Maternal and congenital syphilis attributable to ethnoracial inequalities: a national record-linkage longitudinal study of 15 million births in Brazil

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Summary

Background This study estimated ethnoracial inequalities in maternal and congenital syphilis in Brazil, understanding race as a relational category product of a sociopolitical construct that functions as an essential tool of racism and its manifestations.

Methods We linked routinely collected data from Jan 1, 2012 to Dec 31, 2017 to conduct a population-based study in Brazil. We estimated the attributable fraction of race (skin colour) for the entire population and specific subgroups compared with White women using adjusted logistic regression. We also obtained the attributable fraction of the intersection between two social markers (race and education) and compared it with White women with more than 12 years of education as the baseline.

Findings Of 15 810 488 birth records, 144 564 women had maternal syphilis and 79 580 had congenital syphilis. If all women had the same baseline risk as White women, 35% (95% CI 34·89–36·10) of all maternal syphilis and 41% (40·49–42·09) of all congenital syphilis would have been prevented. Compared with other ethnoracial categories, these percentages were higher among Parda/Brown women (46% [45·74–47·20] of maternal syphilis and 52% [51·09–52·93] of congenital syphilis would have been prevented) and Black women (61% [60·25–61·75] of maternal syphilis and 67% [65·87–67·60] of congenital syphilis would have been prevented). If all ethnoracial groups had the same risk as White women with more than 12 years of education, 87% of all maternal syphilis and 89% of all congenital syphilis would have been prevented.

Interpretation Only through effective control of maternal syphilis among populations at higher risk (eg, Black and Parda/Brown women with lower educational levels) can WHO's global health initiative to eliminate mother-to-child transmission of syphilis be made feasible. Recognising that racism and other intersecting forms of oppression affect the lives of minoritised groups and advocating for actions through the lens of intersectionality is imperative for attaining and guaranteeing health equity. Achieving health equality needs to be addressed to achieve syphilis control. Given the scale and complexity of the problem (which is unlikely to be unique to Brazil), structural issues and social markers of oppression, such as race and education, must be considered to prevent maternal and congenital syphilis and improve maternal and child outcomes globally.

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Introduction

Despite international efforts to eliminate congenital syphilis as a public health concern, it has remained endemic in several low-income and middle-income countries, with the highest rates observed in the African and Eastern Mediterranean region, and has increased rates in high-income countries, including the USA, Canada, and Australia.[1–3] When untreated, maternal syphilis can result in adverse maternal and neonatal outcomes, including stillbirths, low birthweight, long-term neurodevelopmental disorders, and neonatal death.[4–6] However, neither maternal nor congenital syphilis is distributed in the population equally, with higher risk of the disease being associated with different social markers of vulnerability.[6–9]

A growing body of literature has reported ethnoracial inequities regarding maternal and child outcomes.[5,10,11] Studies on racial inequities in health are based on the history of oppression and ethnoracial hierarchies faced by Brown, Black, and Indigenous individuals over many years, and the systematic racial discrimination faced until the present day.[12–14] Racial categories are not biologically meaningful; they have become an indelible marker for overlapping experiences of racialisation and the historical, political, and social processes that shape daily lives.[12,13,15] Therefore, racism is considered the driver of racial health inequities in society since, historically, the enterprise of racial categorisation has been in the service of racism.[12,13,16,17] By definition, racism is an institutionalised system of oppression that hierarchises

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For the Portuguese translation of the abstract see **Online** for appendix 1

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Research in context

Evidence before this study

Racism is a health determinant that can lead to several poor maternal and child outcomes. However, evidence regarding the role and magnitude of ethnoracial inequities in the risk and burden of maternal and congenital syphilis is scarce. We searched published PubMed articles from database inception to Feb 18, 2023, using the search terms "racial disparities AND gestational syphilis or congenital syphilis". Our research identified 11 papers. One study highlighted the ethnoracial disparities in access to syphilis screening among non-Hispanic Black women. There was no estimation of the burden of maternal and congenital syphilis attributed to ethnoracial inequalities.

