ORIGINAL ARTICLE

Congenital syphilis in health regions in the state of Alagoas (2009-2018)

A sífilis congênita nas regiões de saúde no estado de Alagoas (2009-2018)

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ABSTRACT

Introduction: Syphilis is a sexually transmitted infection caused by *Treponema pallidum*. When transmission occurs from mother to child during pregnancy, it is called congenital syphilis (CS). Alagoas is among the Brazilian states with one of the highest mortality rates for CS in children under one year old. Given this scenario, this article aims to analyze the temporal trend of congenital syphilis in the Health Regions (HR) of Alagoas from 2009 to 2018. **Methods:** This is an ecological time series study. Sociodemographic variables and clinical aspects were analyzed. Data were obtained from the Information System for Notifiable Diseases and the Information System for Live Births. Trend analysis was conducted using the joinpoint regression model. **Results:** A total of 3,342 cases of CS were registered in Alagoas, with the 1st HR being the most affected (83.57%). The 8th HR had the lowest number of cases (0.18%). In terms of incidence, the 10th HR had the highest rate (14.51/1,000 inhabitants), while the 8th HR had the lowest (0.24/1,000 inhabitants). Regarding neonatal outcomes, most newborns survived (92.40%), and the majority were of mixed race (74.78%). Among maternal characteristics, there was a predominance of incomplete primary education (32.92%) and mixed race (75.08%). **Conclusion:** The State of Alagoas had a high incidence of CS between 2009 and 2018. The CS rate increased in almost all HRs, except for the 5th HR.

Keywords: Congenital syphilis, Geographic information systems, Public health surveillance.

RESUMO

Introdução: A sífilis é uma infecção sexualmente transmissível causada pelo *Treponema pallidum*. Quando a transmissão ocorre da mãe para o filho durante a gestação, é denominada sífilis congênita (SC). Alagoas está entre os estados brasileiros com um dos maiores coeficientes de mortalidade por SC em menores de um ano. Diante deste cenário, este artigo objetiva analisar a tendência temporal da sífilis congênita nas Regiões de Saúde (RS) de Alagoas no período de 2009 a 2018. **Métodos:** Trata-se de um estudo ecológico de série temporal. Variáveis sociodemográficas e aspectos clínicos foram objetos de análise. Os dados foram obtidos do Sistema de Informação de Agravos de Notificação e do Sistema de Informação de Nascidos Vivos. A análise de tendência foi realizada utilizando-se o modelo de regressão por pontos de inflexão (joinpoint regression model). **Resultados:** Foram registrados 3.342 casos de SC em Alagoas, sendo a 1ª RS a mais afetada (83,57%). A 8ª RS apresentou o menor número de casos (0,18%). Quanto à incidência, a 10ª RS apresentou a maior taxa (14,51/1.000 habitantes), enquanto a 8ª RS teve a menor (0,24/1.000 habitantes). Sobre os aspectos neonatais, destaca-se que a maioria dos neonatos permaneceu viva (92,40%), e a maioria era de cor parda (74,78%). Nas características maternas, observou-se predomínio de ensino fundamental incompleto (32,92%) e raça parda (75,08%). **Conclusão:** O Estado de Alagoas apresentou alta incidência de SC no período de 2009 a 2018. A taxa de SC apresentou crescimento em quase todas as RS, com exceção da 5ª RS.

Palavras-chave: Sífilis congênita, Sistemas de informação geográfica, Vigilância em saúde pública.

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hhttps://doi.org/10.11606/issn.2176-7262.rmrp.2024.207683

INTRODUCTION

Syphilis is a sexually transmitted infection (STI) caused by the spirochete *Treponema pallidum*. *T. pallidum* is an obligate human pathogen known for its capacity to invade and evade the immune system, entering the body through mucous membranes or skin abrasions and presenting in both acquired and congenital forms.

When the transmission of the pathogen occurs from mother to child during pregnancy—transplacentally—it is referred to as congenital syphilis (CS). CS compromises both maternal and fetal health, leading to complications such as early or late congenital manifestations, prematurity, abortion, and fetal or neonatal death.

