

# Syphilis in pregnancy and factors associated with congenital syphilis in Belo Horizonte-MG, Brazil, 2010-2013

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## Abstract

**Objective:** to estimate congenital syphilis (CS) incidence and associated factors in conceptae of pregnant women with syphilis attending primary health care centers in Belo Horizonte-MG, Brazil. **Methods:** retrospective cohort study of the period November/2010 to September/2013; data was obtained from electronic medical records; relative risk (RR) and 95% confidence intervals (95%CI) were calculated. **Results:** 353 pregnant women with syphilis were included in the study; cumulative CS incidence was 33.4%; statistically associated factors were maternal age <20 years (RR=1.44; 95%CI: 1.05;1.99), low schooling (RR=1.64; 95%CI: 1.02;2.62), late starting of prenatal care (RR=1.65; 95%CI: 1.21;2.27), having less than six prenatal checkups (RR=1.37; 95%CI: 1.02;1.84), not having nontreponemal test (Venereal Disease Research Laboratory [VDRL]) in the first quarter (RR=1.68; 95%CI: 1.21;2.32), titer of the first (RR=2.86; 95%CI: 1.85;4.41) and last VDRL test  $\geq 1:8$  (RR=2.35; 95%CI: 1.62;3.42). **Conclusions:** congenital syphilis incidence suggests failures in prenatal care and indicates the need for new strategies to reduce vertical transmission of the disease.

**Keywords:** Syphilis, Congenital; Pregnancy; Prenatal Care; Risk Factors; Cohort Studies.

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## Introduction

Congenital syphilis can be prevented as long as the infected mother and her sexual partner(s) are diagnosed and treated promptly. Its occurrence, then, is indicative of flaws in prenatal care.<sup>1</sup> Prenatal syphilis testing is an efficient method, and the penicillin treatment is effective, cheap, and easily available.<sup>2</sup>

Around the world, roughly 2 million pregnant women get infected with syphilis each year. Most pregnant women do not get tested for syphilis, and those who do are not properly treated, if at all.<sup>3</sup> Approximately 50% of non-treated or inadequately treated pregnant women can pass the disease on to the conceptus, leading to adverse outcomes such as stillbirth, neonatal death, prematurity, low birth weight or congenital infection.<sup>3</sup>

*Inadequate prenatal care is the main factor responsible for the high incidence of congenital syphilis in the world.*

The Pan American Health Organization (PAHO) estimates that, in Latin America and the Caribbean, 330,000 pregnant women seropositive for syphilis are not treated for it in prenatal care visits, and two thirds of the cases of syphilis in pregnancy result in congenital syphilis. In those countries, syphilis testing coverage among women who received prenatal care in 2010 was only 61%. Higher coverage rates were found in the Caribbean (82%) and the Southern Cone (76%), including Brazil. On the other hand, the estimated prevalence of gestational syphilis varied from 0.03% in Cuba to 4.7% in Haiti.<sup>4</sup> In Brazil, a hospital case study carried out between 2011 and 2012 estimated a 1.02% prevalence of gestational syphilis and 89.1% syphilis testing coverage in prenatal care.<sup>5</sup>

The World Health Organization (WHO) has characterized the elimination of congenital syphilis as a priority, and has set the goal of reducing its incidence to 0.5 or lower per 1,000 live births until 2015.<sup>6</sup>

Inadequate prenatal care is the main factor responsible for the high incidence of congenital syphilis in the world. Other studies have also associated the disease with poverty, HIV infection, drug abuse and underused health systems.<sup>7</sup> Individual risk factors

include teenage pregnancy, non-white ethnicity/skin color, low schooling, a history of sexually transmitted diseases (STDs), a history of syphilis in previous pregnancies, multiple partners, and low income.<sup>7</sup> Besides guaranteed access to health care, the quality of prenatal care and of labor assistance is paramount to reducing the incidence of congenital syphilis.<sup>8</sup>

In Belo Horizonte, capital of Minas Gerais State, there was an increase in the number of cases of congenital syphilis despite improved access to prenatal care, the growth of family health strategy (ESF) teams, and the agility of professionals in obtaining the results of the nontreponemal test (Venereal Disease Research Laboratory [VDRL]). Between 2001 and 2013, 809 cases of congenital syphilis were reported in Belo Horizonte,<sup>9</sup> its incidence varying from 0.6 (2001) to 5.4 cases per 1,000 live births (2013), ten times the elimination goal set by WHO. Thus, it is evident that in the country, and particularly in Belo Horizonte, the established purpose of reducing congenital syphilis has not been achieved, despite the efforts and the priority status recommended by existing public health policies.

