

Prevalence of syphilis and HIV infection during pregnancy in incarcerated women and the incidence of congenital syphilis in births in prison in Brazil

Prevalência de sífilis e HIV em gestantes encarceradas e incidência de sífilis congênita em crianças nascidas em prisões brasileiras

Prevalencia de sífilis y VIH en gestantes encarceladas e incidencia de sífilis congénita en niños nacidos en prisiones brasileñas

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Abstract

This study aimed to estimate the prevalence of syphilis and HIV infection during pregnancy, the mother to child transmission of syphilis and the incidence of congenital syphilis in incarcerated women in Brazil; to compare these rates to those observed in pregnant women outside of jail; and to verify the maternal factors associated with syphilis infection during pregnancy in free and incarcerated women. We used data from two nationwide studies conducted during the period 2011-2014. The Birth in Brazil study included 23,894 free women cared for in 266 hospitals. The Maternal and Infant Health in Prisons study included 495 incarcerated pregnant women or mothers living with their children, according to a census conducted in 33 female prisons. The same case definitions and data collection methods were used in both studies. The chi-square test was used to compare the characteristics of incarcerated and free women with a significance of 0.05. For incarcerated women, the estimated prevalence of syphilis during pregnancy was 8.7% (95%CI: 5.7-13.1) and for HIV infection 3.3% (95%CI: 1.7-6.6); the estimated mother to child transmission of syphilis was 66.7% (95%CI: 44.7-83.2) and the incidence of congenital syphilis was 58.1 per 1,000 living newborns (95%CI: 40.4-82.8). Incarcerated women had a greater prevalence of syphilis and HIV infection during pregnancy, lower quality of antenatal care and higher levels of social vulnerability. Syphilis infection showed to be an indicator of social vulnerability in free women, but not in incarcerated women. Health initiatives in prison are necessary to reduce healthcare inequalities and should include adequate antenatal and birth care.

Syphilis; HIV; Vertical Infectious Disease Transmission; Prisons

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Introduction

Health conditions in incarcerated populations are poorer than in free populations, with higher prevalence of mental disturbances, infectious diseases and some chronic diseases ¹. High prevalence of infectious disease is associated with greater social vulnerability of individuals prior to incarceration ^{2,3}, greater exposure to risk factors ⁴, prison conditions that favor the transmission of these diseases ^{3,5,6}, and the lack of preventative and control measures such as diagnosis and treatment of infected individuals ³. A higher prevalence of sexually transmittable diseases can persist throughout the post-incarceration period, as much due to an absence of diagnosis and/or treatment of diseases acquired before or during incarceration, as to the increasing risk of new infection upon re-entry into society ⁷.

Syphilis and HIV are sexually transmittable infections, which can be transmitted from the mother to the foetus during pregnancy and birth. Transmission to the foetus can be prevented through diagnosis during pregnancy and the use of specific prophylactic measures. Opportune treatment with penicillin Benzathine is effective in preventing 97% of mother to child transmission of syphilis ⁸, while administering antiretroviral medications to mothers during pregnancy and birth and to the baby during the first weeks of life, appropriate care during labor and birth, and the use of maternal milk substitutes can reduce the HIV mother to child transmission rates to below 2% ⁹. Therefore, the identification and treatment of these infections during pregnancy are important for the health of the mother, as it can reduce morbidity and mortality associated with these infections, and allow for preventative measures which avoid mother to child transmission of syphilis and HIV.

Studies carried out in several countries, including Brazil, showed a high prevalence of HIV and syphilis infections in incarcerated men ^{3,5,10,11,12,13} and women ^{2,3,6,14,15,16,17,18,19,20,21}, reinforcing the importance of serological diagnosis in prisons for the implementation of available intervention. However, Brazilian studies have been carried out in isolated prison units. There are only two studies operating on a state-wide scale, one in Espírito Santo ¹⁴ and another in Mato Grosso do Sul ³, and no study with a nationwide scope. Moreover, none of these studies specifically evaluated syphilis and HIV prevalence in incarcerated women during the pregnancy-puerperal period.

The hypothesis of this study is that the prevalence of syphilis and HIV infection during pregnancy is greater in incarcerated women than in free women; that incarcerated women have greater social vulnerability than free women; and that syphilis and HIV infections are indicators of social vulnerability.

The objective of this study is to estimate the prevalence of syphilis and HIV infection during pregnancy, the mother to child transmission of syphilis and the incidence of congenital syphilis in incarcerated women – comparing these data with national estimates for free women – and to verify the maternal factors associated with syphilis infection during pregnancy in free and incarcerated women.

Method

We used findings from two national studies: *Birth in Brazil* and *Maternal and Infant Health in Prisons*.

The study *Birth in Brazil* is a hospital based investigation, which took place between February 2011 and October 2012, and included 266 hospitals and 23,894 mothers. We selected the sample in three stages. In the first, we grouped hospitals with more than 500 births per year into the five macro-regions of Brazil (North; Northeast; South; Southeast; Central), by location (non-capital, capital) and according to the type of healthcare service (public, mixed, private), with the selection probability being proportional to the number of births in 2007 for each of the strata. In the second stage, we used a method of inverse sampling for the calculation of the number of days necessary (a minimum of seven) to interview 90 mothers at each hospital. In the third stage, we selected eligible women for each day of fieldwork. The eligibility criteria included women with a hospital birth of a living foetus of any gestational age or weight, or of a foetal loss with a gestational age > 22 weeks or weight > 500g. We carried out interviews with mothers during their hospital stay and we collected data from the hospital records after the patient was discharged from the hospital. In the case of an extended stay, we collected data from the maternal records on the forty-second day of the stay and from the newborn records on the twenty-eighth day of life. We photographed antenatal cards, when available, and

subsequently collected data. More information on the study *Birth in Brazil* is available in Leal et al.²² and Vasconcellos et al.²³.