Considered the most transmissible disease during the pregnancy-puerperal cycle, CS, when diagnosed, can be classified as early or late. The early phase is characterized by manifestations such as prematurity, cutaneous-mucous lesions, hydrops, hepatosplenomegaly, anemia, and costochondritis. In contrast, late CS includes symptoms like scarring and gum formation on the skin, intellectual deficits, sensory alterations, and Hutchinson teeth.

Treatment for infected pregnant women involves the administration of benzathine penicillin G, given intramuscularly. This is the only effective drug for preventing CS during prenatal care and is the treatment of choice for pregnant women, with an efficacy rate of 95% to 100%. This treatment leads to a cure, thereby preventing congenital syphilis.

In Brazil, the incidence of congenital syphilis and the detection rates of syphilis in pregnant women per thousand live births increased significantly between 2010 and 2017, from 2.4 to 8.6 and from 3.5 to 17.2 cases per thousand live births, respectively. Similar increases have been observed in other countries around the world.

The state of Alagoas, located in the Brazilian Northeast, has a Human Development Index (HDI) of 0.631 and is among the states with one of the highest mortality rates due to congenital syphilis in children under one year old, with a rate of 7.7 per 100,000 live births—above the national average of 6.1 per 100,000 live births. Given this scenario, the present study aims to analyze the temporal trend of congenital syphilis in the Health Regions of Alagoas from 2009 to 2018.

METHODOLOGICAL ASPECTS

Type of Study

This is an ecological and time-series study conducted using secondary data from public health information systems and other governmental databases. The data were analyzed through trend analysis to highlight the results related to congenital syphilis (CS) in the state of Alagoas.

Sources of Information

All information for the analysis was collected in September 2021. Data on CS cases were obtained from the Notifiable Diseases Information System (SINAN), and data on the number of live births in Alagoas were extracted from the Live Birth Information System (SINASC). Both systems were accessed through the SUS Department of Informatics (DATASUS) website. The data were exported to a Microsoft Office Excel® spreadsheet, where they were recorded and tabulated. Cartographic data regar-

ding the state's geographical boundaries and population size were obtained from the Brazilian Institute of Geography and Statistics (IBGE) website.

ANALYZED VARIABLES

a) Sociodemographic variables:

- **Mother's education:** Unknown/blank; Illiterate; Incomplete 1st to 4th grade of Elementary School (ES); Completed 4th grade of ES; Incomplete 5th to 8th grade of ES; Completed Elementary School; Incomplete High School; Completed High School; Incomplete Higher Education; Completed Higher Education; Not applicable.
- **Child's race/skin color:** Unknown/blank; White; Black; Yellow; Brown; Indigenous.

b) Clinical aspects:

- **Prenatal care:** Unknown/blank; Yes; No.
- **Time of diagnosis of maternal syphilis:** Unknown/blank; During prenatal care; At the time of delivery/curettage; After delivery; Not performed.
- **Partner's treatment:** Unknown/blank; Yes; No.
- **Final classification:** Unknown/blank; Recent congenital syphilis; Late congenital syphilis; Stillbirth/abortion due to syphilis; Discarded.

The crude annual CS incidence rate was calculated using the direct method: dividing the number of new CS cases in children up to 364 days of age by the number of live births to mothers residing in the state of Alagoas in the same year of notifications. The results were standardized by 1,000.

$$\frac{\text{Number of cases of congenital syphilis}}{\text{Total number of live births}} \times 1000$$

ANALYZED TIME FRAME

The study population consisted of new cases of congenital syphilis (CS) in children under one year of age in Alagoas, reported to SINAN between January 1, 2009, and December 31, 2018. This period was selected due to the incomplete data available for subsequent years at the time of collection. Cases reported in children aged 0 to 364 days were considered as CS in children under one year of age.