In Brazil, many studies have been published about this issue. Few of those evaluated the pregnant women from the positive syphilis test in prenatal care to the end of the pregnancy to verify the occurrence of congenital syphilis and its potential determinant factors.

The objective of this study was to estimate the incidence of congenital syphilis and its associated factors in conceptuses of pregnant women diagnosed with syphilis, treated in primary health care units (UBS) in the municipality of Belo Horizonte.

## Methods

This is a cohort study. The participants were pregnant women who presented for prenatal care in the UBSs of the Municipal Health Department of Belo Horizonte (SMSA/BH) and who first tested positive for syphilis between June 2011 and December 2012. In retrospect, those women were monitored until the end of their pregnancies, from November 2010 to September 2013, to determine the outcome of interest, i.e., incident cases of congenital syphilis.

The data used came from SMSA/BH's Networked Health System (Sisrede). This system comprises an information environment that includes several modules:

electronic medical records; user register; register of the health facilities and professionals; schedule; pharmacy; collection of biological material integrated with the Clinical Pathology Laboratory System (*SLPC*); and others.<sup>10,11</sup> The data is fed into the monitoring system of the Prenatal and Birth Humanization Program (*Sisprenatal*), which is coordinated by the Brazilian Ministry of Health. The patient's electronic medical records guide this monitoring system.

Between 2010 and 2013, when this study was conducted, Belo Horizonte had 147 primary health care units and five laboratories, as well as a network of collection points located inside the *UBS*. In those years, there was an increase in the number of *ESF* teams, and its coverage expanded from 79.02% in 2010 to 83.08% in 2013.<sup>12,13</sup> In the same period, 18 thousand pregnant women (40% of whom lived in other municipalities) signed up for prenatal care, and roughly 52 thousand deliveries a year were performed.

The pregnant women who tested positive for syphilis were selected from *SLPC*'s database, which centralizes the data from the municipalities' four regional laboratories. Out of the 22,720 pregnant women registered in *Sisrede* who presented for prenatal care, 835 were selected at first. Those selected had reactive VDRL (with any titer) and had been tested between July 2011 and December 2012 (from *SLPC*'s database). For women with more than one VDRL test, the first positive result was used. Thus, pregnant women who met at least one of the following criteria participated in the study: (i) reactive VDRL with titer  $\geq 1:8$ ; (ii) reactive VDRL, with any titer, confirmed by positive treponemal test (*Treponema pallidum* haemagglutination [TPHA] test; or fluorescent treponemal antibody absorption [FTA-Abs] test); and (iii) reactive VDRL with any titer, and treponemal test not realized or with unknown results. Pregnant women with multiple results, women with other medical conditions or diagnoses incompatible with pregnancy (e.g., ectopic pregnancy and molar pregnancy), and unconfirmed gestational syphilis cases following SMSA/BH's protocol<sup>15</sup> were excluded from the study (Figure 1).

The outcome of the study was the occurrence of congenital syphilis in the conceptus, as defined at the time by the Brazilian Ministry of Health:

[...] Every child, miscarriage or stillbirth of a mother with clinical evidence of syphilis and/or reactive nontreponemal serologic test for syphilis

done in prenatal care, birth or curettage, in the absence of a confirmatory treponemal test, who were not treated or who received inadequate treatment.<sup>16</sup>

The search for incident cases of congenital syphilis was done via the Notifiable Diseases Information System (*Sinan*) between July 2011 (start of the selection of pregnant women with syphilis) and September 2013 (end of the selection plus a maximum gestation period of nine months).

The dependent variables and other variables of interest were obtained from the electronic medical records of the pregnant women, between November 2010 (nine months before the start of the selection) and September 2013 (end of the selection plus a maximum gestation period of nine months). A standardized data collection form was prepared and tested beforehand.

