Social determinants of health related to the outcome of congenital syphilis: logistical regression

Determinantes sociais de saúde relacionados ao desfecho de sífilis congênita: regressão logística

ABSTRACT

Objective: To determine whether social determinants of maternal health are predictors of the outcome of congenital syphilis in newborns.

Method: A cross-sectional study was conducted at a tertiary-level maternity hospital, which included reported cases of congenital syphilis in the National System of Notifiable Diseases between 2012 and 2017. Data collection occurred in January 2018 and excluded cases in which congenital syphilis was ruled out during the investigation. Binary logistic regression was employed to ascertain the extent to which the outcome of congenital syphilis (death or survival) could be adequately predicted by the social determinants of health, in accordance with the Dalhgreen and Whitehead model.

Results: The logistic regression model was statistically significant, demonstrating an adequate predictive capacity for 96.1% of outcomes. The final regression model included four variables. Of these, only the age variable demonstrated a statistically significant relationship (p=0.013). This indicates that for every additional year in the mother’s age score, the likelihood of the newborn dying due to congenital syphilis increases by 1,145 times.

Conclusion: Among the social determinants of health investigated, the variable with the greatest predictive power for a negative outcome of congenital syphilis was the older age of the mother.

Descriptors: Syphilis Congenital; Syphilis; Social Determinants of Health; Public Health; Health Promotion.

RESUMO

Objetivo: Verificar se determinantes sociais de saúde de genitoras são preditores do desfecho de sífilis congênita de recém-nascidos. Método: Estudo transversal, realizado em maternidade de nível terciário, que incluiu os casos notificados de sífilis congênita no Sistema Nacional de Agravos de Notificação, entre os anos de 2012 e 2017. A coleta de dados ocorreu em janeiro de 2018 e excluiu os casos em que a sífilis congênita foi descartada durante a investigação. Realizou-se regressão logística binária para investigar em que medida o desfecho de sífilis congênita (óbito ou vivo) poderia ser adequadamente previsto pelos determinantes sociais de saúde, conforme o modelo de Dalhgreen e Whitehead. Resultados: O modelo da regressão logística foi estatisticamente significativo, capaz de prever adequadamente 96,1% dos desfechos. O modelo final da regressão incluiu quatro variáveis, todavia, destas, apenas a variável idade teve relação estatisticamente significante (p=0,013), demonstrando que um ponto no escore da idade da genitora eleva 1,145 vezes as chances de o recém-nascido evoluir para óbito por sífilis congênita. Conclusão: Dentre os determinantes sociais de saúde investigados, a idade mais avançada da genitora foi a variável com maior chance de prever um desfecho negativo de sífilis congênita. Descriptores: Sífilis Congênita; Sífilis; Determinantes Sociais da Saúde; Saúde Pública; Promoção da Saúde.
INTRODUCTION

The latest global estimate conducted by the United Nations (UN)\(^1\), in the year of 2017, found more than 900,000 pregnant women infected with syphilis in the world. In Brazil, 118,036 cases of syphilis acquired in pregnant women were reported in 2020, and 64,279 in 2021, and, in both years, the Northeast Region was the second with the highest percentage of cases, behind only the Southeast Region.\(^2\)

These infections resulted in more than 350,000 negative pregnancy outcomes, with 200,000 classified as stillbirths or neonatal deaths. It is observed, therefore, that more than half of pregnancies among women with active syphilis will result in stillbirth, neonatal death, newborn premature or with low birth weight or severe neonatal infection\(^1\)\(^-\)\(^3\). In addition, other adverse events may be observed, such as jaundice, hearing impairment, kidney disease, intellectual disabilities associated with neurosyphilis, hepatomegaly, skin lesions, among others.\(^4\)\(^-\)\(^5\)

Vertical transmission of syphilis occurs in 80% of cases of syphilis in pregnant women, and transmission can occur during vaginal birth if the mother has a syphilitic lesion. Fetal infection is influenced by the stage of the mother's disease, with a greater probability of occurring in the primary and/or secondary stage, and the longer the time the fetus has been exposed.\(^3\)