Added value of this study

This study involving more than 15 million births in Brazil found that a substantial proportion of maternal and congenital syphilis would not have occurred if all women had the same risk as White women. The largest increases in the risk of maternal and congenital syphilis occurred among Black and Parda/Brown populations. We also observed an especially high risk for maternal and congenital syphilis for the intersection between low educational levels and Black women. Black women and Parda/Brown women were also less likely to receive adequate treatment and were diagnosed later than their White counterparts.

Implications of all the available evidence

This study sheds light on ethnoracial inequities in the burden of maternal and congenital syphilis among Black and Parda/Brown women and their offspring in Brazil. Thus, our findings reinforce the importance of prioritised structural interventions, focusing on health equity to achieve the 2007 WHO goal of worldwide mother-to-child syphilis transmission elimination by 2030. Only by addressing racism and the other forms of oppression through the lens of intersectionality might it be possible to dismantle the oppression system that harms the health and wellbeing of Black and Parda/Brown women, prevent maternal and congenital syphilis, and improve child and maternal health outcomes.

people on the basis of their race or ethnicity.[12,13,16] Racism shapes the unequal distribution of key social determinants of health, such as socioeconomic resources, health care, and housing, which tends to harm the health and life conditions of oppressed individuals.[12,16,17]

Despite previous studies pointing out how racism and its manifestation deepen inequities in living conditions,[14,17] seeking of health-care services,[11,14,18] and risks of pregnancy-related complications,[5,11,19] there is a dearth of studies on the contribution of ethnoracial inequities to the burden of maternal and congenital syphilis, despite the acknowledgment of the higher prevalence of the diseases among Black and Brown women than White women.[7,8,20] Research aimed to understand the ethnoracial inequities related to syphilis during pregnancy is crucial to identifying structural and contextual social determinants of health embedded within the disease and developing effective preventive measures and treatment strategies to reduce the incidence and effect of these infections on maternal and child health. Ultimately, this study aims to contribute to the WHO global health initiative to eliminate mother-to-child transmission of syphilis.[3]

In this study, we are guided by the framework (appendix 2 p 2) of racism,[12,16,21] which understands race as a historically sociopolitical construct that functions as an essential tool of racism and its manifestations until the present day.[12,13,15] Race as a construct assigns a hierarchy of value to humans, concentrating power and resources among privileged groups (such as White people) at the expense of marginalised groups such as Black, Parda/Brown, and Indigenous people.[12,15] This study aims to estimate the burden of maternal and congenital syphilis attributed to ethnoracial inequities in Brazil, leveraging data from more than 15 million births.

See Online for appendix 2

Methods

Study design

We conducted a population-based study, including all singleton livebirths in Brazil from Jan 1, 2012 to Dec 31, 2017. The Brazilian Live Births Information System (SINASC) covers more than 90% of all births in the Brazilian territory and records data from the Declaration of Live Births, a legal document completed by the health worker who has assisted the delivery.[22] SINASC records include maternal information (eg, mother's name, place of residence, age, marital status, race and skin colour, education, and obstetric history), pregnancy information (eg, length of gestation and type of delivery) and characteristics of the neonate (eg, multiples, birthweight, and presence of congenital anomalies).

We obtained information about maternal and congenital syphilis from the Information System for Notifiable Disease (SINAN-Syphilis). In Brazil, the registration of suspected maternal and congenital syphilis is compulsory. The maternal syphilis form records information about the pregnant person, the clinical classification of syphilis (eg, primary, secondary, latent, and tertiary), treatment, and laboratory confirmation. The congenital syphilis form records data on the newborn (eg, laboratory tests, symptoms, and treatment) and maternal information (eg, treatment, timing of maternal diagnosis, and partner treatment).