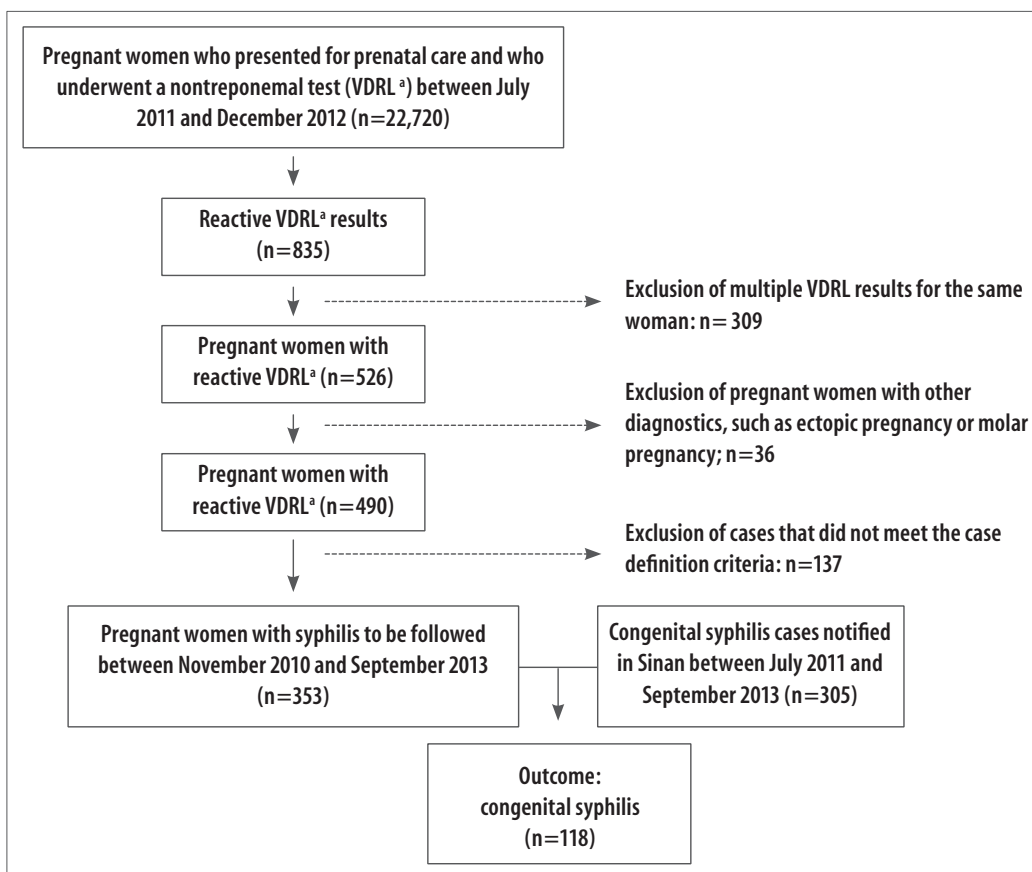
The studied variables were thus classified:

- a) sociodemographic
  - age, in years (<20;  $\geq 20$ )
  - schooling, in years of study ( $\leq 8$ ; >8)
  - ethnicity/skin color (not white; white);
  - marital status (lives alone or with relatives; lives with partner);
  - occupation (housewife; other)
  - history of living on the streets (yes/no)
  - health vulnerability index (HVI; high and very high risk; low and moderate risk)
- b) behavioral
  - uses illicit drugs (marijuana, crack or cocaine: yes/no)
  - information about sexually transmitted infections (STIs), except for syphilis (yes/no)
- c) obstetric history
  - number of previous pregnancies, live births, abortions and stillbirths ( $\geq 1$ ; 0)
  - previous history of syphilis (yes/no)
- d) prenatal care
  - trimester in which prenatal care began (first trimester [ $\leq 12$  weeks of gestation]; second trimester [13-27 weeks of gestation]; third trimester [ $\geq 28$  weeks of gestation])
  - number of prenatal care visits (<6;  $\geq 6$ )
  - health care professional who provided the first prenatal care visit (nurse; gynecologist; non-specialized doctor; general practitioner)
  - trimester of the first VDRL test (first trimester; second trimester; third trimester)

- result of the first VDRL (reactive/nonreactive)
- titer of the first VDRL (<1:8; ≥1:8)
- titer of the last VDRL done in prenatal care (for women with more than one test) (<1:8; ≥1:8)
- e) treatment course prescribed to the pregnant woman and her partner
  - prescription and/or dispensation of penicillin G benzathine to the pregnant woman and her partner (2.4 million – 1, 2 or 3 weeks – or ignored dosage; other treatment (not specified); no information)
- f) outcome of the pregnancy
  - full term birth
  - preterm birth
  - stillbirth
- g) notifier of cases of syphilis in pregnancy
  - UBS
  - hospitals
  - non-notified cases

The health vulnerability index (HVI) is an indicator that combines different socioeconomic and environmental variables. The HVI translates interurban inequalities and expresses the social vulnerabilities of a population by means of a grading scale, which is: low, moderate, high and very high health risk.<sup>17</sup> The first prenatal care visit was considered early if it happened until the 12th week of pregnancy. For the variable "prescription and/or dispensation of penicillin G benzathine," the prescription of at least one dose of penicillin G benzathine to the pregnant woman and her partner was considered to be treatment provided.

