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Prevalence and maternal risk factors of congenital malformations in newborns from Sergipe, Northeastern Brazil

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ABSTRACT

Introduction: Due to the importance of infant death caused by congenital malformations worldwide, more studies are necessary to determine the prevalence of these disorders serving as the basis for more effective control measures. **Objective:** To determine the prevalence and evaluate maternal risk factors for congenital malformations in newborns. **Methods:** A cross-sectional and retrospective study was performed in the reference maternity hospital for high-risk pregnancies in the state of Sergipe, northeastern Brazil. Data were collected from the medical records and declarations of live births of 16,518 births between January 2014 and December 2016, being included children with identified congenital malformations. Data were analyzed using the odds ratio, chi-square, and Fisher's exact test with $p<0.05$. **Results:** The study population was composed of 369 newborns with congenital malformations, which corresponds to 2.23% of total births. 53.9% were male, 47.9% had low birth weight and, 52.5% had adequate Apgar score. Anomalies affecting the musculoskeletal system were the most prevalent (30.9%), with polydactyly being the most frequent (53.5%). The number of prenatal consultations, education, and gestational age were the main observed maternal risk factors of congenital malformations. Anomalies of the circulatory system (OR=3.2 CI95% 1.3-7.84), multiple malformations (OR=9.24 CI95% 3.07-27.83), and chromosomal syndromes (OR=2.72 CI95% 1.48-5.01) were the most commonly associated with newborn deaths. **Conclusion:** The study presents the prevalence and risk factors related to malformations in the state of Sergipe, and improvements on maternal care and socioeconomic variables are important to decrease the number of malformations cases in Brazil.

Keywords: prevalence; congenital abnormalities; infant, newborn; risk factors.

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INTRODUCTION

Congenital anomalies are functional or structural changes in embryofetal development arising from factors that originate before birth. It presents the most diverse clinical

manifestations, from mild dysmorphia to complex defects of organs or extremely rare body segments, composing syndromes of genetic, environmental, or unknown causes[1,2].

Worldwide 2–5% of newborns have some detectable malformation at birth. Around 70% of these malformations have an unknown etiology, and approximately one-quarter have a genetic origin, of which 10-15% are related to chromosomal abnormalities[1]. The congenital infection caused by several infectious agents is also related to anomalies in newborns, such as the Zika virus, which became a public health emergency, and was associated with microcephaly cases and other central nervous system disorders[3].

With the reduction in infant mortality rate caused by infectious, parasitic, and respiratory diseases, deaths related to congenital anomalies have increased considerably. In this context, developed countries report the highest number of deaths caused by such pathologies. In the United States, in 2017, congenital malformations accounted for 21% of infant deaths[4]. In Brazil, congenital malformations were the second highest cause of infant mortality in children under one year of age in 2014, which corresponded to 22% of infant deaths[5].

Congenital malformations can be classified as isolated or associated, and as of major or minor clinical importance. Those classified as of major clinical importance are related to serious anatomical, functional, or aesthetic defects that can lead to death, and usually require surgeries. Malformations of less clinical importance are not serious complications, are not life-threatening to the newborn, and do not usually require surgical intervention[6].

Although the etiology of congenital anomalies is still complex, it is known that they can be influenced by genetic (disorder in a single or multiple genes, and chromosomal aberrations), environmental (exposure to teratogens), or multifactorial factors (genetic and environmental)[3,7,8]. Other predisposing factors may be related to gender, maternal age, lifestyle habits, the presence of pathologies such as diabetes mellitus, hypertension, hypothyroidism, infectious diseases during pregnancy, and a lack of adequate postnatal care[9,10]. Specifically in Northeastern Brazil, the patients with congenital malformations have reported difficulties with accessing clinical genetics services, as they are mostly concentrated in the South and Southeast regions of Brazil, as well as poor laboratory support, and the absence of reference and counter-reference healthcare systems[11].

In the state of Sergipe, there have only been a few studies discussing congenital malformations with a very limited sample size, which demonstrates the relevance of wider and more detailed studies[12,13]. In this context, and due to the importance of infant death caused by congenital malformations worldwide, more studies are necessary to determine the prevalence of these disorders serving as the basis for more effective control measures.

Therefore, this study was aimed to determine the prevalence and evaluate maternal risk factors for congenital malformations in newborns, which could help to improve the evaluation of primary prevention about the reduction in cases of malformations and the quality of care for the integral continuity of the treatment of malformed newborns.

METHODS

This is a cross-sectional, retrospective, exploratory, and documentary study, with a quantitative approach. Data collection was performed at the Medical and Statistical Archive Service of the reference Maternity Hospital of high complexity in the city of Aracaju, State of Sergipe, northeastern Brazil. Female users of the Brazilian Unified Health System (SUS) who live in urban and rural areas of all cities of the state of Sergipe, including the neighboring states such as Bahia and Alagoas, and have high-risk pregnancies, or pathologies such as hypertension, diabetes, heart disease, and preterm labor, attend this maternity hospital.