Livebirth records from SINASC were linked with SINAN records for maternal syphilis and for congenital syphilis separately. Name, date of birth, or age and

residence of the mother were used as matching variables. The linkage was performed with a novel record-linkage tool developed to link large-scale administrative datasets at the Center of Data and Knowledge Integration for Health (CIDACS), called CIDACS-Record Linkage. We applied a combination of indexing and searching algorithms[23] to identify which records from SINAN-Syphilis were most similar to each record in SINASC and submitted them to a pairwise comparisons step. Candidate linking records were ordered by the scores, and only the comparison pair with the highest score was retained as a potential link. All remaining candidate records were discarded. Details about linkage are discussed by Barbosa and colleagues.[23] Analysis of the linkage accuracy included manual verification of a randomly selected sample of records assessing the receiver operating characteristics curve of sensitivity and specificity indexes. In the linkage between SINASC–SINAN maternal syphilis, the sensitivity was 95% and specificity 91%. For the linkage between SINASC–SINAN congenital syphilis, the sensitivity was 93% and specificity 98% (appendix 2 p 6). Linkage procedures were conducted at CIDACS in a strict data protection environment and according to ethical and legal rules.[24]

Procedures

All singleton livebirths with information on maternal race (skin colour) during the study period were eligible. We excluded records without information on gestational age at birth, since we used this variable to estimate the conception date. To investigate maternal syphilis as an outcome, we excluded records with notification dates before conception or after the puerperium period. To investigate congenital syphilis as an outcome, we excluded records notified more than 2 months before birth (since maternal syphilis can still be treated at this stage), records notified more than 3 years after birth, records of suspected congenital syphilis that was ruled out after routine epidemiological investigation, and records of fetal loss.

In this study, we use maternal race (skin colour) from SINASC as our main analytical category. In Brazil, maternal race (skin colour) is self-declared and encompasses five categories (Black, Parda/Brown, Indigenous, Asian descent, and White).[25] The analyses presented here used White women as the reference group, understanding that historically and until the present day they are part of the group that most benefited from the power and resources from the societal and economic structure rooted in racism.

To capture the intersection of more than one oppression marker (and because racism reduces educational opportunities and deepens social vulnerability), we evaluated the intersection between maternal race and maternal educational level using the intersectionality framework, which recognises that individual characteristics intersect with systems and structures to construct identities and shape lived experiences as situated in interlocking systems of inequality.[26] Education level was categorised as 0–3 years, 4–7 years, 8–12 years, or more than 12 years of education. The variable that intersects race and education was categorised by the product of these two variables creating a new variable with 20 categories.

Outcomes

In Brazil, women who meet one or more of the following criteria during prenatal care, childbirth, or the puerperium period should be reported as having maternal syphilis: asymptomatic women with at least one reagent laboratory test for syphilis without previous treatment; symptomatic women with at least one reagent laboratory test for syphilis independent of previous treatment; or women with non-treponemal and treponemal reagent tests independent of treatment and symptoms.

In this study, we defined cases of maternal syphilis as any record from SINAN linked with a record of singleton livebirth from SINASC for which the syphilis notification from SINAN occurred between the livebirth conception date and the puerperium period. We defined maternal syphilis as women whose livebirths were linked with a record of congenital syphilis.

Individuals who meet one or more of the following criteria should be reported as a case of congenital syphilis: livebirths from mothers with untreated or inadequately treated syphilis; children with microbiological evidence of *Treponema pallidum* in a nasal discharge or skin lesion, child biopsy, or autopsy; or children younger than 13 years with at least one of the following situations: clinical, cerebrospinal fluid, or radiological manifestation of congenital syphilis and a reagent non-treponemal test; infants (younger than 1 year) with non-treponemal test titres greater than the maternal titres in at least two dilutions; children with ascending non-treponemal test titres in at least two dilutions; titres of non-treponemal tests that are still positive in a child older than 6 months who was adequately treated in the neonatal period; or a positive treponemal test in a child aged 18 months, without previous diagnose of congenital syphilis.