Link Plus Version 3.0 Beta<sup>18</sup> was used for the deterministic record linkage between the database of pregnant women with syphilis and *Sinan*'s database. At first, the database was organized using the *Sinan* notification number, which was gathered by nominal search. Later, Link Plus's exact matching (deterministic) method was used, with the notification number as the



a) VDRL: Venereal Disease Research Laboratory

Figure 1 – Flowchart of the selection of pregnant women infected with syphilis

key variable to identify cases of pregnant women with syphilis and cases of congenital syphilis. The patient's name, birth date, municipality or district of residence were used to help identify each case correctly.

The descriptive analysis was based on the frequency distribution of the selected variables, calculation of the median, standard deviation and proportions, to evaluate the profile of pregnant women with syphilis and of the incident cases of congenital syphilis. The cumulative incidence of congenital syphilis was estimated by dividing the number of cases of congenital syphilis by the total number of pregnant women who presented for prenatal care in the *UBS* whose syphilis diagnosis was confirmed by laboratory test. The proportion of pregnant women with syphilis was determined by dividing the number of laboratory-confirmed cases of gestational syphilis by the total number of pregnant women who presented for prenatal care and underwent nontreponemal (VDRL) serology for syphilis.

The cumulative incidence of congenital syphilis was estimated between exposed and non-exposed pregnant women, in accordance with the categories of the explanatory variables. The magnitude of the associations between the independent variables – sociodemographic; behavioral; obstetric history – and the outcome – i.e., "occurrence of congenital syphilis in the conceptus" – was estimated using relative risk, with a 95% confidence interval (95%CI). Differences in proportions were assessed using Pearson's Chi-square test and Fisher's exact test, when indicated. For all analyses, the significance level considered was 0.05. The data were stored in the software Epi Info version 3.5.4 and analyzed by Stata/SE version 12.0.

This study was approved by the Research Ethics Committee of the Municipal Health Department of Belo Horizonte (*CEP-SMSA/BH*): Report No. 498,321.

## Results

Of the 835 pregnant women with reactive VDRL selected to participate in this study, 309 (37.0%) were excluded because of disparate results, 36 (4.3%) for having other conditions, and 137 (16.4%) for not meeting the case definition criteria. A total of 353 (42.3%) pregnant women were included in our analyses (Figure 1). The proportion of pregnant women diagnosed with syphilis was 1.6%; and the cumulative incidence of congenital syphilis was 33.4%.

The median age of the pregnant women was 25 years (range: 14 to 48), with predominance of those aged 20-29 (51.6%). Over half of them (72.9%) declared themselves to be non-white, to have  $\leq 8$  years of schooling (74.1%), to live alone or with relatives (69.5%) and to have some occupation (68.6%). About 2% of the women analyzed were homeless or had a history of living on the streets; and 56.0% lived in areas of high or very high health vulnerability index (HVI) at the time of childbirth (Table 1).

Regarding obstetric history, most (77.8%) had a history of previous pregnancies, 72.2% had one or more living children – average of two children per woman –, almost a third had a previous history of syphilis, and 31.7% reported adverse outcomes (miscarriage or stillbirth) in previous pregnancies (Table 1). Over half of the pregnant women observed (51.6%) started prenatal care after the first trimester; and 65.2% attended 6 or more visits. The average number of visits was 7.1 (SD=3.1). Among women who started prenatal care late (second or third trimester of pregnancy), 48.6% had less than 6 visits, and for 63.8% of the pregnant women, the first visit was conducted by a nurse.

The first VDRL exam was late for 56.6% of the pregnant women; 67.2% of these had a titer  $\geq 1:8$ . It is noticeable that, for 7.1% of the pregnant women, the first VDRL result was non-reactive, which likely indicates an infection during pregnancy. Among those who had more than one VDRL test done, most (54.9%) kept high titers ( $\geq 1:8$ ) in the last prenatal test. On average, 2.4 VDRL exams were performed during prenatal care (SD=1.3). Out of the 71.7% pregnant women who had it done more than once, only 5.9% repeated it in the third trimester of pregnancy.

In the majority (81.1%) of the cases of congenital syphilis, the pregnant women had higher ( $\geq 1:8$ ) VDRL titers. Over two thirds of the women (71.4%) and only 19.0% of the partners got at least one dose of penicillin G benzathine, while 19.0% had a prescription for both the pregnant woman and her partner (Table 1). Only 44.8% of the pregnant women with syphilis were notified by *UBSs*, for an estimated under-notification of 55.2% (Table 1).