The study *Maternal and Infant Health in Prisons* was a census study with an institutional base, undertaken between August 2012 and January 2014, in all the female prison institutions which housed pregnant women and women with children located in the capital and metropolitan regions of all Brazilian states and in the Federal District. Thirty-three prison units were included in twenty-four states, excluding the states of Tocantins and Acre, which had no pregnant women or mothers at the time of the fieldwork. We considered pregnant detainees, detainees who gave birth in the two years prior to research and detainees who were with their children as eligible for the study, even though they had not given birth in prison. The interviewed population consisted of 495 women: 206 pregnant women and 289 mothers. We carried out structured interviews with pregnant women and mothers in prison units, collected data from maternal and newborn hospital records at the time of birth, and took photographs of the antenatal care cards. More information about the study *Maternal and Infant Health in Prisons* is available in Leal et al.²⁴.

For this analysis, we excluded all women younger than eighteen years old and who had private funding for birth care from the *Birth in Brazil* study, with 16,931 women remaining eligible. This exclusion aimed to guarantee comparability with the study *Maternal and Infant Health in Prisons*, given that juvenile prisons (with inmates less than eighteen years of age) were not included and that antenatal and birth care for incarcerated women is the responsibility of the state (public funding). From the study *Maternal and Infant Health in Prisons*, 206 pregnant women, 36 mothers with children of one year of age or older and 12 women who were imprisoned after giving birth were excluded, leaving 241 mothers to minors of one year of age who gave birth after being detained. The exclusion of pregnant women sought to guarantee compatibility with the *Birth in Brazil* study, which only evaluated mothers and avoided underestimation of syphilis and HIV prevalence resulting from a lack of serology test data. The exclusion of mothers with children of one year of age or more sought to reduce recall bias regarding information on pregnancy and birth. Mothers who gave birth before imprisonment were excluded given that antenatal and birth care had been provided outside of prison units. Figure 1 presents the flow chart of the selection process for women from the study *Maternal and Infant Health in Prisons*.

We compared the characteristics of incarcerated and free women using chi-squared tests with a significance of 0.05. We verified demographic (age, self-reported skin color), social (education, marital status), and reproductive (number of pregnancies, abortions, and previous births; occurrence in a previous birth of preterm newborn and/or with low birth weight) characteristics. Furthermore, we investigated maternal habits (prevalence of smoking during pregnancy; suspicion of alcohol abuse), data regarding the current pregnancy (antenatal care, prevalence of syphilis and HIV infection) and birth (incidence of congenital syphilis and mother to child transmission rates of syphilis).

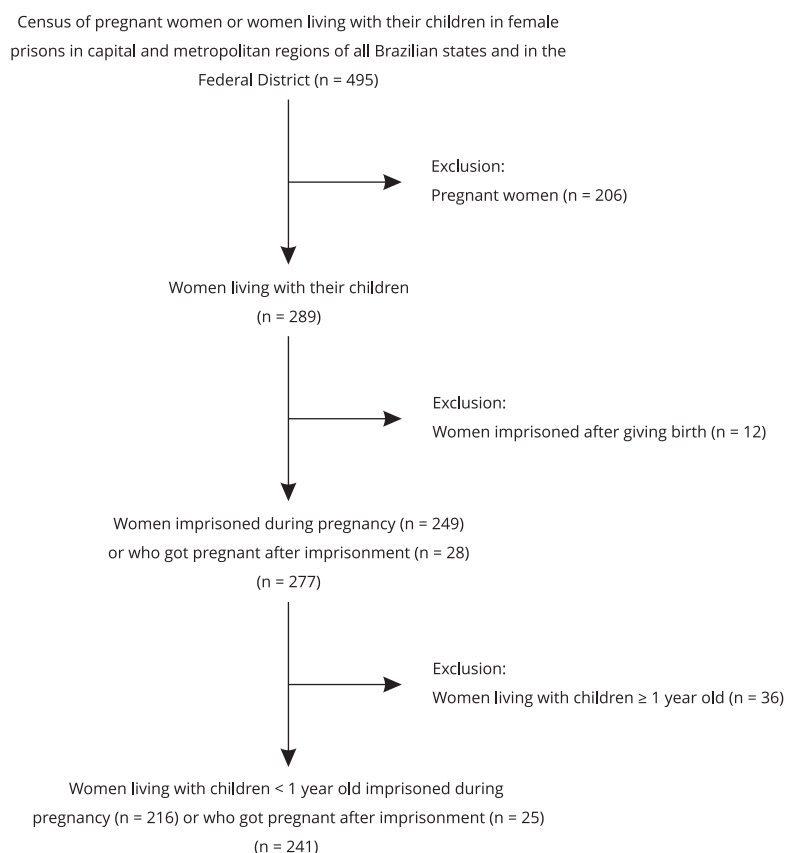
We set the status “smoked during pregnancy” if it was reported by mothers, regardless of the amount they smoked during pregnancy. To measure for levels of inappropriate alcohol use we used the *Tolerance Worry Eye-opener Annoyed Cut-down* (TWEAK)²⁵ instrument with a cut-off of two. History of preterm birth and low birth weight was collected via interviews or from antenatal card records, when available. For the evaluation of antenatal care we used the following criteria: (a) proportion of women who had had at least one antenatal consultation; (b) proportion of pregnant women who reported having received the antenatal card; (c) the gestational age at the beginning of antenatal care, with initiation of care at the 12th gestational week or less considered as “early beginning”; (d) proportion of women with an adequate number of antenatal consultations adjusted for gestational age at birth (minimum number of six antenatal consultations for a term pregnancy); and (e) proportion of women whose antenatal card recorded the results of syphilis and/or HIV serology test.