We considered cases of congenital syphilis as all records from SINAN linked with a record of singleton livebirth from SINASC for which the syphilis notification from SINAN occurred less than 2 months before birth and no more than 3 years after birth.

As secondary outcomes, we analysed the timing of maternal syphilis diagnosis (prenatally or during or after birth), adequacy of maternal treatment (adequate or inadequate or not treated) and partner treatment (treated or not treated). According to the Brazil Ministry of Health,[27] adequate treatment involves following the complete regimen recommended for the clinical phase of syphilis, starting more than 30 days before the delivery, and the maternal titres need to have dropped in response

to treatment. For these variables we used the information recorded on the congenital syphilis form.

Statistical analysis

Descriptive statistics are presented by maternal ethnoracial group. Women racialised as White were considered as the reference group (or the non-exposed group) throughout the analysis. We applied the risk of maternal or congenital syphilis in this group to the entire study population or to specific ethnoracial groups to estimate the expected number of women with maternal and congenital syphilis. Attributable fraction was defined as the proportion of risk among an exposed group that is attributable to exposure.[28] Therefore, the attributable fractions estimated in this study describe the proportion of maternal and congenital syphilis that would not have occurred if the risk of the outcomes were the same as among women racialised as White. The attributable fraction can compare the reference group either with the entire population (ie, population attributable fraction [PAF]), or with a specific racial group (ie, exposed-population attributable fraction).[29]

We used the results of a logistic regression model to calculate the attributable fractions and PAFs. The model accounted for confounding of year of birth, maternal region of residence, maternal age, and marital status. Results were obtained using the punaf function of Stata version 15.0, whose details are provided by Newson.[29] In scenarios with multicategory exposure when confounding exists—and as a result, adjusted odds ratios (aORs) must be used—such a function can provide internally valid estimates for the PAF and attributable fraction.[30] The 95% CIs for the attributable fractions were estimated on the log scale. Unadjusted attributable fractions refer to those estimated using the entire study population and adjusted attributable fractions refer to those estimated after excluding missing values from the data.

To understand the intersection between race and education, we estimated the attributable fraction of maternal and congenital syphilis considering White women with more than 12 years of education as the reference group (ie, the group with more social benefits and privileges).

Finally, we used logistic regression models adjusted for year of birth, maternal age, marital status, and region of residence to evaluate the association of maternal race, timing of maternal syphilis diagnosis, and adequacy of treatment and partner's treatment.

This study analysed de-identified data and was approved by the Research Ethics Committee of the Federal University of Bahia Institute of Health Collective Research Ethics Committee (18022319.4.0000.5030). This study is reported as per the reporting of studies conducted using observational routinely collected health data (RECORD) guideline.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

We identified 17 587 979 livebirth records in Brazil during Jan 1, 2012 to Dec 31, 2017, 15 858 090 (90·16%) of which were singleton births with complete information on maternal ethnoracial group and gestational age at birth. After excluding livebirths linked with a syphilis record that occurred before the conception date or after the puerperium period, 15 810 488 records were included in the study (figure 1). Of those, 144 564 had maternal syphilis and 79 580 had congenital syphilis. The characteristics of the study population are reported in table 1. In general, White and Asian women were older, more educated, more likely to be married, and had more antenatal care appointments than other ethnoracial groups.

The proportion of maternal syphilis in the study population was 0·91%. This percentage varied greatly according to the ethnoracial group of the mother, ranging from 0·56% among Indigenous women, 0·64% among White women, and 1·71% among Black women. After adjustment, the PAF using White women as the reference group was 35·50% (95% CI 34·89–36·10). Attributable fractions for maternal syphilis were substantially increased among Parda/Brown women (46·47% [45·74–47·20]) and Black women (61·01% [60·25–61·75]; table 2).

