth weight in children with and without Zika Congenital Syndrome (CZS) according to maternal sociodemographic characteristics. Bahia, Brazil 2013[a] and 2017[b].

Maternal characteristics	Saturated model				Final model			
	With CZS		Without CZS		With CZS		Without CZS	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Race/Color								
White	1	–	1	–	–	–	–	–
Black	1.04	0.36; 3.04	1.54	0.48; 4.92	–	–	–	–
Mixed	0.86	0.33; 2.26	1.29	0.47; 3.53	–	–	–	–
Age group (years)								
Adult (≥20)	1	–	1	–	–	–	–	–
Adolescent (≤19)	0.96	0.48; 1.91	0.88	0.48; 1.62	–	–	–	–
Marital status								
Stable union/Married	1	–	1	–	–	–	–	–
Single/Separated	1.27	0.74; 2.19	1.1	0.65; 1.85	–	–	–	–
Education								
High school or more	1	–	1	–	–	–	–	–
Elementary	0.66	0.37; 1.18	2.08	1.15; 3.76	–	–	1.8	1.05; 3.07
Delivery type								
Vaginal	1	–	1	–	–	–	–	–
Cesarean	1.9	1.11: 3.24	1.38	0.82; 2.33	1.63	1.01; 2.63	–	–
Pregnancy time (weeks)								
Term/Post term (≥37)	1	–	1	–	–	–	–	–
Preterm (<37)	15.75	6.74; 36.80	9.2	5.50; 15.42	10.76	5.30; 21.83	8.4	5.13; 13.74

[a] Live births without CZS period: January to December 2013
[b] Live births with CZS period: November 2015 to May 2017

Table 5
Numbers and percentage[a] of children under investigation for Zika Congenital Syndrome (CZS) and confirmed for CZS according to sociodemographic and health characteristics. State of Bahia. Brazil. November 2015 to May 2017.

Characteristics	Under investigation		Confirmed CZS		*P*
	N	%	N	%	
Children					
Sex	535	100.0	393	100.0	0.029
Female	323	60.4	209	53.2	
Male	212	39.6	184	46.8	
Low birth weight	535	100	393	100	0.143
No	361	67.5	247	62.8	
Yes	174	32.5	146	37.2	
Mothers					
Race/Color	371	100.0	371	100.0	0.000
White	14	3.8	28	7.5	
Black	60	16.2	73	19.7	
Mixed	294	79.2	270	72.8	
Yellow/Indian	3	0.8	–	–	
Age group (years)	535	100.0	393	100.0	0.018
Adolescent (≤19)	133	24.9	72	18.3	
Adult (≥20)	402	75.1	321	81.7	
Marital status	526	100.0	387	100.0	0.292
Single/separated	308	58.5	240	62.0	
Stable union/married	218	41.5	147	38.0	
Education	414	100.0	383	100.0	0.000
Elementary	377	91.0	268	70.0	
High school or more	37	9.0	115	30.0	
Delivery type	535	100.0	391	100.0	0.000
Vaginal	382	71.4	190	48.6	
Cesarean	153	28.6	201	51.4	
Pregnancy type	532	100.0	393	100.0	0.110
Only	517	97.1	388	98.7	
Twin/Multiple	15	2.9	5	1.3	
Pregnancy time (weeks)	481	100.0	355	100.0	0.135
Term/post-term (≥37)	420	87.3	297	83.7	
Preterm (<37)	61	12.7	58	16.3	
N° living children	363	100	303	100	0.755
Until 2	325	89.6	269	88.8	
3 or more	38	10.4	34	11.2	

[a] Refers to live births with information recorded on each variable.

between the CZS and LB2013 groups, the high proportion of LBW found in neonates with this syndrome raises the need for further research that can elucidate the extent to which congenital ZIKV infection can determine this outcome.

Declaration of interest

None.

Conflict of interest

None.

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None.

Ethical approval

This study was approved by the Research Ethics Committee of the Institute of Public Health of the Federal University of Bahia, under number 2.102.890.

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