In both studies, we used the same case definition of syphilis during pregnancy, congenital syphilis and HIV infection during pregnancy. For the diagnosis of congenital syphilis, we used data obtained from newborn records. We then classified newborns as a case of congenital syphilis if there was a diagnosis of congenital syphilis recorded in the hospital records and/or if the cause of foetal or neonatal death was congenital syphilis.

For the diagnosis of syphilis during pregnancy, researchers considered the occurrence of at least one of the following situations: (a) reagent results of a syphilis serology test recorded on the antenatal

Figure 1

Process of selection of women in the *Maternal and Infant Health in Prisons* study, Brazil, 2012-2014.



card, regardless of title; (b) indication of syphilis infection on the maternal medical records; (c) indication of congenital syphilis diagnosis on the newborn medical records.

For the diagnosis of HIV infection during pregnancy, we took into account the presence of at least one of the following conditions: (1) reagent results recorded on the antenatal card (two rapid tests or ELISA+Immunofluorescence or ELISA+Western Blot); or (2) evidence in the hospital records of: (a) diagnosis of HIV infection, or (b) indication of caesarean as a result of HIV infection, or (c) the use of zidovudine (AZT) during labor and/or birth, or (d) the use of AZT syrup on the newborn, or (e) the suspension of maternal breastfeeding due to maternal HIV infection, or (f) a record of the diagnosis "child exposed to HIV".

We estimated the prevalence of HIV and syphilis infection during pregnancy, the incidence of congenital syphilis per 1,000 live births, and the rate of MTCT of syphilis using corresponding 95% confidence intervals (95%CI) for the populations of the two studies: incarcerated women and free women.

We analyzed the social, demographic, reproductive and antenatal care characteristics of the women according to syphilis diagnosis during pregnancy in each study, seeking to identify the association between maternal factors and syphilis infection in each particular context. Due to the small number of cases in the study *Maternal and Infant Health in Prisons*, we re-categorised variables with three or more categories into two, to allow the use of the Fisher test in the analysis.

In all the statistical analyses of the *Birth in Brazil* study data, we considered the complex sampling design. We calculated the data weighting according to the inverse of the probability of inclusion of each puerperal woman in the sample and we used a calibration procedure in each selection stratum²³. For the study *Maternal and Infant Health in Prisons*, weighting and calibration procedures were unnecessary, as the study was a census. In both studies, we excluded women who self-reported as East Asian or indigenous from the analysis, due to the very small proportion of cases (1.5% in *Birth in Brazil* and 1.7% in *Maternal and Infant Health in Prisons*).

The Research Ethics Committee of the Sergio Arouca National School of Public Health, Oswaldo Cruz Foundation approved the study *Birth in Brazil* and the study *Maternal and Infant Health in Prisons* (report n. 92/2010 and 78.618/2012, respectively). We took care to ensure the anonymity and confidentiality of information and data was collected after participants gave their consent and signed a free and informed consent form.

Results

Of the 16,931 women included in the *Birth in Brazil* study, 77.7% were between 20 and 34 years old, 42.6% had twelve or more years of schooling, 29.4% self-reported as white, 81.3% lived with a partner, 11.8% reported smoking during pregnancy and 11.4% showed a suspicion of alcohol abuse. More than a third of the women had no history of previous pregnancy. Of those who had been pregnant before, 29.4% had a previous abortion; 61% had previously given birth and amongst those who had already given birth, 11.8% and 13.8% reported having had a preterm or low birth weight newborn, respectively.

Significant differences were observed in incarcerated women when compared with free women. The majority of incarcerated women were between 20 and 34 years old (91.3%), with a lower proportion of women younger than 20 years old (2.5%). Incarcerated women had lower levels of education, with 87.5% reporting less than eight years of schooling, and a higher proportion lived without a partner before incarceration (55.6%). The prevalence of smoking during pregnancy (63.9%) and the suspicion of alcohol abuse (32.6%) were, respectively, five and three times more likely in incarcerated women. They also had a higher proportion of previous pregnancies (88%), abortions (43.4%), and previous births (82.9%), as well as preterm newborns (23.4%) or newborns with low birth weight (28%) in previous births. All these differences were significant (Table 1).

In relation to antenatal care, the percentage of free women who had previously had one antenatal consultation was 98.5%. Almost 60% of these women had an early initiation of antenatal care, 73% had an adequate number of consultations for gestational age at birth and almost 100% reported having received the antenatal care card. Among those women who had access to an antenatal care card, 88.3% had at least one serology test for syphilis and 80% had at least one serology test for HIV. Incarcerated women showed significantly lower levels for all evaluated indicators, including: lower rates of at least one antenatal consultation (94.6%); lower rates of early initiation of antenatal care (48.1%); lower rate of adequate number of antenatal consultations (48%); lower likelihood of receiving an antenatal care card (81.9%); and lower rates of serology tests – at least one – for syphilis (68.2%) and for HIV (69.2%) (Table 2).