The proportion of congenital syphilis in the study population was 0·50%, and varied greatly according to ethnoracial categories: 0·26% among livebirths

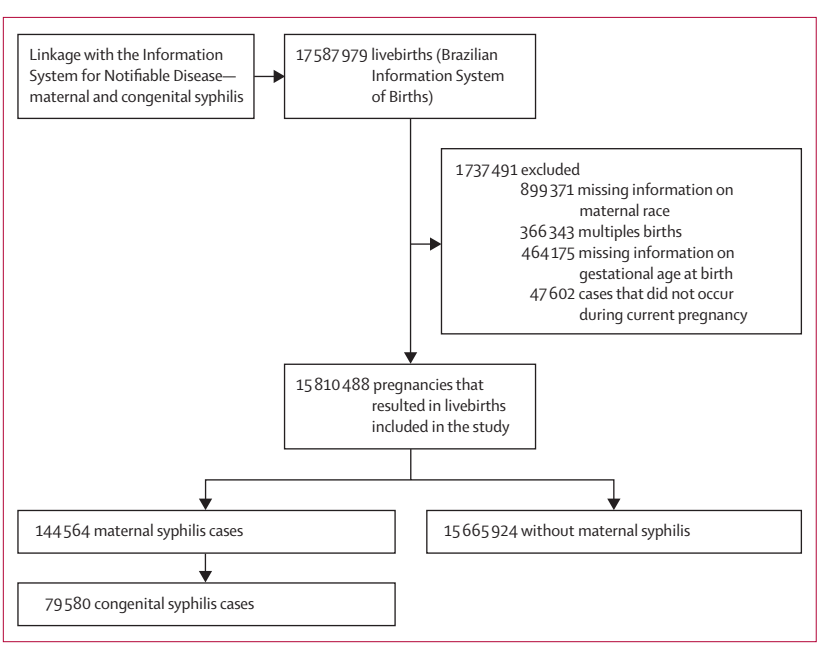

Figure 1: **Study profile**
Flow chart study population, Brazil (Jan 1, 2012 to Dec 31, 2017).

	White	Asian	Parda/Brown	Black	Indigenous
Maternal age					
<20 years	796 083 (13·35%)	8522 (13·35%)	1 899 967 (21·61%)	151 276 (17·47%)	35 961 (29·22%)
20–34 years	4 227 871 (70·87%)	43 805 (68·60%)	5 976 775 (67·98%)	602 057 (69·54%)	74 793 (60·77%)
≥35 years	941 428 (15·78%)	11 526 (18·05%)	915 425 (10·41%)	112 460 (12·99%)	12 324 (10·01%)
Missing data	11	0	42	2	160
Marital status					
Single	2 114 131 (35·59%)	22 460 (35·41%)	3 905 490 (44·74%)	445 035 (51·76%)	50 663 (41·96%)
Widow	10 373 (0·17%)	442 (0·70%)	14 877 (0·17%)	2271 (0·26%)	291 (0·24%)
Divorced	92 529 (1·56%)	877 (1·38%)	71 514 (0·82%)	7804 (0·91%)	363 (0·30%)
Married or union	3 722 488 (62·67%)	39 658 (62·52%)	4 736 864 (54·27%)	404 686 (47·07%)	69 416 (57·50%)
Missing data	25 872	416	63 464	5999	2505
Maternal education					
0–3 years	90 111 (1·52%)	1537 (2·44%)	393 847 (4·55%)	41 735 (4·88%)	29 207 (24·93%)
4–7 years	727 871 (12·30%)	8366 (13·30%)	2 048 024 (23·64%)	203 004 (23·72%)	38 765 (33·09%)
8–12 years	3 296 129 (55·71%)	32 524 (51·71%)	5 329 309 (61·52%)	520 229 (60·79%)	45 339 (38·70%)
>12 years	1 802 978 (30·47%)	20 470 (32·55%)	891 334 (10·29%)	90 750 (10·61%)	3845 (3·28%)
Missing	48 304	956	129 695	10 077	6082
Number of prenatal appointments					
0–3	272 968 (4·60%)	4302 (6·77%)	881 462 (10·09%)	90 457 (10·53%)	32 767 (26·83%)
4–6	508 659 (8·57%)	7370 (11·60%)	1 402 919 (16·06%)	131 206 (15·28%)	32 008 (26·21%)
≥7	5 153 098 (86·83%)	51 875 (81·63%)	6 453 626 (73·86%)	637 208 (74·19%)	57 357 (46·96%)
Missing data	30 668	306	54 202	6924	1106
Birth region					
North	143 421 (2·40%)	3654 (5·72%)	1 424 377 (16·20%)	38 904 (4·49%)	66 912 (54·35%)
Northeast	562 023 (9·42%)	13 677 (21·43%)	3 429 276 (39·01%)	223 138 (25·77%)	16 980 (13·79%)
Southeast	3 075 116 (51·56%)	34 316 (53·76%)	2 838 678 (32·29%)	461 399 (53·29%)	10 870 (8·83%)
South	1 822 058 (30·55%)	4664 (7·31%)	299 332 (3·40%)	93 634 (10·82%)	8247 (6·70%)
Northwest	361 943 (6·07%)	7520 (11·78%)	799 443 (9·09%)	48 697 (5·62%)	20 101 (16·33%)
Missing data	832	22	1103	23	128
Mode of delivery					
Vaginal	1 980 987 (33·22%)	27 012 (42·34%)	4 437 439 (50·51%)	442 417 (51·14%)	99 001 (80·43%)
Caesarean section	3 981 548 (66·78%)	36 790 (57·66%)	4 347 337 (49·49%)	422 705 (48·86%)	24 091 (19·57%)
Missing data	2858	51	7433	673	146