DATA ANALYSIS STRATEGIES (JOINPOINT)

Data analysis was conducted in two phases:

1. In the first phase, a simple descriptive analysis was performed, including absolute and relative frequencies.
2. In the second phase, temporal trends in the incidence of CS were analyzed using the Health Regions (HR) of the state of Alagoas as the

unit of analysis. Temporal trends were examined using the joinpoint regression model to calculate the annual percent change (APC). The analyses were conducted using the Joinpoint Regression Program version 4.1.0 (US National Cancer Institute, Bethesda, MD, USA).

The APC analysis identifies inflection points using an algorithm that tests whether a multi-segmented line fits the data significantly better than a straight line or a line with fewer segments. The joinpoint regression analysis connects a series of straight lines on a logarithmic scale to detect the trend in the annual value of the indicator. The analysis begins with the minimum number of joinpoints (a straight line) and tests whether additional joinpoints significantly improve the model. Each joinpoint indicates a statistically significant change in the slope of the line.

When multiple slopes are identified, the Average Annual Percent Change (AAPC) is calculated to provide an average trend over the entire period, based on the underlying joinpoint model. An increase in indicators is identified when the trend is positive, and the minimum value of the confidence interval is greater than zero. Conversely, a reduction is identified when the trend is negative, and the maximum value of the confidence interval is below zero. Stability is defined when the confidence interval includes zero.

ETHICAL ASPECTS

This study was conducted using secondary, publicly available data of documentary and electronic origin, which are in the public domain. Therefore, approval from the Research Ethics Committee was not required, in accordance with the National Health Council Resolutions No. 466/2012 and 580/2018.

STUDY LIMITATIONS

Despite the methodological precautions taken, this study has several limitations:

1. Incomplete registration of certain variables.
2. The use of secondary data from health information systems, which may not accurately reflect reality.
3. Variations in the quality of information recorded in health information systems, due to differences in organizational and institutional capacity within health management and surveillance across different Brazilian contexts.

RESULTS

Tabel 1 – Descriptive analysis of cases of congenital syphilis, in the State of Alagoas, Brazil, from 2009 to 2018.

0. Neonatais		b) Maternas	
Variable	**n (%)**	**Variable**	**n (%)**
Final Classification		**Schooling**	
Recent Congenital Syphilis	3.012 (90,13)	Ignored/White	716 (21,21)

Late Congenital Syphilis	5 (0,15)
Stillborn	117 (3,50)
Discarded	208 (6,22)
Evolution	
Ignored/White	125 (4,08)
Alive	2.834 (92,40)
Death due to the notified grievance	77 (2,51)
Death due to another cause	31 (1,01)
Age	
Up to 6 days	3.221 (50,76)
7-27 days	3.062 (48,25)
28 days to <1 year	54 (0,85)
1 year (12 to 23 months)	7 (0,11)
5 a 12 years	2 (0,03)
Race	
Ignores/White	590 (17,32)
White	178 (5,23)
Black	74 (2,17)
Yellow	7 (0,21)
Brown	2.547 (74,78)
Indigenous	10 (0,29)
Gender	
Ignored	171 (4,93)
Masculine	1.660 (47,88)
Feminine	1.636 (47,19)

Illiterate	136 (4,03)
1st to 4th incomplete series of ES	361 (10,70)
4th complete of ES	280 (8,30)
5th to 8th incomplete of ES	1.111 (32,92)
Complete Elementary School	214 (6,34)
Incomplete high school	214 (6,34)
Complete high school	275 (8,15)
Incomplete higher education	22 (0,65)
Complete higher education	14 (0,41)
Not applicable	32 (0,95)
Moment of diagnosys	
Ignored/White	136 (4,00)
During prenatal	1.056 (31,09)
At the time of delivery/curet-tage	1.631 (48,01)
After delivery	565 (16,63)
Unrealized	9 (0,26)
Race	
Ignores/White	591 (17,39)
White	178 (5,24)
Black	62 (1,82)
Yellow	6 (0,18)
Brown	2.551 (75,08)
Indigenous	10 (0,29)
Prenatal	
Ignored/White	435 (12,83)
Yes	2.486 (73,31)
No	470 (13,86)
Partner Treatment	
Ignores/White	810 (24,09)
Yes	336 (9,99)
No	2.216 (65,92)

Source: SINAN/DATASUS (2021).