Brazil, like many other countries, has experienced a re-emergence of this disease, which implies a greater need for training health professionals in relation to clinical manifestations, diagnostic tests and results and control of the treatment of syphilis in pregnant women and newborns. Other factors, such as social, economic, geographic, and cultural factors, can also positively or negatively influence this health-disease process.\(^3\)\(^,\)\(^6\)

It is understood that understanding health inequalities can enable the understanding of mechanisms associated with the health-disease process and enable preventive interventions to be conducted in a more timely and highly effective manner. Public health problems, such as acquired and congenital syphilis, persist at high levels for decades, because of the country's social inequalities, which end up generating health inequalities. To address them effectively, it is crucial to understand how social and economic factors affect health, to seek solutions that consider these influences.\(^7\)

Therefore, it is essential to develop or improve models that seek to understand the influence or relationship of social determinants of health on individuals' health levels.
OBJECTIVE

To verify whether proximal, intermediate, or distal social determinants of health of mothers are predictors of the outcome of congenital syphilis in newborns. The study considered the Social Determinants of Health (DSS) model, proposed by Dahlgren and Whitehead.8

METHOD

This is a cross-sectional study, using the STROBE checklist (The Strengthening the Reporting of Observational Studies in Epidemiology) as a guide9, carried out in a reference tertiary maternity hospital in the city of Fortaleza, Ceará, Brazil, which makes up the hospital network of the Unified Health System and functions as a back-up unit, providing support in the care of women and newborns in the city. The hospital offers more than 15 medical specialties, in addition to services such as psychology and social assistance.

The study included all cases of congenital syphilis in children, stillbirths or miscarriages reported in the National Disease Notification System (SINAN in Portuguese) by the unit that occurred between 2012, when the hospital was opened, and 2017. They excluded cases in which the investigation ruled out congenital syphilis. SINAN consists of a Brazilian information system powered by the notification and investigation of compulsory notification diseases listed in Ordinance No. 264, of January 17, 2020.10

Data collection took place in January 2018, by a single researcher, and through the compulsory notification form for congenital syphilis made available by the Ministry of Health, which includes various data related to the mother and the newborn, some of which are considered as Determinants Health Social Security (DSS), according to the assumptions of Dahlgreen and Whitehead.8

For the present study, individual determinants were considered: age and color; proximal determinants: having had prenatal care; intermediate determinants: occupation (component of living and working conditions), schooling (education component), time of diagnosis of syphilis and treatment carried out on the mother and provision of treatment to the partner (component of social health services) (Figure 1). As a dependent variable, the outcome of the newborn’s congenital syphilis was considered, which included death from congenital syphilis (including miscarriage or stillbirth, or alive).

The data were organized and analyzed using the Statistical Package for the Social Sciences (SPSS), version 21.0. Binary logistic regression (backward stepwise method)
was performed with the objective of determining the extent to which the outcome of congenital syphilis (death or survival) could be accurately predicted by the social determinants of health, in accordance with the Dalhgreen and Whitehead model.

Binary logistic regression is a statistical technique that is used to estimate the probability of an effect occurring based on the predictors (social determinants of health) included in the model. This method was selected in consideration of the objective of estimating the probability of the outcome of congenital syphilis (dependent variable), which is dichotomous (deaths due to congenital syphilis or alive).¹¹ Inferential analyses with p-values less than 0.05 were considered statistically significant.

The research was submitted to the Research Ethics Committee of the School of Public Health of Ceará, in accordance with Opinion 2.199.632 and Certificate of Presentation of Ethical Appreciation 72503317.3.0000.5037.

Figure 1. Social Determinants of health analyzed by layer, according to the assumptions of Dahlgren and Whitehead.

RESULTS

In total, there were 213 reported cases of congenital syphilis, of which 206 were confirmed and used as a sample for the study, after excluding duplicate twins.

Most mothers were of mixed race (95.6%), homemakers (67.6%), and had completed between the 5th and 8th grade of elementary school (30.5%). The average age was 23.9 years, with a minimum age of 14 and a maximum of 42 years. Among the
patients studied, 83.9% underwent prenatal care, and 64% were diagnosed with syphilis during prenatal care. Of those diagnosed, 47.5% were inadequately treated for syphilis, and 36.5% did not receive any treatment.