In the univariate analysis, the variables that associated ( $p < 0.05$ ) with the occurrence of congenital syphilis were: maternal age  $< 20$  years (RR=1.44; 95%CI 1.05;1.99); eight or less years of schooling

**Table 1 – Sociodemographic, risk behavior and current prenatal care characteristics of pregnant women with syphilis who presented for prenatal care at the primary health care units of the municipality of Belo Horizonte, Minas Gerais State, November 2010 to September 2013**

Characteristics	n (353) <sup>a</sup>	%
<b>Sociodemographic</b>		
<b>Age (in years)</b>		
<20	65	18.4
≥20	288	81.6
<b>Education (years in school)</b>		
≤8	212	74.1
>8	74	25.9
<b>Skin color</b>		
Not white	218	72.9
White	81	27.1
<b>Marital status</b>		
Lives alone or with relatives	198	69.5
Lives with partner	87	30.5
<b>Occupation</b>		
Housewife	59	31.4
Others	129	68.6
<b>A history of living on the streets</b>		
Yes	8	2.3
No	345	97.7
<b>Health Vulnerability Index (HVI)</b>		
High and very high risk	164	56.0
Low and moderate risk	129	44.0
<b>Behavioral</b>		
<b>Use of illicit drugs (marijuana, crack or cocaine)</b>		
Yes	31	8.8
No	322	91.2
<b>Information about sexually transmitted infections (STIs), except for syphilis</b>		
Yes	6	1.7
No	347	98.3
<b>Obstetric history</b>		
<b>Number of previous pregnancies</b>		
≥1	235	77.8
0	67	22.2
<b>Number of previous live births</b>		
≥1	218	72.2
0	84	27.8
<b>Number of previous abortions</b>		
≥1	81	26.7
0	222	73.3
<b>Number of stillbirths</b>		
≥1	15	5.0
0	287	95.0
<b>Previous history of syphilis</b>		
Yes	96	27.2
No	257	72.8

Continues

Table 1 – Conclusion

Characteristics	n (353) <sup>a</sup>	%
<b>Prenatal care</b>		
<b>Trimester in which prenatal care began</b>		
First	168	48.4
Second	156	45.0
Third	23	6.6
<b>Number of prenatal care visits</b>		
<6	121	34.8
≥6	227	65.2
<b>Health care professional who provided the first prenatal care visit</b>		
Nurse	111	63.8
Gynecologist	34	19.5
Non-specialized doctor	28	16.1
General Practitioner	1	0.6
<b>Trimester of the first VDRL<sup>b</sup> test</b>		
First	152	43.4
Second	160	45.7
Third	38	10.9
<b>Result of the first VDRL<sup>b</sup> test</b>		
Reactive	328	92.9
Non-reactive	25	7.1
<b>Titer of the first VDRL<sup>b</sup> test</b>		
≥1:8	197	60.1
<1:8	131	39.9
<b>Titer of the last prenatal VDRL<sup>b</sup> test (of pregnant women with more than one test)</b>		
≥1:8	139	54.9
<1:8	114	45.1
<b>Treatment course prescribed to the pregnant woman and her partner</b>		
<b>Prescription and/or dispensation of penicillin G benzathine to the pregnant woman</b>		
2.4 million (1 week)	38	10.8
2.4 million (2 weeks)	64	18.1
2.4 million (3 weeks)	137	38.8
2.4 million (unknown dosage)	13	3.7
Other treatment (not specified)	2	0.6
No information	99	28.0
<b>Prescription and/or dispensation of penicillin G benzathine to the partner</b>		
2.4 million (1 week)	12	3.4
2.4 million (2 weeks)	11	3.1
2.4 million (3 weeks)	37	10.5
2.4 million (unknown dosage)	7	2.0
No information	286	81.0
<b>Outcome of the pregnancy</b>		
Full term birth	96	82.1
Preterm birth	17	14.5
Stillbirth	4	3.4
<b>Source of notification of gestational syphilis cases</b>		
Primary Health Care Units (UBSs)	158	44.8
Hospitals	76	21.5
Non reported cases	119	33.7

a) The totals vary because missing data were excluded

b) VDRL: Venereal Disease Research Laboratory

(RR=1.64; 95%CI 1.02;2.62); late start of prenatal care (RR=1.65; 95%CI 1.21;2.27); less than 6 prenatal care visits (RR=1.37; 95%CI 1.02;1.84); and not doing the VDRL test in the first trimester (RR=1.68; 95%CI 1.21;2.32). It is noteworthy that high VDRL titers ( $\geq 1:8$ ) – in the first (RR=2.86; 95%IC 1.85;4.41) and in the last test (RR=2.35; 95%IC 1.62;3.42) – meant high risks of occurrence of congenital syphilis in this population. The following variables were negatively associated with the occurrence of congenital syphilis: pregnant women with one or more previous pregnancies (RR=0.69; 95%CI 0.49;0.98) and with previous abortions (RR=0.64; 95%CI 0.42;0.99) (Table 2).