Data were collected from 369 medical records and declarations of live births of newborns with any congenital malformation between January 2014 and December 2016. There were a total of 16,518 births between January 2014 and December 2016 at the reference high-risk maternity. All available medical records and live birth statements were evaluated, and 369 had a description of any congenital anomaly, which corresponds to 2.23%. The analysis of the medical records and the declarations of live births were manually performed, indistinctly. However, it was possible to observe a high level of missing or ignored information in the medical records, especially in the declaration of live births.

The International Classification of Diseases (ICD10) was used as a reference to classify congenital anomalies in the body systems, along with whether they were isolated or associated, as well as their clinical importance. The selected variables for the analysis were related to congenital defects (type of malformation and classification), mothers (age, residence, maternal schooling, pathology), gestations (prenatal care, gestational age, and gestation type), neonates (gender, weight at birth and Apgar score at 1st and 5th minutes, newborn evolution), and birth type (vaginal or cesarean). Apgar score between 7 and 10 at 1st and 5th minutes was considered adequate, and <7 inadequate.

According to the recommendations of the Brazilian Ministry of Health, an ideal prenatal was considered when the pregnant woman has had six or more consultations. In addition, the criteria for defining the newborn's weight was newborns with a weight of less than 2,500 g being considered to have a low birth weight. This criterion includes both preterm and full-term newborns with delayed intrauterine growth. The newborns considered to have high weight, on the other hand, are those born weighing more than 4,000 g. Any pathology, chronic or infectious, reported in the medical records, whether previous or developed during pregnancy, and which could affect the baby's development, was taken

into account. However, in the analysis, we grouped these conditions into present or absent. In addition, term birth was defined as between 37 and 41 weeks of gestation.

Nominal and ordinal qualitative variables were obtained with data analysis performed in two ways. A univariate descriptive analysis was performed categorizing the extracted data with the respective frequencies and percentages. A bivariate analysis was also performed crossing the variables related to body systems with other variables referring to mothers and children. In the second analysis, Chi-Square[14] and Fisher's exact tests were used[15] with 5% significance as the decision threshold. The Odds Ratio (OR)[16] was also calculated. The program used was R version 3.3.2.

The study followed all of the ethical precepts of Resolution 466/2012 of the Brazilian National Health Council and it was approved by the Research Ethics Committee of the Universidade Federal de Sergipe (CAAE: 63197816.6.0000.5546).

RESULTS

Nine body systems were affected by congenital malformations and several newborns presented multiple malformations. It was not possible to classify some malformations, so these are noted as "others".

In 2014, malformations of the musculoskeletal system were the most prevalent (36.63%), followed by the central nervous system (27.72%). In 2015, malformations of the musculoskeletal (29.79%) and the central nervous (29.79%) systems were the most prevalent. In addition, in 2016, malformations of the nervous system (28.35%) were more prevalent than those which affect the musculoskeletal system (27.56%). The malformations that affected the other systems varied throughout the years, as shown in Figure 1.

In addition, the annual distribution of the prevalence of types of congenital malformations is shown in Table 1. It can be seen that, in the annual distribution by systems, the most prevalent anomaly for the musculoskeletal system in 2014 was malformations of the upper and lower limbs. In 2015 and 2016, polydactyly was the most prevalent anomaly. The most prevalent anomaly for the nervous system in 2014 was hydrocephaly. In this system, microcephaly was the most prevalent in 2015 and 2016 (Table 1).

In the analysis of maternal age, it was observed that the predominant age group was between 13 and 53 years old, with a mean age of 26.22 (±7.67). The average number of prenatal visits was 6.13 (±3.05). Tables 2, 3, and 4 describe the data distribution with percentage, OR, and p, according to the congenital malformation categories and maternal variables.

It was possible to observe that illiteracy was one of the main maternal factors associated with musculoskeletal (OR=2.3 CI95% 0.17-30.6), nervous (OR=1.06 CI95% 0.16-7.06), reproductive (OR=1.47 CI95% 0.12-17.21), cleft lip and palate (OR=4.8 CI95% 0.26-90.3) and chromosomal (OR=1.05 CI95% 0.1-11.56) malformations. However, only in the musculoskeletal anomalies was this association significant (p=0.0337).