For the non-incarcerated women of the *Birth in Brazil* study included in the current analysis, the prevalence of syphilis during pregnancy was estimated at 1.3% (95%CI: 1.0-1.6) and the prevalence of HIV infection at 0.5% (95%CI: 0.4-0.7). We estimated a mother to child transmission rate of syphilis of 36.8% (95%CI: 25.8-48.4) with an incidence of congenital syphilis of 4.6 for 1,000 living newborns (95%CI: 2.9-7.2). The estimated prevalence of syphilis during pregnancy for incarcerated women was 8.7% (95%CI: 5.7-13.1) and for HIV infection 3.3% (95%CI: 1.7-6.6). The estimated mother to child transmission of syphilis in incarcerated women was 66.7% (95%CI: 44.7-83.2), with the incidence of congenital syphilis being 58.1 per 1,000 living newborns (95%CI: 40.4-82.8). These results showed significant differences between free and incarcerated women (Table 2).

Among free women, those who were diagnosed with syphilis during pregnancy had a lower level of education; were in the majority of cases black or brown; less frequently lived with a partner; more frequently reported smoking during pregnancy; presented a higher suspicion of alcohol abuse; and

Table 1

Social, demographic and reproductive characteristics of women in the *Birth in Brazil* study and in the *Maternal and Infant Health in Prisons* study. Brazil, 2011-2014.

Maternal characteristics *	<i>Birth in Brazil</i> (free women) [n = 16,931] (%)	<i>Maternal and Infant Health in Prisons</i> (incarcerated women) [n = 241] (%)	p-value **
Age (years)			
< 20	2,134 (12.6)	6 (2.5)	< 0.001
20-34	13,162 (77.7)	220 (91.3)	
35 and over	1,636 (9.7)	15 (6.2)	
Level of schooling (years)			
< 8	4,985 (29.6)	128 (53.3)	< 0.001
8-10	4,688 (27.8)	82 (34.2)	
11-14	6,649 (39.4)	28 (11.7)	
15 and over	542 (3.2)	2 (0.8)	
Skin color (self-reported) ***			
White	4,903 (29.4)	68 (28.8)	0.352
Mixed	1,712 (10.3)	31 (13.1)	
Black	10,062 (60.3)	137 (58.1)	
Marital status			
Lives without partner	3,164 (18.7)	134 (55.6)	< 0.001
Lives with partner	13,752 (81.3)	107 (44.4)	
Smoking during pregnancy			
No	14,925 (88.2)	86 (36.1)	<0.001
Yes	2,006 (11.8)	152 (63.9)	
Alcohol use			
No	13,943 (84.4)	152 (65.2)	< 0.001
No suspect of abusive use	686 (4.2)	5 (2.1)	
Suspect of abusive use	1,883 (11.4)	76 (32.6)	
Number of previous pregnancies			
0	5,785 (34.2)	29 (12.0)	< 0.001
1 or 2	7,875 (46.5)	89 (37.0)	
3 and over	3,265 (19.3)	123 (51.0)	
Previous abortion #			
No	7,864 (70.6)	120 (56.6)	< 0.001
Yes	3,282 (29.4)	92 (43.4)	
Number of previous births			
0	6,598 (39.0)	41 (17.2)	< 0.001
1 or 2	7,966 (47.1)	106 (44.4)	
3 and over	2,366 (14.0)	92 (38.5)	
Previous preterm birth ##			
No	9,114 (88.2)	134 (76.6)	< 0.001
Yes	1,219 (11.8)	41 (23.4)	
Previous low birth weight ##			
No	8,908 (86.2)	134 (72.0)	< 0.001
Yes	1,426 (13.8)	52 (28.0)	

* Totals vary due to small number of missing data;

** Chi-square test ;

*** Women who self-reported as East Asian or Indigenous were excluded from this analysis (1.5% and 1.7% in the *Birth in Brazil* study and in the *Maternal and Infant Health in Prisons* study, respectively);

Women with previous pregnancies (*Birth in Brazil* study n = 11,146; *Maternal and Infant Health in Prisons* study n = 212);

Women with previous births (*Birth in Brazil* study n = 10,334; *Maternal and Infant Health in Prisons* study n = 198).

Table 2

Antenatal care, prevalence of syphilis and HIV infection, incidence of congenital syphilis and mother to child transmission of syphilis in women in the *Birth in Brazil* study and in the *Maternal and Infant Health in Prisons* study. Brazil, 2011-2014.

Maternal characteristics *	<i>Birth in Brazil</i> (free women) [n = 16,931] (%)	<i>Maternal and Infant Health in Prisons</i> (incarcerated women) [n = 241] (%)	p-value **
Antenatal care			
No	255 (1.5)	13 (5.4)	< 0.001
Yes	16,669 (98.5)	228 (94.6)	
Start of antenatal care ***			
Up to 12 th week	9,609 (58.1)	103 (48.1)	0.001
13 th to 28 th week	6,273 (37.9)	94 (43.9)	
> 28 th week	661 (4.0)	17 (7.9)	
Adequate number of consultations ***			
No	4,415 (27.0)	115 (52.0)	< 0.001
Yes	11,943 (73.0)	106 (48.0)	
Received an antenatal care card			
No	194 (1.2)	41 (18.1)	< 0.001
Yes	16,429 (98.8)	186 (81.9)	
Result from one syphilis serological test #			
No	1,489 (11.7)	34 (31.8)	< 0.001
Yes	11,241 (88.3)	73 (68.2)	
Result from one anti-HIV serological test #			
No	2,550 (20.0)	33 (30.8)	0.006
Yes	10,179 (80.0)	74 (69.2)	
Syphilis infection			
No	16,719 (98.7)	220 (91.3)	< 0.001
Yes	212 (1.3)	21 (8.7)	
HIV infection			
No	16,843 (99.5)	233 (96.7)	< 0.001
Yes	88 (0.5)	8 (3.3)	
Congenital syphilis ##			
No	16,967 (99.5)	227 (94.2)	< 0.001
Yes	78 (0.5)	14 (5.8)	
Mother to child transmission of syphilis ###			
No	134 (63.2)	7 (33.3)	0.008
Yes	78 (36.8)	14 (66.7)	