## Discussion

The cumulative incidence of congenital syphilis found in this study was high, corresponding to a third of the conceptuses of the pregnant women diagnosed with syphilis. The result was similar to that found by Domingues et al.<sup>1</sup> for the municipality of Rio de Janeiro between 2007 and 2008, who estimated a vertical transmission rate of 34.8%<sup>1</sup>, and higher than the incidence for Brazil (25%)<sup>19</sup> estimated in a study of prevalence of syphilis in parturients conducted in 2004.

The factors associated with the occurrence of congenital syphilis among the pregnant women analyzed were maternal age lower than 20 years, low schooling, late start of prenatal care and less than six prenatal visits, not doing the VDRL test, and first and last VDRL titer equal to or higher than 1:8. Unwanted pregnancies and teenage pregnancies, as well as unfavorable living conditions, contribute to the late start of prenatal care. Half of the participants lived in areas of high and very high health risk, and a third had a history of syphilis. Early identification and the mother's adherence to prenatal care, as well as quality care, give her the opportunity to receive information and instructions that will allow her to prevent an unplanned pregnancy and protect herself from sexually transmitted infections.

The proportion of pregnant women with syphilis found (1.6%) was similar to that revealed by a study conducted in health centers accredited by Brazil's National Program on Sexually Transmitted Diseases and AIDS in 1999-2000 (1.7%)<sup>7</sup> and lower than the one found by Domingues et al. (1.9%)<sup>1</sup>. A more recent

study, hospital-based and of national scope, carried out from 2011 to 2012, estimated a lower prevalence of pregnant women with syphilis (1.02%), which varied between regions: from 0.76% in the North Region to 1.1% in the South Region.<sup>5</sup>

It should be noted that, in this study, all estimates were calculated for pregnant women who registered for prenatal care in Belo Horizonte's *UBSs* and who got at least one VDRL test. Thus, they may be underestimated for the municipality's population of pregnant women: many women register for prenatal care but do not return to the health units to be examined, and, consequently, are only diagnosed during the childbirth.

Among the sociodemographic characteristics of the pregnant women, age lower than 20 years and education equal to or less than eight years of schooling were – significantly – associated with the outcome, i.e., the occurrence of congenital syphilis in the conceptus. Similar results were found in different studies.<sup>7</sup> Domingues et al.<sup>5</sup> report that women with low schooling and black or brown skin color had a greater prevalence of syphilis in pregnancy. Low schooling is related to less access to information, to a limited understanding of the importance of health care and, especially, of infection prevention measures.

Regarding obstetric history, there was a negative association between women with more than one pregnancy and previous abortion(s) and the occurrence of congenital syphilis. Similarly, Qin et al.,<sup>20</sup> in a study conducted in China from 2007 to 2012, observed a negative association between previous abortions and congenital syphilis. Adherence to prenatal care in previous pregnancies, which should result in a better prevention of syphilis and other STIs in the current pregnancy, could possibly explain the negative association found for previous pregnancies and abortions. However, over a third of those women reported a previous history of syphilis and high VDRL titers. Congenital syphilis occurred in 30.2% of those with previous pregnancies and in 23.5% of those with a history of more than one abortion. It is known that pregnancy does not alter the clinical course of syphilis in the pregnant woman and there are no uterine mechanisms to protect her from the illness.<sup>21</sup>

In this study, 51.5% of the pregnant women started prenatal care after the first trimester of pregnancy, a factor statistically associated with a greater risk of congenital syphilis. Other studies<sup>1,7</sup>



**Table 2 – Bivariate analysis of factors associated with congenital syphilis in the municipality of Belo Horizonte, Minas Gerais State, November 2010 to September 2013**