The pathologies of the circulatory system were 3.2 (CI95% 1.3-7.84) times more associated with neonatal death, as 63.64% of newborns with these diseases died (p=0.015). Associating newborn variables and clinical importance with congenital anomalies, it was observed that 82.61% of newborns with multiple

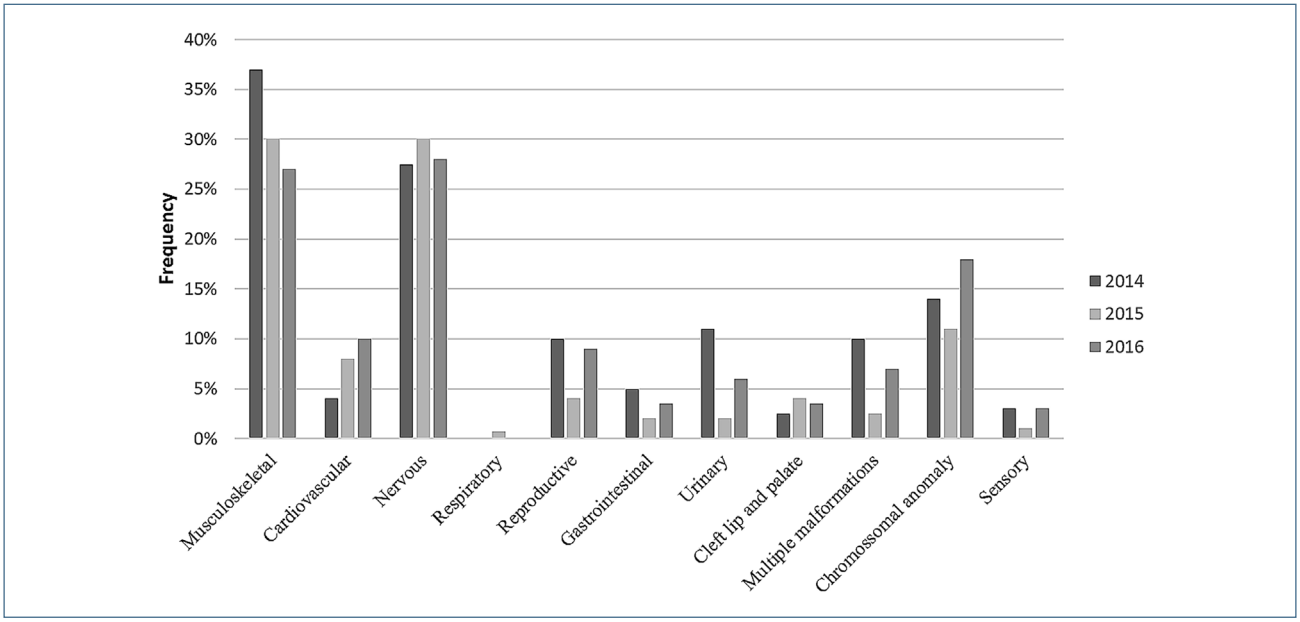

Figure 1: Temporal distribution of congenital malformations among live births in a reference maternity hospital organized by body system or structure affected. Sergipe, Brazil, 2014-2016.

Table 1: Annual distribution of the most prevalent congenital malformation among live births in a reference maternity hospital organized by body system. Sergipe, Brazil, 2014-2016.

Affected Body System	2014		2015		2016	
	Type	N (%)	Type	N (%)	Type	N (%)
Musculoskeletal	Malformations of the upper and lower limbs	27/37 (73.0)	Polydactyly	17/42 (40.4)	Polydactyly	18/35 (51.4)
Central nervous system	Hydrocephalus	7/28 (25.0)	Microcephaly	36/42 (85.7)	Microcephaly	14/36 (38.9)
Chromosomal abnormalities	Down's syndrome	4/14 (28.6)	Unspecified genetic syndrome	8/16 (50.0)	Unspecified genetic syndrome	9/23 (39.1)
Urinary system	Polycystic kidneys	5/11 (45.5)	Kidney malformation	2/3 (66.7)	Polycystic kidneys	4/7 (57.1)
Digestive system	Anal imperforation	2/5 (40.0)	Esophageal atresia	2/3 (66.7)	Anal imperforation	3/5 (60.0)
Circulatory system	Unspecified cardiopathy	3/4 (75.0)	Unspecified cardiopathy	6/12 (50.0)	Unspecified cardiopathy	7/13 (53.8)
Reproductive system	Hypospadias	7/10 (70.0)	Hypospadias	3/6 (50.0)	Hypospadias	6/12 (50.0)

malformations evolved to death, with statistical significance shown between these variables (p=0.000). Infants with multiple malformations were 9.24 (CI95% 3.07-27.83) times more likely to evolve to death (Table 4). Chromosomal syndromes were also significantly associated with infant death (p=0.001), of which 58% of patients died. Infants with chromosomal syndromes were 2.72 (CI95%: 1.48-5.01) more likely to be associated with infant death (Table 4).