About the neonatal aspects (Table 1A) it is highlighted that regarding the final Classification there was a predominance of recent Congenital Syphilis (n= 3,012; 90.13%). In the Evolution indicator, most neonates remained alive (n=2,834; 92.40%). Regarding race, the brown color was the majority (n=2,547; 74.78%). As for gender, there was little discrepancy (n= 1,660; 47.88%) were male and (1,636; 47.19%) female.

According to the variables related to maternal characteristics (Table 1B), regarding education, there was a predominance of incomplete Elementary School (5th to 8th grade incomplete of ES) (n= 1,111; 32.92%). The diagnosis of maternal syphilis was made more frequently (n= 1,631; 48.01%) during delivery or curettage. Maternal syphilis was diagnosed during prenatal care in (n= 1,059; 31.09%) of the cases. It is observed, in relation to race, that most women were brown (n= 2,551; 75.08%). It is also reported that Prenatal care was performed in (n= 2,486; 73.31%) of the cases and with regard to the treatment of the mother's partner (n=2,216; 65.92%) did not undergo the treatment.

Tabel 2 - Descriptive analysis of cases of congenital syphilis in the health regions of the State of Alagoas, Brazil, from 2009 to 2018.

Health Region	Number of municipalities	Number of live births	Number of cases - %	Cases per 1000 inhabitants
1ª	12	192445	2793 (83,57%)	14,51
2ª	9	27470	15 (0,45%)	0,55
3ª	11	37316	56 (1,68%)	1,50
4ª	9	22917	12 (0,36%)	0,52
5ª	7	33486	118 (3,53%)	3,52
6ª	8	33102	76 (2,27%)	2,30
7ª	17	84840	108 (3,23%)	1,27
8ª	8	25093	6 (0,18%)	0,24
9ª	14	40440	120 (3,59%)	2,97
10ª	7	26948	38 (1,14%)	1,41
TOTAL	102	524057	3342 (100%)	6,37

Source: SINAN/DATASUS, 2020.

It is observed that among the ten Health Regions of Alagoas, the 7th HR is the one with the largest number of municipalities, 17 municipalities, and the 5th HR and 10th HR have a smaller number of municipalities, both with 7 municipalities (Table 2). During the analyzed period, n= 3,342 cases of congenital syphilis were registered in Alagoas, with emphasis on the 1st HR (n = 2,793; 83.57%) with the highest number of cases. The 8th HR appears with the lowest number of cases (n=6; 0.18%). Furthermore, regarding to cases per 1000 inhabitants, the 10th HR and 8th HR appear to be the ones with the highest and lowest number of cases, 14.51/1000 inhabitants and 0.24/1000 inhabitants, respectively.

Tabel 3 – Descriptive analysis and trend analysis of Congenital Syphilis cases in the health regions of the state of Alagoas, Brazil, from 2009 to 2018.

Health Region	N (%)	Rate		AAPC*	CI † 95%	pValue
		2009	2018			
1th Region	2793 (83,57%)	0,74	1,40	6,7*	1,9 a 11,6	0,0
2th Region	15 (0,45%)	0,04	0,22	30,5*	11,5 a 52,7	0,0
3th Region	56 (1,68%)	0,05	0,08	12,4	-20,4 a 58,6	0,5
4th Region	12 (0,36%)	0,09	0,30	-21,6*	-31,1 a -10,7	0,0
5th Region	118 (3,53%)	0,30	0,24	-14,5	-34,0 a 10,8	0,2
6th Region	76 (2,27%)	0,09	0,60	16,9*	4,8 a 30,6	0,0
7th Region	108 (3,23%)	0,01	0,45	41,0	-21,1 a 152,1	0,2
8th Region	6 (0,18%)	0,01	0,01	0,5	-12,4 a 15,4	0,9
9th Region	120 (3,59%)	0,02	0,59	48,8	-7,8 a 140,4	0,1
10th Region	38 (1,14%)	0,15	0,22	3,1	-8,5 a 16,2	0,6

Source: SINAN/DATASUS (2021).