* Totals vary due to small number of missing data;

** Chi-square test;

*** Only women who received antenatal care;

Only women who presented an antenatal care card: *Birth in Brazil* study n = 12,730 (76.3%); *Maternal and Infant Health in Prisons* n = 107 (57.2%);

Incidence per 1,000 live births: *Birth in Brazil* study 4.6/1,000 and *Maternal and Infant Health in Prisons* 58.09/1,000;

Only women with diagnosis of syphilis in pregnancy: *Birth in Brazil* study (n = 212); *Maternal and Infant Health in Prisons* (n = 21).

had a higher number of pregnancies, abortions, and previous births, as well as a higher proportion of preterm and/or low birth weight newborns in previous births (Table 3). Free women diagnosed with syphilis during pregnancy also reported a later start of antenatal care and had a higher prevalence of

coinfection with HIV. All these differences were statistically significant (Table 4). Among incarcerated women, we observed no significant differences in maternal characteristics when comparing women according to the diagnosis of syphilis during pregnancy (Tables 3 and 4).

Table 3

Social, demographic and reproductive characteristics of women in the *Birth in Brazil* study and in the *Maternal and Infant Health in Prisons* study according to the diagnosis of syphilis infection during pregnancy. Brazil, 2011-2014.

Maternal characteristics *	<i>Birth in Brazil</i> (free women) [n = 16,931] (%)		p-value **	<i>Maternal and Infant Health in Prisons</i> (incarcerated women) [n = 241] (%)		p-value **
	Without syphilis [n = 16,719]	With syphilis [n = 212]		Without syphilis [n = 220]	With syphilis [n = 21]	
Age (years)						
18-34	15,106 (90.4)	189 (89.2)	0.566	208 (94.5)	18 (85.7)	0.131
35 and over	1,613 (9.6)	23 (10.8)		12 (5.5)	3 (14.3)	
Level of schooling (years)						
Up to 10	9,515 (57.1)	158 (74.9)	< 0.001	191 (87.2)	19 (90.5)	1.000
11 and over	7,138 (42.9)	53 (25.1)		28 (12.8)	2 (9.5)	
Skin color (self-reported) ***						
White	4,864 (29.5)	39 (18.8)	< 0.001	64 (29.6)	4 (20.0)	0.447
Black or mixed	11,605 (70.5)	169 (81.3)		152 (70.4)	16 (80.0)	
Marital status						
Lives without partner	3,104 (18.6)	60 (28.3)	0.001	121 (55.0)	13 (61.9)	0.648
Lives with partner	13,600 (81.4)	152 (71.7)		99 (45.0)	8 (38.1)	
Smoking during pregnancy						
No	14,775 (88.4)	150 (70.8)	< 0.001	81 (37.3)	5 (23.8)	0.245
Yes	1,943 (11.6)	62 (29.2)		136 (62.7)	16 (76.2)	
Alcohol use						
No suspect of abusive use	14,464 (88.7)	166 (83.0)	0.015	144 (67.9)	13 (61.9)	0.628
Suspect of abusive use	1,849 (11.3)	34 (17.0)		68 (32.1)	8 (38.1)	
Number of previous pregnancies						
0, 1 or 2	13,511 (80.8)	149 (70.3)	< 0.001	111 (50.5)	7 (33.3)	0.171
3 and over	3,202 (19.2)	63 (29.7)		109 (49.5)	14 (66.7)	
Previous abortion #						
No	7,776 (70.7)	88 (58.3)	0.001	111 (57.2)	9 (50.0)	0.623
Yes	3,220 (29.3)	63 (41.7)		83 (42.8)	9 (50.0)	
Number of previous births						
0, 1 or 2	14,402 (86.1)	162 (76.4)	< 0.001	138 (63.3)	9 (42.9)	0.098
3 and over	2,316 (13.9)	50 (23.6)		80 (36.7)	12 (57.1)	
Previous preterm birth ##						
No	8,999 (88.3)	115 (80.4)	0.004	124 (78.0)	10 (62.5)	0.212
Yes	1,191 (11.7)	28 (19.6)		35 (22.0)	6 (37.5)	
Previous low birth weight ##						
No	8,793 (86.3)	115 (80.4)	0.046	123 (72.8)	11 (64.7)	0.571
Yes	1,397 (13.7)	28 (19.6)		46 (27.2)	6 (35.3)	

* Totals vary due to small number of missing data;

** Chi-square test;

*** Women who self-reported as East Asian or Indigenous were excluded from this analysis (1.5% and 1.7% in the *Birth in Brazil* study and in the *Maternal and Infant Health in Prisons* study, respectively);

Women with previous pregnancies (*Birth in Brazil* study n = 11,146; *Maternal and Infant Health in Prisons* study n = 212);

Women with previous births (*Birth in Brazil* study n = 10,334; *Maternal and Infant Health in Prisons* study n = 198).

Table 4

Antenatal care and prevalence of HIV infection during pregnancy of women in the *Birth in Brazil* study and in the *Maternal and Infant Health in Prisons* study according to the diagnosis of syphilis infection during pregnancy. Brazil, 2011-2014.