Data shown are frequency (%).

Table 1: **Baseline characteristics of singleton livebirths in the cohort-linked data by maternal race status**

from Indigenous women, 0·31% among livebirths from White women, and 1·02% among livebirths from Black women. After adjustment, the PAF to ethnic group (using White women as the reference group) was 41·30% (95% CI 40·49–42·09). Attributable fractions for congenital syphilis were substantially increased among livebirths of Parda/Brown women (52·02% [51·09–52·93]) and Black women (66·75% [65·87–67·60]; table 2).

PAFs for maternal and congenital syphilis were especially high for the intersection between maternal race and education level ($PAF_{maternal\ syphilis}$=86·67%; $PAF_{congenital\ syphilis}$=89·03%). An increased chance of maternal and congenital syphilis was observed with decreased years of maternal education. Among women in the most educated group, the risk of maternal and congenital syphilis might be reduced by more than 58% if Parda/Brown, Black, and Indigenous women had the same baseline risk as their White counterparts. Less educated women and Black women had the highest attributable fractions for both outcomes, reaching approximately 96% (figure 2).

Parda/Brown and Black women were more likely to have been inadequately treated or not treated for maternal syphilis ($aOR_{Parda/Brown}$ 1·10 [95% CI 1·01–1·24]; aOR_{Black} 1·23 [1·07–1·41]), more likely to have been diagnosed during or after delivery ($aOR_{Parda/Brown}$ 1·13 [1·08–1·17]; aOR_{Black} 1·17 [1·11–1·24]), and their partners were less likely to have been treated for syphilis ($aOR_{Parda/Brown}$ 1·11 [1·05–1·17]; aOR_{Black} 1·11 [1·03–1·20]) compared with their White counterparts (table 3).