*AAPC: Average Annual Percent Change; †: Confidence interval.

During the study period, Alagoas notified 3,342 cases of CS, with predominance in the 1st HR (n = 2,793; 83.57%) (Table 3). The CS rate in 2009 among health regions ranged from 0.01 cases/1000 inhabitants to 0.74 cases/1000 inhabitants and in 2018 ranged from 0.01 cases/1000 inhabitants to 1.40 cases/1000 inhabitants. The CS rate increased in almost all health regions, with the exception of the 5th HR, which presented, in 2008, 0.30 cases/1000 inhabitants and in 2018, 0.24 cases/1000 inhabitants. The joinpoint analysis showed a significant increasing trend in: 1st HR (AAPC = 6.7*; 95%CI: 1.9 to 11.6; p<0.001), 2nd HR (AAPC = 30.5*; 95%CI: 11 .5 to 52.7; pValue 0.0); 6th HR (AAPC = 16.9*; 95%CI: 4.8 to 30.6; p<0.001). The 4th HR was the only one that showed a significant decreasing trend (AAPC = -21.6*; 95%CI: -31.1 to -10.7; p<0.001).

Figure 1 - Incidence rate in the 1st Health Region by time of maternal diagnosis of syphilis, Alagoas, Brazil, from 2009 to 2018.