Characteristics	Total	Congenital syphilis		RR <sup>b</sup> (95%CI <sup>c</sup> )	P-value <sup>d</sup>
	n <sup>a</sup>	n <sup>a</sup>	Incidence (%)		
<b>Sociodemographic</b>					
<b>Age (in years)</b>					
<20	65	29	44.6	1.44 (1.05;1.99)	0.025
≥20	288	89	30.9	1	
<b>Schooling (years in school)</b>					
≤8	212	75	35.4	1.64 (1.02;2.62)	0.040*
>8	74	16	21.6	1	
<b>Skin color</b>					
Not white	218	76	34.9	1.09 (0.75;1.56)	0.657
White	81	26	32.1	1	
<b>Marital status</b>					
Lives alone or with relative	198	68	34.3	1.36 (0.90;2.05)	0.143
Lives with partner	87	22	25.3	1	
<b>Occupation</b>					
Housewife	59	19	32.2	0.94 (0.61;1.47)	0.798
Other occupation	129	44	34.1	1	
<b>Health Vulnerability Index (HVI)</b>					
High and very high risk	164	65	39.6	1.31 (0.95;1.81)	0.100
Low and moderate risk	129	39	30.2	1	
<b>Behavioral</b>					
<b>Use of illicit drugs (marijuana, crack or cocaine)</b>					
Yes	31	11	35.5	1.07 (0.65;1.76)	0.797
No	322	107	33.2	1	
<b>Alcohol consumption</b>					
Yes	14	7	50.0	1.53 (0.88;2.64)	0.128
No	339	111	32.7	1	
<b>Smoking</b>					
Yes	82	34	41.5	1.34 (0.98;1.82)	0.068
No	271	84	30.9	1	
<b>Obstetric history</b>					
<b>Number of previous pregnancies</b>					
≥1	235	71	30.2	0.69 (0.49;0.98)	0.036*
0	67	29	43.3	1	
<b>Number of previous live births</b>					
≥1	218	68	31.2	0.82 (0.58;1.14)	0.244
0	84	32	38.1	1	
<b>Number of previous abortions</b>					
≥1	81	19	23.5	0.64 (0.42;0.99)	0.044*
0	222	81	36.5	1	
<b>Number of stillbirths</b>					
≥1	15	4	26.7	0.79 (0.34;1.87)	0.603
0	287	96	33.5	1	
<b>Previous history of syphilis</b>					
Yes	96	25	26.0	0.72(0.49;1.05):	0.085
No	257	93	36.2	1	

Continues

**Table 2 – Conclusion**

Characteristics	Total	Congenital syphilis		RR <sup>b</sup> (95%CI <sup>c</sup> )	P-value <sup>d</sup>
	n <sup>a</sup>	n <sup>a</sup>	Incidence (%)		
<b>Current pregnancy</b>					
<b>Late start of prenatal care</b>					
Yes	179	74	41,3	1,65 (1,21;2,27)	0,002*
No	169	42	24,9	1	
<b>Number of prenatal care visits</b>					
<6	121	49	40,5	1,37 (1,02;1,84)	0,036*
≥6	227	67	29,5	1	
<b>VDRLe in the first trimester</b>					
Yes	152	37	24,3	1	
No	198	81	40,9	1,68 (1,21;2,32)	0,002*
<b>Titer of the first VDRL<sup>e</sup></b>					
<1:8	131	20	15,3	1	
≥1:8	197	86	43,7	2,86 (1,85;4,41)	<0,001*
<b>Titer of the last VDRL<sup>e</sup> in prenatal care (of pregnant women with more than one exam)</b>					
<1:8	114	56	49,1	1	
≥1:8	139	29	20,9	2,35 (1,62;3,42)	<0,001*
<b>Active search</b>					
Yes	106	37	34,9	1	
No	24,7	81	32,7	0,94 (0,69;1,29)	0,698
<b>Clinical interurrences during pregnancy</b>					
Yes	59	19	32,2	1	
No	294	99	33,7	0,96 (0,64;1,43)	0,828
<b>Referral to HRPC<sup>f</sup></b>					
Yes	247	83	33,6	1	
No	106	35	33,0	0,98 (0,71;1,36)	0,915

a) The totals vary because missing data were excluded

b) RR: relative risk

c) 95%CI: 95% confidence interval

d) Pearson's chi-square test and Fisher's exact test

e) VDRL: Venereal Disease Research Laboratory

f) HRPC High-risk prenatal care

\* p<0.05

conducted in Brazil found a lower percentage of pregnant women who started prenatal care late (after 12 weeks of pregnancy).<sup>9</sup> First-trimester prenatal care is used as an indicator of greater quality of maternal care.<sup>5,9</sup>

In this study, it is noticeable that over half of the pregnant women did the VDRL test late, increasing the risk of congenital syphilis by 1.68 times. Among the women with more than one VDRL exam, 54.9% kept a high titer in the last exam, increasing the risk of

the illness by two times. This might mean the women were not treated, inadequately treated, or even re-infected. Lin et al.<sup>22</sup> reported that mothers with high nontreponemal test titers were more likely to pass the infection on to their children, while Vasquez et al.<sup>23</sup> found an association between high titers and lower birth weight.