Discussion

In this study of more than 15 million births, 35% of syphilis cases during pregnancy and

	Number of individuals in each group	Observed number of individuals with the outcome	Proportion of the outcome	Number of individuals with outcome if rate the same as reference group	Attributable fraction (95% CI)	Adjusted* attributable fraction (95% CI)	Adjusted* PAFs (95% CI)
Syphilis during pregnancy							
White	5 965 393	37 895	0·64%	37 895	1 (ref)	1 (ref)	NA
Asian	63 853	400	0·63%	406	−1·40 (−11·87 to 8·07)	13·13 (4·15 to 21·27)	NA
Parda/Brown	8 792 209	90 737	1·03%	55 852	38·44 (37·70 to 39·17)	51·70 (51·04 to 52·34)	NA
Black	865 795	14 836	1·71%	5500	62·92 (62·22 to 63·62)	66·47 (65·82 to 67·11)	NA
Indigenous	123 238	696	0·56%	783	−12·48 (−21·21 to 4·37)	18·71 (12·29 to 25·65)	NA
Total	15 810 488	144 564	0·91%	100 436	NA	NA	39·39 (38·83 to 39·95)
Congenital syphilis							
White	5 962 963	18 451	0·31%	18 451	1 (ref)	1 (ref)	NA
Asian	63 830	206	0·32%	198	4·12 (−9·96 to 16·40)	18·15 (6·11 to 28·64)	NA
Parda/Brown	8 787 411	51 788	0·59%	27 191	47·49 (46·60 to 48·36)	57·22 (56·40 to 58·03)	NA
Black	865 027	8815	1·02%	2677	69·63 (68·85 to 70·39)	71·99 (71·26 to 72·71)	NA
Indigenous	123 196	320	0·26%	381	−19·12 (−33·02 to 6·67)	16·26 (6·41 to 25·07)	NA
Total	15 802 427	79 580	0·50%	48 897	NA	NA	45·32 (44·58 to 46·06)

NA=not applicable. PAF=population attributable fraction. *Adjusted for year of birth, maternal age, marital status, and region of residence.

Table 2: **Attributable fraction for the entire population and specific groups of gestational and congenital syphilis by maternal race**

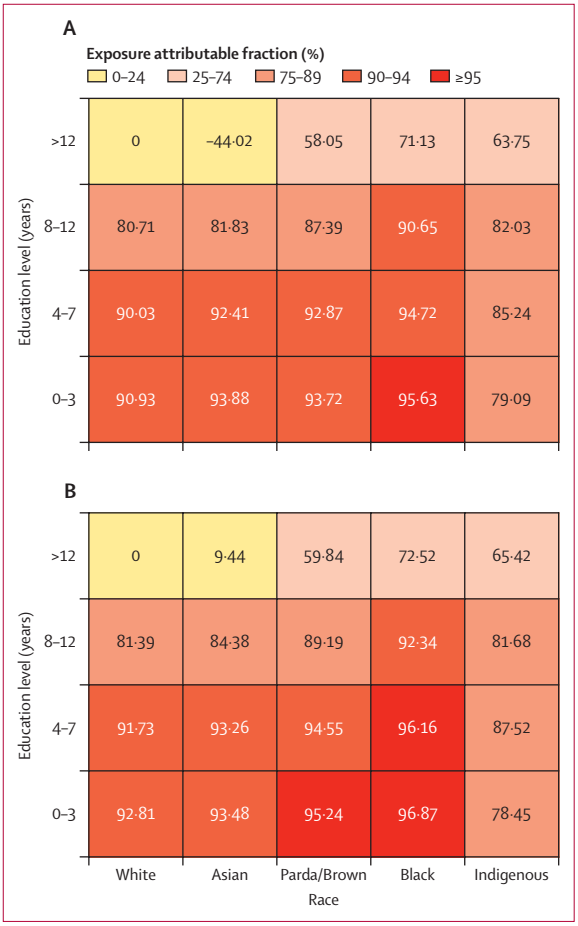

Figure 2: **Attributable fractions of maternal (A) and congenital syphilis (B) by stratum of maternal race and education level**

41% of congenital syphilis would not have occurred if all women had the same baseline risk as White women. The highest preventable percentages were observed among Parda/Brown women and Black women. When analysing the overlapping role of race and education, we observed that 86% of maternal syphilis and 89% of congenital syphilis would have been prevented if all women had the same risk as White women with more than 12 years of education. Lastly, the findings of this study indicate that Parda/Brown women and Black women are less likely to have a timely diagnosis and to receive adequate treatment for maternal syphilis, and their partners are less likely to be treated.