DISCUSSION

The prevalence of congenital malformations found in this study was similar to those found in the states of Rio de Janeiro and Ceará[17,18]. However, the prevalence of congenital malformations in Sergipe was higher than the one found in the states of Maranhão (0.5%) and Paraíba (0.7%)[10,19]. Of particular relevance is the fact that the prevalence in the state of Sergipe was lower than the prevalence in a high complexity nursery in São Paulo (6%)[2]. These findings point to a differentiated regional distribution of congenital anomalies in Brazil, which highlights the importance of novel studies that aim to assess the main causes of these. From this perspective, this study helps to increase the knowledge of congenital malformations in newborns and its risk factors in Sergipe to serve as the basis for new public health policies.

Data reported in Africa and Asia show that the musculoskeletal system was the most prevalent system affected by congenital malformations[20]. Similar results were reported in the state of São Paulo and three tertiary-level hospitals in Northeastern Brazil, with a prevalence of approximately 30%[21,22]. In Sergipe, the main system affected by congenital malformations was the musculoskeletal system, corresponding to 30.89% of the cases, with emphasis on polydactyly. The predominance of musculoskeletal malformations may be related to an easier diagnosis since they are visible upon physical examination at birth[22]. Although this bias may occur, our results agree with those of other geographical regions, showing consistency with that which is observed worldwide.

In a Brazilian study conducted from 2000-2015, it was observed that the number of live births with microcephaly was stable until 2014[23]. However, in October 2015, there was an unexpected increase in the number of cases. The highest prevalence, 71% of the cases, was recorded in the Northeastern region, with emphasis on the states of Pernambuco, Sergipe, and Paraíba[23]. In this study, the central nervous system was the second most affected system by congenital malformations, with microcephaly being particularly prevalent, which confirms the current Brazilian scenario associated with the sudden increase in the number of cases of microcephaly due to Zika virus infections. However, it is interesting to note that microcephaly was not present in another study carried out in Sergipe in 2015[12].

We have observed that the mean maternal age in the assessed population was 26.22 years. In addition, a relationship of maternal age with urinary tract anomalies and chromosomal syndromes was found. In contrast, one study reported that the extremes of childbearing age could also be a risk factor for abnormal development of the fetus; advanced maternal age has been reported to increase the risk of chromosomal abnormalities[22]. Although the mean maternal age was not high in this study, other factors may be responsible for the observed malformations, rather than maternal age.

In this study, most of the pregnant women came from the urban zone and attended elementary school. Low schooling negatively influences socioeconomic conditions and, consequently, results in nutritional deficiency which may lead to the occurrence of fetal malformations[24]. In addition, it has already been shown that the level of maternal education is a factor that contributes to obtaining prenatal care[25]. Also, an association between illiteracy and exposure to teratogens has been shown, pointing to the increased vulnerability to birth defects in newborns of illiterate women[3]. Therefore, the greater the level of maternal education, the better the understanding of the need to follow up the pregnancy will be, and their vulnerability to exposure to teratogens will be lower, which could decrease the number of cases born with an anomaly[25].

Table 2: Distribution of maternal, gestational, and neonatal variables for congenital malformations among live births in cardiovascular, musculoskeletal, and nervous systems. Sergipe, Brazil, 2014-2016.