In the present study, in 18.9% of the cases of congenital syphilis, the mothers' VDRL titer was  $\leq 1:4$ , making clear the importance of considering low titers in maternal syphilis diagnostic exams. Campos et al.<sup>24</sup> described that low VDRL titers have clinical meaning and should be interpreted as a good predictor of congenital syphilis.

The average number of VDRL tests per pregnant woman (2.4) meets the recommendation of the Ministry of Health. In this study, the total number of pregnant women who did more than one VDRL test (71.7%) was higher than that found by Nascimento et al.<sup>25</sup> in Rio de Janeiro, between 2005 and 2008, when none of the women were tested more than twice in prenatal care; it was also higher than the proportion found in a study carried out by Hildebrand<sup>26</sup> in the municipality of Campo Grande, capital of Mato Grosso do Sul State, between 2008 and 2009, when only 40% of the pregnant women had more than one test. In the present analysis, it was discovered that only a very small percentage (10.9%) of the women were tested in the third trimester of the pregnancy. Rodrigues et al.<sup>7</sup> found an even smaller percentage (3.9%) in their national study with postpartum women (1999-2000). Performing the VDRL test in the last trimester of pregnancy allows the start and completion of treatment 30 days before the infected women in the end of the pregnancy go into labor.<sup>9</sup>

In the present study, for 28% of the pregnant women and 81.1% of the partners, their electronic medical records had no information about them receiving any dose of penicillin. The global strategy for the control of congenital syphilis has the following goal: over 90% of syphilis-seropositive pregnant women and over 80% of their partners to be treated with at least one dose of penicillin G benzathine.<sup>6</sup>

Despite well-established care protocols and the availability of penicillin G benzathine in the *UBS* consulted at the time of this study, it is likely that there are still difficulties in diagnosing and managing the illness, as well as identifying and treating the partner(s), which is one of the great challenges for

the control of congenital syphilis in Brazil. The Ministry of Health recommends that health professionals encourage men to take preventive screenings to detect possible illnesses harmful to women, fetuses and themselves.<sup>27</sup> In spite of the low rates of partner participation in prenatal care visits, the health unit must use strategies to ease their commitment to the service, such as flexible opening hours and/or a referral to units closer to their workplace.<sup>9,28</sup>

This study, analyzing only the *UBS* as sources of notification, estimated a 55.2% under-notification rate of syphilis in pregnancy. The under-notification of health information can be taken as a direct indicator of poor quality in prenatal care. The notification of syphilis in pregnancy makes it possible to control the vertical transmission of the infection, observe the illness's behavior in pregnant women, help plan health initiatives, define intervention priorities and evaluate the impact of these interventions.<sup>11</sup>

Detecting and treating syphilis in pregnant women are important public health measures, and essential to control and prevent congenital syphilis. Family Health Strategy workers play a fundamental role in the application of proper measures to control the vertical transmission of syphilis, with routine screenings and the reduction of adverse events such as premature births, miscarriages and stillbirths.<sup>6,22</sup>

This research faced some limitations, such as the use of secondary data, which depend on the quality of the records. It was clear that a large amount of data was missing, possibly because it was not recorded by the professional in charge, or because *Sisrede* was inoperative, making it hard or even impossible to log the data into the electronic medical records. The results achieved here do not represent the serological situation of Belo Horizonte's pregnant women, given the fact that it included only those who presented for prenatal care in the *UBS* of the municipality's National Health System. Thus, the real incidence of congenital syphilis in Belo Horizonte can be overestimated.

Another limitation of this study relates to information about the women's treatment, which does not consider gestational age, stage of the disease or prescribed dosage, or even the time elapsed between the end of the treatment until the childbirth. Furthermore, the low percentage of treated partners may be related to the amount of unknown records, underestimating that information.

The cases of congenital syphilis were identified in the Notifiable Diseases Information System's database (*Sinan*), and may have been underestimated. At last, the analysis was restricted to a descriptive approach and a bivariate analysis, making it impossible to investigate potential confounding factors in the associations.

The factors associated to congenital syphilis found in this study suggest failures in prenatal care and indicate the necessity of proposing new strategies to reduce vertical transmission of syphilis, such as (i) continuous education of health care workers, through case analysis, (ii) stronger epidemiological surveillance, to monitor VDRL results of pregnant women in laboratories, and (iii) integrated HIV/AIDS

and syphilis prevention approaches, increasing the visibility of congenital syphilis, a public health issue that is still far from being eliminated.

### Authors' contributions

Nonato SM, Melo APS and Guimarães MDC participated in the conception and design of the study, analysis and interpretation of the data, as well as the drafting and critical revision of the manuscript's intellectual content.

All authors approved the final version of the manuscript and are responsible for all aspects of the work, assuring its accuracy and integrity.

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