Regarding sexual partners, the majority did not undergo concomitant treatment with the pregnant woman (68.9%), and in 13.5% of the cases, this field was marked as unknown, leaving it unclear whether these partners received treatment or not.

Regarding clinical data on newborns, 55.7% were asymptomatic. Among the symptoms observed, jaundice was the most prevalent (26.9%). Additionally, 55.7% of the newborns did not show changes in cerebrospinal fluid (CSF) analysis, and 46.1% did not show changes on long bone X-rays.

Regarding the outcomes of reported cases, 87.5% of the newborns were born alive, 7.2% were stillborn, and 3.3% resulted in miscarriage.

The logistic regression model was statistically significant $[\chi^2(8) = 106.116, p = 0.000; \text{Nagelkerke } R^2 = 0.788]$, and it accurately predicted 96.1% of outcomes. Specifically, it correctly classified 99.4% of cases for newborns who were born alive and 70.8% of cases for those who died due to congenital syphilis (Table 1).

| Table 1. Classifications predicted by the model (n=206). Fortaleza (CE), Brazil, 2018. |
|---|---|---|---|
| Predicted values | Correct classifications |
| Alive | Death by CS* | Alive | Death by CS* |
| Observed values | | 180 | 1 | 99.4% |
| | 7 | 17 | 70.8% |

CS* = congenital syphilis.

The final binary logistic regression model included only four variables, which are presented in Table 2. Of all the predictors included in the analysis, only age demonstrated a statistically significant relationship ($\text{Exp (B) = 1.145 [95% CI: 1.029 – 1.275]}$). This indicates that for every one-point increase in the mother's age score, the chance of the newborn dying from congenital syphilis increases by 1,145 times (Table 2).

| Table 2. Variables predicting the outcome of congenital syphilis (n=206). Fortaleza (CE), Brazil, 2018. |
|---|---|---|---|---|---|
| Variables | df | p-value | Exp(B) | IC for Exp (B) 95% |
| | | | Lower limit | Upper limit |

DISCUSSION

The present study identified that most mothers whose newborns developed congenital syphilis were young, mixed-race women with low education, without formal employment, and who received inadequate treatment or were not treated at all.

It was observed that the increase in the number of congenital syphilis cases is due to the rise in infectious syphilis cases among women of reproductive age and, consequently, in the general population, especially among more vulnerable populations, such as Indigenous and marginalized people. Additionally, changes in sexual practices, increased travel and migration, difficulty accessing health services, and limited awareness and education among mothers and maternity services may also be related.\(^{12-13}\)

There are significant problems in the context of congenital syphilis that deserve to be highlighted, such as inadequate coverage of primary health care, diagnostic limitations, and inadequacies in the management and treatment of acquired syphilis.\(^{14-15}\)

Research that analyzed temporal trends in gestational syphilis in Brazil between 2008 and 2018 found a significant correlation between the percentage of Primary Health Care coverage and the proportion of doctors, nurses, and basic health units per inhabitant with the rate of detection of gestational syphilis. This suggests that public health policies are necessary to reduce social vulnerabilities and strengthen Primary Health Care.\(^{16}\)

As the majority of patients received prenatal care but there was inadequacy or non-existence of treatment for both the pregnant woman and her partner, it is believed that the quality of the service offered by Primary Health Care may be compromised. This could be due to a lack of human resources, supplies, or the lack of training of health professionals to deal with gestational and/or acquired syphilis.\(^{17-18}\)

Furthermore, regarding the inadequate clinical management of acquired syphilis, whether it be the failure to treat the pregnant woman and her partner or incorrect treatment, significant weaknesses were observed. The first two points can justify the fact...
that there was a reduction in the use of Benzathine Penicillin (PB), procaine, and crystalline in PHC between 2014 and 2017. This reduction occurred due to a shortage of the drug, caused by a decrease in the number of Final Dose Formulators (FDF) on the market and the interruption of the Active Pharmaceutical Ingredient (API) quality certificate. Drug shortages are known to be one of the obstacles to the timely and adequate treatment of preventable diseases such as syphilis.19-20