Variables	Total	Cardiovascular			Musculoskeletal			Nervous		
	N (%)	N (%)	OR (CI95)	p	N (%)	OR (CI95)	p	N (%)	OR (CI95)	p-value
Age										
<15	6 (1.69)	0 (0.00)	-	0.6075	3 (2.65)	2.22 (0.43-11.44)	0.4778	4 (3.81)	5.44 (0.96-30.87)	0.2246
15-24	158 (44.51)	9 (34.62)	0.57 (0.24-1.35)		47 (41.59)	0.94 (0.58-1.54)		48 (45.71)	1.19 (0.72-1.95)	
>35	46 (12.96)	3 (11.54)	0.65 (0.18-2.38)		18 (15.93)	1.43 (0.72-2.84)		14 (13.33)	1.19 (0.57-2.46)	
25-35	145 (40.85)	14 (53.85)	1.00		45 (39.82)	1.00		39 (37.14)	1.00	
Residence										
Rural	111 (32.36)	6 (24)	0.64 (0.25-1.65)	0.4801	36 (33.64)	1.09 (0.67-1.77)	0.8278	36 (35.64)	1.23 (0.76-2.01)	0.4760
Urban	232 (67.64)	19 (76)	1.00		71 (66.36)	1.00		65 (64.36)	1.00	
Maternal schooling										
Illiterate	6 (1.85)	0 (0)	-	0.0190	1 (0.98)	2.3 (0.17-30.6)	0.0337	2 (2.04)	1.06 (0.16-7.06)	0.3712
Elementary school	155 (47.69)	5 (20.83)	0.18 (0.04-0.7)		53 (51.96)	5.98 (1.36-26.32)		53 (54.08)	1.1 (0.45-2.73)	
High school	139 (42.77)	15 (62.5)	0.64 (0.19-2.1)		46 (45.1)	5.69 (1.29-25.18)		35 (35.71)	0.72 (0.28-1.8)	
Graduate	25 (7.69)	4 (16.67)	1.00		2 (1.96)	1.00		8 (8.16)	1.00	
Prenatal care										
Ideal	169 (48.99)	10 (43.48)	0.9 (0.38-2.11)	0.9718	53 (52.48)	1.47 (0.91-2.36)	0.1433	40 (41.67)	0.78 (0.48-1.26)	0.3672
Not ideal	144 (41.74)	13 (56.52)	1.00		48 (47.52)	1.00		56 (58.33)	1.00	
Gestational age										
To term	206 (56.44)	13 (46.43)	1.13 (0.52-2.46)	0.9044	55 (48.67)	1.35 (0.86-2.11)	0.2284	36 (33.96)	0.57 (0.36-0.91)	0.0245
Preterm	159 (43.56)	15 (53.57)	1.00		58 (51.33)	1.00		70 (66.04)	1.00	
Gestation type										
Twin	14 (3.92)	1 (3.7)	0.94 (0.12-7.45)	>0.9999	7 (6.25)	2.27 (0.78-6.62)	0.2155	3 (2.86)	0.64 (0.18-2.36)	0.7654
Single	343 (96.08)	26 (96.3)	1.00		105 (93.75)	1.00		102 (97.14)	1.00	
Birth type										
Cesarean	201 (55.68)	16 (59.26)	1.17 (0.53-2.6)	0.8509	55 (50.00)	0.72 (0.46-1.13)	0.1859	63 (59.43)	1.24 (0.78-1.97)	0.4181
Vaginal	160 (44.32)	11 (40.74)	1.00		55 (50.00)	1.00		43 (40.57)	1.00	
Pathology										
No	213 (64.16)	10 (40)	1.21 (0.53-2.79)	0.8151	32 (30.48)	0.71 (0.43-1.16)	0.2063	39 (38.61)	1.19 (0.73-1.93)	0.5675
Yes	119 (35.84)	15 (60)	1.00		73 (69.52)	1.00		62 (61.39)	1.00	
Gender										
Female	156 (43.94)	11 (40.74)	0.87 (0.39-1.93)	0.8830	42 (37.84)	0.69 (0.44-1.1)	0.1476	50 (48.54)	1.3 (0.82-2.06)	0.3180
Male	199 (56.06)	16 (59.26)	1.00		69 (62.16)	1.00		53 (51.46)	1.00	
Weight at birth										
low	177 (48.36)	9 (33.33)	0.6 (0.25-1.43)	0.0347	57 (50.00)	1.03 (0.66-1.62)	0.4265	45 (42.86)	0.72 (0.45-1.15)	0.3793
adequate	171 (46.72)	4 (14.81)	3.2 (0.93-11.05)		3 (2.63)	0.43 (0.12-1.56)		5 (4.76)	0.81 (0.28-2.39)	
high	18 (4.92)	14 (51.85)	1.00		54 (47.37)	1.00		55 (52.38)	1.00	
Apgar score at 1st and 5th minute										
Adequate	194 (54.65)	10 (37.04)	0.69 (0.31-1.55)	0.4828	58 (52.25)	1.5 (0.95-2.35)	0.0997	42 (40)	0.73 (0.46-1.17)	0.2317
Inadequate	161 (45.35)	17 (62.96)	1.00		53 (47.75)	1.00		63 (60)	1.00	
Malformation classification										
Associated	169 (45.80)	12 (41.38)	0.82 (0.38-1.78)	0.7615	57 (50.00)	1.28 (0.82-1.99)	0.322	47 (44.34)	0.92 (0.59-1.45)	0.8089
Isolated	200 (54.2)	17 (58.62)	1.00		57 (50.00)	1.00		59 (55.66)	1.00	
Classification of clinical malformation										
Greater importance	298 (80.98)	28 (96.55)	7.16 (0.96-53.52)	0.0247	69 (60.53)	0.17 (0.1-0.29)	<0.0001	106 (100)	-	<0.0001
Lesser importance	70 (19.02)	1 (3.45)	1.00		45 (39.47)	1.00		0 (0)	1.00	
Newborn evolution										
Discharge	218 (62.82)	14 (63.64)	3.2 (1.3-7.84)	0.0153	39 (34.82)	0.86 (0.54-1.38)	0.6117	32 (31.68)	0.71 (0.44-1.16)	0.2171
Death	129 (37.18)	8 (36.36)	1.00		73 (65.18)	1.00		69 (68.32)	1.00	

Regarding gestational age, we have observed that there was compatibility with other Brazilian studies[2,12,26]. A higher prevalence in term pregnancy was observed in this study. An association was found between this variable and congenital malformations of the central nervous system. However, it diverged from the results of a study performed at the Hospital das Clínicas in São Paulo, where 51% were preterm birth[2].