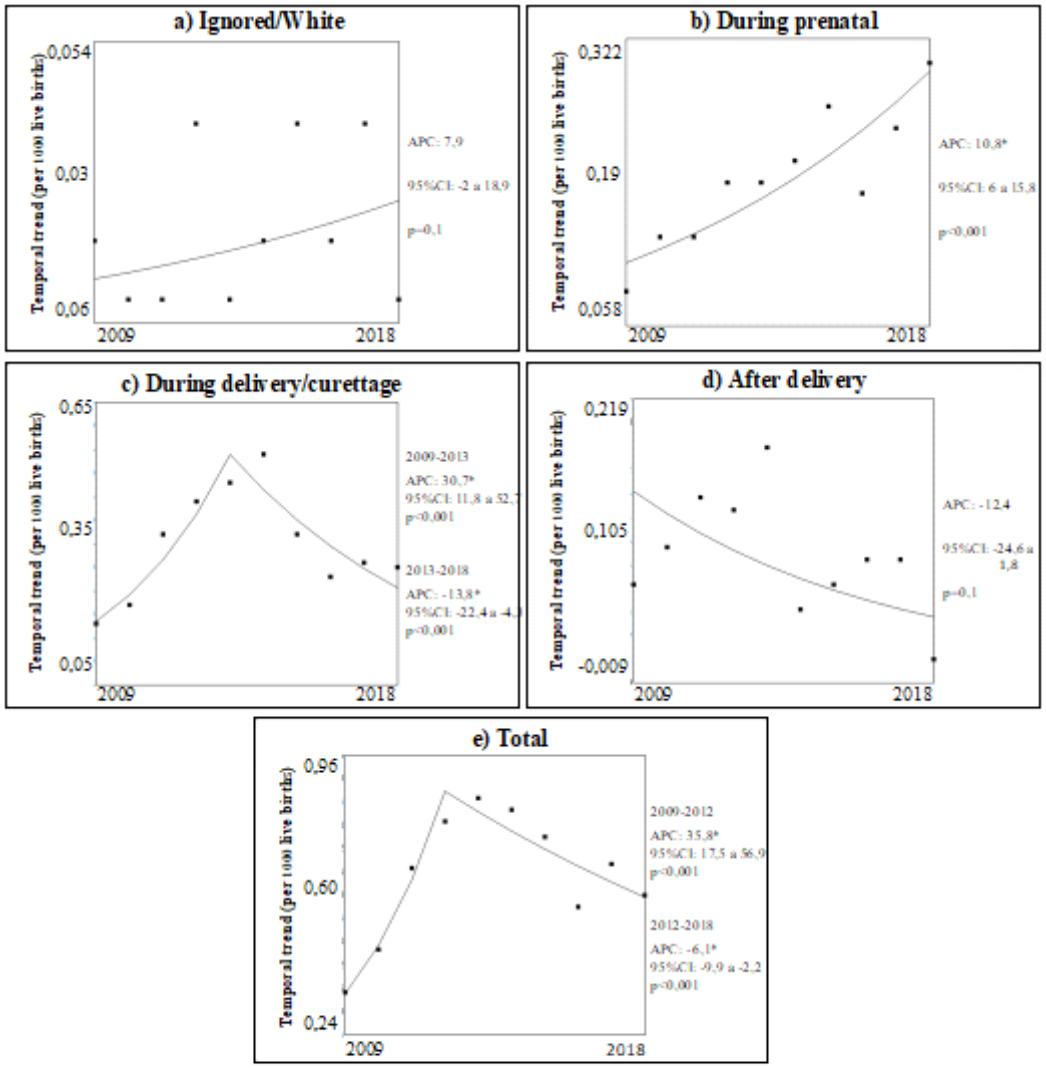

Figure 1 - Incidence rate in the 1st Health Region by time of maternal diagnosis of syphilis, Alagoas, Brazil, from 2009 to 2018.
*Statistical significance (p<0,05); APC: annual percent change; 95%CI: 95% confidence interval.

*Statistical Significance (p<0.05); APC: annual percent change; 95%CI: 95% Confidence interval.

The temporal trend analysis by moment of diagnosis of maternal syphilis in the HR of Alagoas with the highest incidence of cases, the 1st HR, shows that the moment of maternal diagnosis increased during prenatal care (Figure 1B; AAPC 10.8*; 95%CI from 6.0 to 15.8; p<0.001). The variable “At the time of delivery/Curetage” showed an increasing trend between 2009 and 2013 (Figure 1C; APC 30.7*; 95%CI from 11.8 to 52.7; p<0.001) which became decreasing between the years 2013 to 2018 (Figure 1C; APC = -13.8*; 95%CI from -22.4 to -4.3; p<0.001). Furthermore, when analy-

zing the total, there is a growing trend between the years 2009 to 2012 (Figure 1E; APC = 35.8*; 95%CI from 17.5 to -56.9; p<0.001) and a decreasing trend between the years 2012 to 2018 (Figure 1E; APC = -6.1*; 95%CI from -9.9 to -2.2; p<0.001). Finally, the segments “Ignored/white” and “After childbirth” in this indicator were stationary in the period.

DISCUSSION

This study describes the epidemiological profile and trend analysis of congenital syphilis (CS) across the ten Health Regions of the State of Alagoas from 2009 to 2018. The findings generally indicate an increasing trend in the number of cases over the years, attributable to multifactorial causes. The rise in syphilis testing and the intensification of surveillance through initiatives such as the “Rede Cegonha” and “Projeto Nascer” campaigns are possible explanations for the increased identification of maternal and congenital syphilis cases .

Additionally, this study highlights the high prevalence of CS diagnoses at the time of delivery or curettage, which may be linked to failures in conducting syphilis testing during the first prenatal consultation and again in the third trimester (28 weeks), as recommended by national maternal and child health protocols . Furthermore, the high rate of untreated sexual partners, leading to the reinfection of pregnant women, is another possible explanation for the continued rise in maternal syphilis rates despite prenatal care involvement . It is important to note that since 2017, treating the sexual partner has been removed from the criteria defining adequate maternal treatment .