Maternal characteristics *	<i>Birth in Brazil</i> (free women) [n = 16,931] (%)		p-value **	<i>Maternal and Infant Health in Prisons</i> (incarcerated women) [n = 241] (%)		p-value ***
	Without syphilis [n = 16,719]	With syphilis [n = 212]		Without syphilis [n = 220]	With syphilis [n = 21]	
	Antenatal care					
No	251 (1.5)	5 (2.4)	0.257	11 (5.0)	2 (9.5)	0.315
Yes	16,462 (98.5)	207 (97.6)		209 (95.0)	19 (90.5)	
Start of antenatal care ***						
Up to 12th week	9,507 (58.2)	102 (50.0)	0.022	98 (50.0)	5 (27.8)	0.086
13th and over	6,832 (41.8)	102 (50.0)		98 (50.0)	13 (72.2)	
Adequate number of consultations ***						
No	4,351 (26.9)	64 (31.1)	0.205	103 (51.0)	12 (63.2)	0.346
Yes	11,801 (73.1)	142 (68.9)		99 (49.0)	7 (36.8)	
Received an antenatal care card						
No	190 (1.2)	4 (2.0)	0.306	39 (18.8)	2 (10.5)	0.538
Yes	16,229 (98.8)	200 (98.0)		169 (81.3)	17 (89.5)	
Result from one syphilis serological test #						
No	1,472 (11.7)	17 (10.0)	0.542	30 (32.3)	4 (28.6)	1.000
Yes	11,087 (88.3)	153 (90.0)		63 (67.7)	10 (71.4)	
Result from one anti-HIV serological test #						
No	2,514 (20.0)	36 (21.2)	0.706	30(32.3)	3 (21.4)	0.543
Yes	10,046 (80.0)	134 (78.8)		63 (67.7)	11 (78.6)	
HIV infection						
No	16,637 (99.5)	205 (96.7)	< 0.001	214 (97.3)	19 (90.5)	0.147
Yes	81 (0.5)	7 (3.3)		6 (2.7)	2 (9.5)	

* Totals vary due to small number of missing data;

** Chi-square test;

*** Only women who received antenatal care;

Only women who presented an antenatal care card: *Birth in Brazil* study n = 12,730 (76.3%); *Maternal and Infant Health in Prisons* study n = 107 (57.2%).

Discussion

This is the first Brazilian study to estimate the national prevalence of syphilis and HIV infection during pregnancy in incarcerated women, as well as the mother to child transmission of syphilis and the incidence of congenital syphilis in births during incarceration. The availability of the results of a national study with free women, carried out at practically the same time, using the same methodological procedures for data collection and identification of cases, allowed the comparison of the data of these two groups.

The prevalence of HIV infection during pregnancy in incarcerated women estimated by this study (3.3%) was lower than findings reported by Miranda et al.¹⁴ (9.9%), Lopes et al.¹⁵ (14.5%), and Strazza et al.¹⁶ (13.9%), in studies carried out in Brazil in the early 2000s, but similar to results in more recent studies conducted by Berra et al.¹⁷ (3.6%) and Sgarbi et al.³ (1.9%). A reduction in the prevalence of HIV infection for incarcerated men has also been reported in recent studies^{3,13}, although it remained higher than in free men.

The estimated prevalence of syphilis during pregnancy in incarcerated women (8.7%) was lower than the prevalence of syphilis in incarcerated women reported by Miranda et al.¹⁴ (16%), Strazza et

al. ¹⁶ (22.8%) and Sgarbi et al. ³ (17%), but higher than that reported by Lopes et al. ¹⁵ (5.7%) and Berra et al. ¹⁷ (3%). Differences between the studies related to the definitions of syphilis cases and the use of treponemal and/or non-treponemal tests may explain some of the differences found in terms of the prevalence of syphilis infection.

The estimated prevalence of syphilis and HIV infection in pregnancy in incarcerated women was almost 7 times greater than that found in free women. A greater prevalence of syphilis infection in incarcerated women was also reported in a systematic review of studies undertaken across the period from 1996 to 2010 ². Studies carried out in Peru ²⁰, Mexico ⁶, and the USA ⁷ found an elevated prevalence of syphilis and HIV infection in incarcerated women.

In this study, incarcerated women showed greater social vulnerability, with lower levels of education, less support from their partner, and greater exposure to risk factors such as smoking and alcohol consumption when compared with free women. Previous studies had already demonstrated worse social conditions ^{3,15,20,26}, the elevated prevalence of smoking ^{6,15,26,27}, alcohol and drug use ^{15,21,26,27} and mental disturbances ²⁷ in incarcerated women.

Incarcerated women also showed a greater number of pregnancies, births and abortions, whilst negative outcomes were more frequent during previous pregnancies. These pregnant women would benefit most from adequate antenatal care, which would allow the identification of risk situations, diagnosis and treatment of infection, educational initiatives, and adequate management of clinical complications. However, incarcerated women showed worse results in all the evaluated antenatal indicators. The main strategy to prevent the mother to child transmission of syphilis and HIV infections is the diagnosis and treatment of infected women during pregnancy ²⁸. The inadequate antenatal care received by incarcerated women resulted in poorer pregnancy outcomes: a mother to child transmission of syphilis two times higher in incarcerated women than in free women and an incidence of congenital syphilis 12.6 times higher at birth.