No significant association was found between the malformation types and previous or developed maternal comorbidities

Table 3: Distribution of maternal, gestational, and neonatal variables for congenital malformations among live births in reproductive, urinary, and gastrointestinal systems. Sergipe, Brazil, 2014-2016.

Variables	Reproductive			Urinary			Gastrointestinal		
	N (%)	OR (CI95)	P-value	N (%)	OR (CI95)	P-value	N (%)	OR (CI95)	p-value
Age									
<15	0 (0.00)	-	0.7815	0 (0.00)	-	0.2706	0 (0.00)	-	0.0704
15-24	10 (37.04)	0.69 (0.29-1.62)		7 (33.33)	0.47 (0.18-1.21)		10 (83.33)	4.83 (1.04-22.43)	
>35	4 (14.81)	0.97 (0.30-3.13)		1 (4.76)	0.23 (0.03-1.77)		0 (0.00)	-	
25-35	13 (48.15)	1.00		13 (61.90)	1.00		2 (16.67)	1.00	
Residence									
Rural	10 (37.04)	1.25 (0.55-2.83)	0.7439	8 (38.1)	1.31 (0.53-3.25)	0.7347	3 (25)	0.69 (0.18-2.59)	0.7579
Urban	17 (62.96)	1.00		13 (61.9)	1.00		9 (75)	1.00	
Maternal schooling									
Illiterate	1 (4.17)	1.47 (0.12-17.21)	0.1400	0 (0)	-	0.9500	0 (0)	-	0.5352
Elementary school	14 (58.33)	0.73 (0.19-2.74)		8 (44.44)	1.31 (0.16-10.92)		5 (41.67)	0.38 (0.07-2.09)	
High school	6 (25)	0.33 (0.08-1.42)		9 (50)	1.66 (0.2-13.72)		5 (41.67)	0.43 (0.08-2.35)	
Graduated	3 (12.5)	1.00		1 (5.56)	1.00		2 (16.67)	1.00	
Prenatal care									
Ideal	10 (40)	0.77 (0.33-1.76)	0.6752	9 (45)	0.96 (0.39-2.38)	>0.9999	7 (63.64)	2.11 (0.6-7.35)	0.3565
Not ideal	15 (60)	1.00		11 (55)	1.00		4 (36.36)	1.00	
Gestational age									
To term	13 (46.43)	1.13 (0.52-2.46)	0.9044	11 (52.38)	1.46 (0.6-3.52)	0.5399	4 (33.33)	0.64 (0.19-2.16)	0.5628
Preterm	15 (53.57)	1.00		10 (47.62)	1.00		8 (66.67)	1.00	
Gestation type									
Twin	1 (3.7)	0.94 (0.2-7.45)	>0.9999	1 (5)	1.31 (0.16-10.56)	0.5607	0 (0)	-	>0.9999
Single	26 (96.3)	1.00		19 (95)	1.00		13 (100)	1.00	
Birth type									
Cesarean	20 (74.07)	2.42 (0.99-5.6)	0.0720	15 (75)	2.5 (0.89-7.03)	0.1192	10 (76.92)	2.74 (0.74-10.13)	0.1571
Vaginal	7 (25.93)	1.00		5 (25)	1.00		3 (23.08)	1.00	
Pathology									
No	12 (48)	1.73 (0.76-3.91)	0.2708	10 (50)	1.86 (0.75-4.61)	0.2621	2 (18.18)	0.39 (0.08-1.82)	0.3393
Yes	13 (52)	1.00		10 (50)	1.00		9 (81.82)	1.00	
Gender									
Female	0 (0)	-	<0.0001	1 (5.56)	0.07 (0.01-0.52)	0.0004	7 (58.33)	1.82 (0.57-5.86)	0.4679
Male	22 (100)	1.00		17 (94.44)	1.00		5 (41.67)	1.00	
Weight at birth									
low	15 (53.57)	1.23 (0.56-2.7)	0.8881	12 (57.14)	1.48 (0,59-3,72)	0.6370	8 (61.54)	1.98 (0.58-6.69)	0.3498
adequate	1 (3.57)	0.78 (0.1-6.37)		1 (4.76)	1.2 (0.14-10.17)		1 (7.69)	2.46 (0.26-23.24)	
high	12 (42.86)	1.00		8 (38.1)	1.00		4 (30.77)	1.00	
Apgar score at 1st and 5th minute									
Adequate	13 (46.43)	1.05 (0.48-2.27)	>0.9999	9 (42.86)	0.9 (0.37-2.19)	0.9914	7 (53.85)	1.42 (0.47-4.33)	0.7316
Inadequate	15 (53.57)	1.00		12 (57.14)	1.00		6 (46.15)	1.00	
Malformation classification									
Associated	10 (35.71)	0.64 (0.29-1.42)	0.3592	4 (19.05)	0.26 (0.09-0.79)	0.0125	5 (38.46)	0.73 (0.23-2.28)	0.7970
Isolated	18 (64.29)	1.00		17 (80.95)	1.00		8 (61.54)	1.00	
Classification of clinical malformation									
Greater importance	15 (53.57)	0.23 (0.1-0.51)	0.0003	10 (47.62)	0.19 (0.08-0.46)	0.0002	13 (100)	-	0.1405
Lesser importance	13 (46.43)	1.00		11 (52.38)	1.00		0 (0)	1.00	
Newborn evolution									
Discharge	5 (18.52)	0.36 (0.13-0.97)	0.0599	5 (23.81)	0.51 (0.18-1.42)	0.2825	5 (50)	1.72 (0.49-6.05)	0.6034
Death	22 (81.48)	1.00		16 (76.19)	1.00		5 (50)	1.00	