Alagoas represents 5.9% of the population of the Northeast region and 1.63% of the population of Brazil. It is divided into ten Health Regions. Among these, the 1st Health Region (HR), which includes Maceió, the state capital and most populous municipality, had the highest number of CS cases, accounting for 38.1% of the state’s population . The higher number of cases in this region may be related to the implementation of rapid tests in all health units in Maceió since 2014, increasing the number of diagnoses. Additionally, in the same year, Maceió established the Research Committee on Vertical Transmission of HIV, Syphilis, Hepatitis B, and C, in accordance with guidelines from the Ministry of Health, which aims to analyze missed opportunities for preventing vertical transmission and to identify potential failures and intervention measures .

In Brazil, the incidence rate of congenital syphilis and the detection rate of syphilis in pregnant women per thousand live births have both increased significantly between 2010 and 2017, from 2.4 to 8.6 and from 3.5 to 17.2 cases per thousand live births, respectively. This upward trend has also been observed in other countries, including the United States, Canada, and Japan . Among the Brazilian states, in addition to Alagoas, other states such as Ceará, Pernambuco, Piauí, Rio Grande do Norte, Sergipe, and Tocantins have CS incidences higher than the number of gestational syphilis detections, which may indicate shortcomings in prenatal care and epidemiological surveillance in these regions .

However, it is noteworthy that when examining the trends during the analyzed years (2011 and 2016), four Brazilian states, including Alagoas, showed a decrease in congenital syphilis detection rates. Despite this improvement, Alagoas still ranks

among the states with the highest mortality rates for congenital syphilis in children under one year old, with a rate of 7.7 per 100,000 live births, exceeding the national mortality rate of 6.1 per 100,000 live births .

This situation can be partially explained by the implementation of the “Rede Cegonha” in Alagoas since 2012, through which the state government has been outlining strategies and goals to improve syphilis diagnosis during pregnancy, including rapid testing for HIV, syphilis, and viral hepatitis during the 1st and 3rd trimesters of pregnancy . This strategy is crucial for reducing vertical transmission of the disease because detecting syphilis in pregnant women allows for prevention and treatment, thereby reducing transmission rates .

In this study, it was observed that the 1st HR had very high incidences of CS (above 8.00 cases per 1,000 live births). Emphasis was placed on the timing of maternal syphilis diagnosis in the municipalities within this region, where an increase in cases was noted beginning in 2009, followed by a decrease starting in 2013. This trend may be related to the expansion of syphilis diagnosis and the adoption of rapid testing following the resolutions proposed in conjunction with the implementation of the “Rede Cegonha” in 2012, which improved prenatal care and enabled earlier diagnosis of syphilis .

According to the recommendations of the Brazilian Ministry of Health, syphilis testing should be conducted during pregnancy at three points: the first test in the first trimester (during the first prenatal consultation), a second test after 28 weeks (at the beginning of the third trimester), and a third test at the time of delivery . Our study reveals that this testing sequence was not fully adhered to in Alagoas during the 2009-2018 period, as a significant number of pregnant women were diagnosed at the time of delivery or curettage (n = 1,631; 48.01%) and after delivery (n = 565; 16.63%). This non-compliance with the earlier detection protocol in Alagoas was also observed in a study conducted in Cali, Colombia , where tests were performed late, not following the country’s diagnostic and treatment guidelines .

Timely diagnosis of syphilis in pregnant women is essential to reducing vertical transmission, along with early and appropriate treatment . Late detection may indicate that access to diagnostic tests during the appropriate period of prenatal care is inadequate, leading to insufficient treatment for pregnant women.

Given the above, the methods used in this study were effective in analyzing CS cases to identify the Health Regions with the highest incidences, allowing for the identification of the challenges faced in these regions and enabling the development of localized strategies. These findings emphasize the importance of enhancing the training of healthcare professionals in the prevention and treatment of CS. Additionally, the need to integrate pregnant women and their sexual partners into prenatal care is highlighted to ensure timely and appropriate treatment, reducing preventable cases and outcomes.

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Funding information:

This study was supported by the Center for Studies in Social and Preventive Medicine at the Federal University of Alagoas.

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Received: fev 05, 2023
Approved: aug 21, 2023
Editor: Profa. Dra. Ada Clarice Gastaldi