Studies carried out in other countries also showed low quality antenatal care for incarcerated women ^{26,29,30,31}. In Australia, a study found that being pregnant whilst incarcerated was the main predictor for a negative perinatal outcome, showing the inequality of health outcomes for this population ³¹. Researchers have described the inadequate health care provided in prisons, with low access to serological diagnosis of sexually transmittable diseases ^{3,17}; lack of knowledge and treatment of these infections ^{3,16,21}; and a low rate of implementation of preventative measures, including immunisation and harm minimisation measures ¹³. Health care in prisons has been recognised as a central item on the public health agenda and as a right of incarcerated individuals ^{2,4,6,7}, with adequate antenatal and birth care being part of this agenda ^{24,32}.

There are few studies regarding the experiences and results of pregnancy in incarcerated women and few studies evaluating the effectiveness of interventions to improve the wellbeing of these women and their infants over the short and long term ^{33,34}. The few available studies show a positive association between the number of prenatal care consultations among women entering prison during the first trimester of pregnancy and infant birth weight ³⁵, the cost effectiveness of testing for HIV in incarcerated pregnant women ³⁶, the applicability of strategies that ensure opportune diagnosis and treatment of syphilis with a reduction in the number of cases of congenital syphilis ³⁷, and lower rates of preterm births and c-sections in women receiving enhanced prison care when compared to women receiving usual care ³⁴. Clinical guidelines focusing on pregnancy in incarcerated women are available and underline the specific needs of these women ³⁸. Recent studies have also reported and evaluated new strategies and organization of services ^{34,39,40,41} indicating new possibilities for action in prisons.

For free women, syphilis infection was associated with social vulnerability. Infected women had lower levels of education; self reported as black or brown in higher proportions; more frequently lived without a partner; had greater exposure to smoking and alcohol; had a greater number of previous pregnancies, births, abortions, and prior negative birth outcomes; had a greater prevalence of HIV infection; and a later initiation of antenatal care. Previous studies had already identified greater social vulnerability among free women with syphilis ^{42,43} and/or HIV ⁴⁴ infection.

However, in incarcerated women we observed no difference in women characteristics according to syphilis infection. Although women diagnosed with syphilis were more likely to have HIV, to have smoked and used alcohol during pregnancy, and to have had less antenatal care when compared with

incarcerated women who were not diagnosed with syphilis, these differences were not statistically significant. It is possible that the study was not of a large enough size to detect significant differences due to the small number of cases of syphilis during pregnancy ($n = 21$) identified in prisons. Previous studies in prisons identified associations of syphilis infection with the age of the woman (higher in women of more than 40 years of age), with black skin color, with imprisonment for prostitution or sexual crimes⁴, and with fewer years of education². An alternative explanation, however, is that the prison population in general is more socially vulnerable and that the presence of syphilis in these women is not an indicator of who is the most vulnerable.

This study presents some limitations. The *Birth in Brazil* study included neither home births nor births that occurred in maternity hospitals with less than 500 births/year. As more than 80% of births in Brazil take place in maternity hospitals with more than 500 births/year, we expect no significant changes in the results presented here. The study *Maternal and Infant Health in Prisons* included women with children younger than one year of age and it was not possible to rule out a possible survivor bias, in cases where women and babies had died or been freed from prison after birth but before the study was carried out. Data regarding these potential losses is not available and it is not possible to estimate the direction of the bias, if these losses did in fact occur. Considering that the study performed a census of the prison population, the present data represents the best national estimate possible for incarcerated women aged over eighteen years.

Contrarily to other national and international studies, we calculated the prevalence estimates for syphilis and HIV infection using secondary data recorded on antenatal cards and hospital records, as opposed to collecting blood in order to perform serological exams for syphilis and HIV. It is possible that we underestimated cases of syphilis and HIV infection if medical records were inaccurate. However, we collected information from a number of sources including antenatal cards and hospital records for mothers and newborns, with the intention of minimizing the loss. On the other hand, we may have overestimated the number of recorded cases of syphilis, given that we considered any reagent serological test as evidence of infection and we may have classified past infections as active syphilis during pregnancy. Although these limitations affect the comparison of the results presented in this study with other national and international studies that used different methodologies, the comparison between incarcerated and free pregnant women was not affected. Both the *Birth in Brazil* and the *Maternal and Infant Health in Prisons* studies used the same case definitions and data collection methods allowing for the comparisons presented in this article.

In both studies, we excluded cases of miscarriage. In the study carried out in prison, data on cases of foetal mortality after the 22nd week of gestation were not available. These exclusions could have underestimated the incidence of congenital syphilis, given that syphilis can lead to miscarriage and late foetal loss. The exclusion of stillbirths from the study conducted in prisons may have also attenuated the differences in prevalence of syphilis during pregnancy and incidence of congenital syphilis between incarcerated and free women.

We defined cases of congenital syphilis when there was a record of this diagnosis in the newborn records or as a cause of foetal/neonatal death. These criteria are different from those currently used by the Brazilian Ministry of Health, which also include data concerning the treatment of pregnant women and the partner when defining cases of congenital syphilis. The use of different criteria limits the comparison of the data of this study with cases reported in the Brazilian Information System for Notifiable Diseases (SINAN) and with studies that used the same case definition as the Brazilian Ministry of Health. However, this did not affect the comparison of the incidence of congenital syphilis in incarcerated and free women, given that both studies used the same case definitions.

Finally, it was not possible to verify the maternal characteristics associated with HIV infection due to the small number of cases of HIV infection identified amongst incarcerated women ($n = 8$) and the absence of relevant maternal characteristics for the study in terms of HIV infection, such as the use of condoms and drug use^{13,45,46}. Future studies are necessary to enhance our knowledge regarding incarcerated pregnant women.