during pregnancy. However, maternal diseases are known to be predisposing factors and may increase the risk of deformities[9]. The analysis of the number of prenatal consultations reveals that 48.9% of women attended the six minimum consultations recommended by the Brazilian Ministry of Health for the follow-up of gestation risk. Nevertheless, these data show a high association of not-ideal prenatal care (41.74%) and the presence of congenital malformations. In high-risk pregnancies, the adequate number of consultations is relative for each case and depends on the risk in question[27]. However, these results could

Table 4: Distribution of maternal, gestational, and neonatal variables for congenital malformations among live births (cleft lip and palate, multiple malformations, and chromosomal anomaly). Sergipe, Brazil, 2014-2016.

Variables	Cleft lip and palate			Multiple malformations			Chromosomal anomaly		
	N (%)	OR (CI95)	P-value	N (%)	OR (CI95)	P-value	N (%)	OR (CI95)	p-value
Age									
<15	1 (7.14)	5.60 (0.55-57.27)	0.3489	0 (0.00)	-	0.7327	0 (0.00)	-	0.1088
15-24	6 (42.86)	1.11 (0.33-3.70)		13 (56.52)	1.54 (0.62-3.82)		20 (40.00)	1.02 (0.52-2.02)	
>35	2 (14.29)	1.27 (0.24-6.79)		2 (8.70)	0.78 (0.16-3.80)		12 (24.00)	2.49 (1.09-5.67)	
25-35	5 (35.71)	1.00		8 (34.78)	1.00		18 (36.00)	1.00	
Residence									
Rural	1 (7.14)	0.15 (0.02-1.19)	0.0423	8 (34.78)	1.12 (0.46-2.73)	0.9791	17 (36.96)	1.27 (0.66-2.42)	0.5847
Urban	13 (92.86)	1.00		15 (65.22)	1.00		29 (63.04)	1.00	
Maternal schooling									
Illiterate	1 (7.14)	4.8 (0.26-90.3)	0.3900	0 (0)	-	0.7143	1 (2.33)	1.05 (0.1-11.56)	0.5818
Elementary school	6 (42.86)	0.97 (0.11-8.38)		13 (61.9)	2.2 (0.27-17.58)		17 (39.53)	0.65 (0.2-2.11)	
High school	6 (42.86)	1.08 (0.12-9.4)		7 (33.33)	1.27 (0.15-10.82)		21 (48.84)	0.93 (0.29-3)	
Graduate	1 (7.14)	1.00		1 (4.76)	1.00		4 (9.3)	1.00	
Prenatal care									
Ideal	4 (30.77)	0.51 (0.15-1.69)	0.3951	9 (60)	1.81 (0.63-5.22)	0.3959	19 (46.34)	1.02 (0.53-1.96)	>0.9999
Not ideal	9 (69.23)	1.00		6 (40)	1.00		22 (53.66)	1.00	
Gestational age									
To term	5 (35.71)	0.71 (0.23-2.16)	0.7421	15 (65.22)	2.58 (1.06-6.24)	0.0516	26 (49.06)	1.3 (0.72-2.32)	0.4698
Preterm	9 (64.29)	1.00		8 (34.78)	1.00		27 (50.94)	1.00	
Gestation type									
Twin	0 (0)	-	>0.9999	2 (8.7)	2.56 (0.54-12.17)	0.2256	1 (1.96)	0.45 (0.06-3.52)	0.7021
Single	14 (100)	1.00		21 (91.3)	1.00		50 (98.04)	1.00	
Birth type									
Cesarean	6 (42.86)	0.58 (0.2-1.72)	0.4773	13 (56.52)	1.04 (0.44-2.43)	>0.9999	29 (54.72)	0.96 (0.53-1.72)	0.9977
Vaginal	8 (57.14)	1.00		10 (43.48)	1.00		24 (45.28)	1.00	
Pathology									
No	2 (14.29)	0.29 (0.06-1.3)	0.0961	4 (17.39)	0.36 (0.12-1.07)	0.0707	13 (29.55)	0.72 (0.36-1.44)	0.4433
Yes	12 (85.71)	1.00		19 (82.61)	1.00		31 (70.45)	1.00	
Gender									
Female	5 (35.71)	0.7 (0.23-2.13)	0.7201	10 (47.62)	1.17 (0.48-2.83)	0.9019	22 (42.31)	0.92 (0.51-1.68)	0.9155
Male	9 (64.29)	1.00		11 (52.38)	1.00		30 (57.69)	1.00	
Weight at birth									
low	5 (35.71)	0.52 (0.17-1.59)	0.4347	16 (72.73)	2.73 (1.04-7.16)	0.0648	26 (49.06)	0.96 (0.53-1.73)	0.6752
adequate	0 (0)	-		0 (0)	-		1 (1.89)	0.33 (0.04-2.57)	
high	9 (64.29)	1.00		6 (27.27)	1.00		26 (49.06)	1.00	
Apgar score at 1st and 5th minute									