From the perspective of clinical management, the partner's treatment also poses a significant obstacle to controlling congenital syphilis. When the partner is not treated, a cycle of reinfection begins in the pregnant woman. Today, men must be considered an active part of the prenatal care process. When this happens, it leads to improved adherence to prenatal care and professional guidance for the pregnant woman.21

As congenital syphilis is avoidable, it is essential to adopt a more comprehensive approach involving public and hospital health services. This should include educating patients and health professionals, providing updated guidelines for prevention and treatment, prioritizing testing during prenatal care, ensuring accessible and immediate treatment, and adequate monitoring and evaluation of infants.12,22

It is noteworthy that most newborns were asymptomatic or presented mild symptoms, such as jaundice, showing no changes in laboratory and/or imaging tests. Most studies report mild cases of congenital syphilis, with most newborns presenting one or no signs or symptoms.23 However, it is important to highlight that serious complications can occur when the mother does not receive adequate treatment, such as neurosyphilis and neonatal sepsis.18,23

When analyzing the ability of social determinants of health to predict the outcome of congenital syphilis, it was found that, despite the model being statistically relevant, only the age variable was significant. This identified that the older the patients, the greater the chance of the newborn dying from congenital syphilis. This prediction may be associated with the patients' reproductive capacity, as several studies have shown that a woman's older age is a risk factor for various gestational and neonatal complications.24 Although the average age of the patients in this study was lower, there were women up to 42 years of age in the sample.

Recent research highlights the need to investigate the social and economic aspects associated with the increase in congenital syphilis, noting that most patients affected by this condition are women with communication difficulties and lower economic and educational levels.19,25 Although the education variable was included in the regression model in this study, no statistical significance was identified with the outcome.
This is why many researchers advocate for the implementation of congenital syphilis prevention programs targeting specific maternal risk profiles, with the establishment of specialized units as a preferred model to improve surveillance and health care for this neglected population\textsuperscript{21}. The best way to prevent congenital syphilis is to optimize screening for acquired syphilis in women of reproductive age and provide appropriate treatment for patients and their partners.\textsuperscript{26}

As a limitation, it is noted that this research was based on the data collection instrument of the National Disease Notification System for congenital syphilis, which caused restrictions on the sociodemographic and economic variables of the mothers included. There was also difficulty in analyzing the data due to the absence of some information, stemming from the incompleteness of the completed forms. Therefore, it is suggested that new research be conducted to evaluate the prediction of social determinants of health using instruments that include more variables to provide a more comprehensive view of these determinants.

Despite these limitations, the findings of this research can contribute to a greater understanding of individual aspects of mothers that can impact the outcome of congenital syphilis, which are often not noticed by health professionals as they are not considered relevant. Therefore, it is essential that health professionals, particularly those in Primary Health Care, understand the factors related to the worst outcomes of congenital syphilis. This knowledge will enable them to conduct more effective screening for acquired syphilis among women of childbearing age in the enrolled population, as well as ensure timely testing and treatment for pregnant women and their partners.

CONCLUSION

Among the social determinants of health examined, maternal age was the variable with the greatest likelihood of predicting a negative outcome of congenital syphilis.

The use of these data can encourage the development of more effective public policies. Understanding that factors such as living, working, and housing conditions influence susceptibility to diseases such as syphilis allows for more targeted health planning, especially in a context of inequality that has persisted for centuries. It is therefore recommended that new studies take into account a wider range of social factors in order to obtain more accurate data.

Likewise, it is essential that nurses working mainly in primary health care units recognize and understand the relevance of knowing the social and economic context of
patients diagnosed with syphilis, in order to measure the degree of vulnerability of these patients and their respective families, so that it is possible to provide care in a more comprehensive manner, including support from other entities of the health care network, if necessary, with the aim of avoiding or minimizing potential problems resulting from acquired or congenital syphilis.

CONTRIBUTIONS

All authors contributed equally to writing and reviewing the manuscript and approved the final version of the manuscript.

CONFLICTS OF INTERESTS

There were no conflicts of interest.

REFERENCES


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