Conclusion

The results of this study showed that incarcerated women with children younger than one year old, when compared with free mothers, exhibited higher levels of social vulnerability, higher prevalence of syphilis and HIV infection during pregnancy, and lower quality of antenatal care, resulting in elevated rates of mother to child transmission of syphilis and high incidence of congenital syphilis. Syphilis infection showed to be associated with social vulnerability in free women, but not in incarcerated women.

Adequate antenatal and birth care, with opportune diagnosis and treatment of infected pregnant incarcerated women, is essential for the reduction of maternal morbidity and mortality³² and the prevention of mother to child transmission of syphilis and HIV infections. Other health initiatives in the prison environment should be implemented, including the provision of tests for the diagnosis of pregnancy and sexually transmitted diseases, and the continuity of healthcare in services within and outside prison. This would seek to ensure that incarcerated populations have access to the same quality of healthcare as that given to free populations, according to national^{47,48} and international³² recommendations, with the consequent reduction of healthcare inequalities.

Contributors

R. M. S. M. Domingues, M. C. Leal, A. P. Esteves-Pereira and B. Ayres designed the study, analyzed and interpreted the data, wrote, revised, read and approved the final version of the manuscript. A. R. Sanches revised, read and approved the final version of the manuscript. B. Larouzé revised, read and approved the final version of the manuscript.

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Resumo

O estudo teve como objetivos estimar a prevalência de infecção de sífilis e HIV na gravidez, transmissão vertical de sífilis e incidência de sífilis congênita em filhos de mulheres encarceradas no Brasil, comparar as taxas com aquelas observadas em gestantes não encarceradas e verificar os fatores maternos associados à sífilis gestacional em mulheres encarceradas e não encarceradas. Usamos os dados de dois inquéritos nacionais realizados entre 2011 e 2014. O estudo Nacer no Brasil incluiu 23.894 mulheres não encarceradas atendidas em 266 hospitais. O estudo sobre Saúde Materno-Infantil nas Prisões do Brasil incluiu 495 mulheres encarceradas, entre gestantes e mães vivendo com seus filhos, de acordo com um censo realizado em 33 presídios femininos. Os dois estudos usaram a mesma definição de casos e os mesmos métodos de coleta de dados. O teste do qui-quadrado foi utilizado para comparar as características das mães encarceradas e não encarceradas, com significância definida em $p < 0,05$. Nas mulheres encarceradas, a prevalência estimada de sífilis gestacional era 8,7% (IC95%: 5,7-13,1) e para infecção pelo HIV era 3,3% (IC95%: 1,7-6,6); a taxa de transmissão vertical da sífilis foi 66,7% (IC95%: 44,7-83,2) e a incidência de sífilis congênita foi 58,1 por 1.000 nascidos vivos (IC95%: 40,4-82,8). As mulheres encarceradas mostraram uma prevalência mais alta de sífilis e de infecção pelo HIV durante a gravidez, pior qualidade de atendimento pré-natal e níveis mais elevados de vulnerabilidade social, quando comparadas às mulheres não encarceradas. A sífilis mostrou ser indicador de vulnerabilidade social em mulheres não encarceradas, mas não em mulheres encarceradas. Os achados destacam a importância de iniciativas nas prisões para reduzir as desigualdades na assistência à saúde e de cuidados adequados durante o período pré-natal e parto.

Sífilis; HIV; Transmissão Vertical de Doença Infecciosa; Prisões

Resumen

Los objetivos del estudio fueron estimar la prevalencia de infección de sífilis y VIH en el embarazo, la transmisión vertical de sífilis y la incidencia de sífilis congénita en hijos de mujeres encarceradas en Brasil, además de comparar las tasas con las observadas en gestantes no encarceradas y verificar los factores maternos asociados a la sífilis gestacional en mujeres encarceradas y no encarceradas. Usamos los datos de dos encuestas nacionales, realizadas entre 2011 y 2014. El estudio Nacer en Brasil incluyó a 23.894 mujeres no encarceradas, atendidas en 266 hospitales. El estudio sobre Salud Materno-Infantil en las Prisiones de Brasil incluyó a 495 mujeres encarceradas, entre gestantes y madres, viviendo con sus hijos, de acuerdo con un censo realizado en 33 presidios femeninos. Los dos estudios usaron la misma definición de casos y los mismos métodos de recogida de datos. El test del chi-cuadrado se utilizó para comparar las características de las madres encarceradas y no encarceradas, con significancia definida en $p < 0,05$. En las mujeres encarceradas, la prevalencia estimada de sífilis gestacional era 8,7% (IC95%: 5,7-13,1) y para infección por VIH era 3,3% (IC95%: 1,7-6,6); la tasa de transmisión vertical de la sífilis fue 66,7% (IC95%: 44,7-83,2) y la incidencia de sífilis congénita fue 58,1 por 1.000 nacidos vivos (IC95%: 40,4-82,8). Las mujeres encarceradas mostraron una prevalencia más alta de sífilis y de infección por VIH durante el embarazo, peor calidad de atención prenatal y niveles más elevados de vulnerabilidad social, cuando se comparan con las mujeres no encarceradas. La sífilis mostró ser un indicador de vulnerabilidad social en mujeres no encarceradas, pero no en no mujeres encarceradas. Los hallazgos destacan la importancia de iniciativas en las prisiones para reducir las desigualdades en la asistencia a la salud y de cuidados adecuados durante el período prenatal y parto.

Sífilis; VIH; Transmisión Vertical de Enfermedad Infecciosa; Prisiones

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