Adequate	8 (57.14)	1.64 (0.56-4.82)	0.5285	14 (87.5)	9.14 (2.05-40.86)	0.0005	30 (57.69)	1.79 (0.99-3.25)	0.0744
Inadequate	6 (42.86)	1.00		2 (12.5)	1.00		22 (42.31)	1.00	
Malformation classification									
Associated	9 (64.29)	2.19 (0.72-6.68)	0.2535	22 (95.65)	29.78 (3.97-223.46)	<0.0001	51 (96.23)	42.79 (10.23-178.99)	<0.0001
Isolated	5 (35.71)	1.00		1 (4.35)	1.00		2 (3.77)	1.00	
Classification of clinical malformation									
Greater importance	12 (85.71)	1.43 (0.31-6.52)	>0.9999	23 (100)	-	0.0113	51 (98.08)	14.25 (1.93-104.96)	0.0002
Lesser importance	2 (14.29)	1.00		0 (0)	1.00		1 (1.92)	1.00	
Newborn evolution									
Discharge	7 (50)	1.73 (0.59-5.05)	0.4646	19 (82.61)	9.24 (3.07-27.83)	<0.0001	29 (58)	2.72 (1.48-5.01)	0.0017
Death	7 (50)	1.00		4 (17.39)	1.00		21 (42)	1.00	

demonstrate the importance of maternal care for the birth of healthy babies.

In São Paulo, a significant association was found between mortality and the presence of congenital malformations, corresponding to 24% of deaths. When correlating this variable with congenital anomalies, there was only a significant difference with cardiac malformations[2]. This result was similar to those described in our study, where mortality corresponded to 36.6%. The chance of mortality was 3.2 times higher for babies with an abnormality of the circulatory system, 2.7 times higher for those with any genetic malformation, and 9.24 times higher for those with multiple malformations. These results point to a worse prognosis when heart

diseases occur, as well as multiple malformations, which are of greater clinical importance.

Among the neonates diagnosed with a congenital anomaly in a study in São Paulo, 52.63% presented isolated malformations and 92% presented major malformations[2]. We have observed similar results, with 54.2% being described as isolated, and most of the malformations (80.98%) being classified as of major clinical importance. This is an important result because it shows that most of the malformations observed in this study presented a very negative outcome for newborns. The predominance of the most important clinical anomalies in this study was justified by the high prevalence of abnormalities of the central nervous system, together with cardiovascular malformations and multiple malformations.

Most live births had a low birth weight, which was similar to a study in São Paulo, where 44% of newborns also presented low birth weight[2]. Congenital malformations could be involved in the genesis of low birth weight, thus demonstrating the association between the presence of congenital anomalies and low birth weight[28].

The study presented significant data on the prevalence and risk factors of malformations in the state of Sergipe; it is important to highlight the limitations related to missing or ignored information in medical records, especially with the declaration of live births. However, the study presents some important maternal risk factors of congenital malformations, such as the number of prenatal consultations, education, and gestational age, which suggests that improvements on maternal prenatal care and socioeconomic variables are important to decrease the number of malformations cases in Brazil.

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