These results add to the growing body of evidence highlighting ethnoracial health inequities faced by Black women and Parda/Brown women, underscoring the pervasive impact of racism on maternal and neonatal health.[5,10,11] Racism and its manifestations affect health outcomes through different pathways.[14,16,17] The incidence of syphilis infection in Brazil is associated with several economic and social determinants of health, including poverty, lack of access to education and health resources, and insufficient financial support.[5,7–9] The persistent concentration of these unfavourable social indicators among marginalised populations shapes the socioeconomic context and leads to unequal distribution of resources and opportunities.[11,16,17] This inequality perpetuates a cycle of vulnerability to infection and denial of fundamental rights (eg, health care, screening for sexually transmitted diseases, and education) that directly influence maternal and neonatal health conditions, reinforcing the need for interventions that address racism, the root cause of racial health inequalities.[12,13]

To capture more than one manifestation of racism and the extent to which numerous institutions and sectors

	White	Asian	Parda/Brown	Black	Indigenous
Maternal treatment					
Adequate	875	12	2097	308	22
Inadequate or not treated	15 603	169	43 885	7477	234
Adjusted* model OR (95% CI)	1 (ref)	0·74 (0·41–1·35)	1·10 (1·01–1·24)	1·23 (1·07–1·41)	0·61 (0·39–0·96)
Timing of maternal syphilis diagnosis					
Prenatal	11 910	116	27 548	4921	186
Delivery or postpartum	5841	81	21 705	3443	115
Adjusted* model OR (95% CI)	1 (ref)	1·08 (0·80–1·44)	1·13 (1·08–1·17)	1·79 (1·11–1·24)	1·01 (0·79–1·29)
Partner treatment					
Treated	3233	33	7409	1170	72
Not treated	11 489	125	32 667	5340	171
Adjusted* model OR (95% CI)	1 (ref)	0·97 (0·66–1·44)	1·11 (1·05–1·17)	1·11 (1·03–1·20)	0·70 (0·52–0·93)

OR=odds ratio. *Adjusted for year of birth, maternal age, marital status, and region of residence.

Table 3: **OR for the association between maternal race and indicators of diagnosis and treatment of maternal syphilis**

reinforce health inequities, we conducted the analyses intersecting two social markers (ie, race and educational level). Even for women in the most educated group, the risk of maternal and congenital syphilis might be reduced by more than half when Black women and Parda/Brown women have the same opportunities as their White counterparts. Moreover, independent of the educational level, Black women had the highest attributable factor for both outcomes, reaching approximately 96% among those with fewer years of education. This finding highlights the importance of using the lens of intersectionality[26] to better understand the system of oppression and to help rethink pathways to address syphilis as a public health concern worldwide.

Furthermore, racism acts on different levels, producing inequities in access to prenatal care and health services (such access is essential to avoid mother-to-child transmission of syphilis).[5,19] Even when marginalised women can access health services, they still encounter barriers to receiving quality care.[6,18,19] Additionally, previous experiences of racism and race-based discrimination in health services might lead to distrust in the health-care system and a reluctance to seek medical care, which can further exacerbate racial health inequities.[14,16,18] Our findings show that Black women and Parda/Brown women are less likely to be treated adequately for maternal syphilis and are more likely to have a delay in their diagnosis compared with White women, which increases the burden of the disease among Black and Parda/Brown populations. Similar results had been reported previously in Brazil,[7,8,19,20] Canada, the USA, and Mexico.[2,6,31] Previous reviews[17,18,21] have reported how implicit racial bias (ie, negative attitudes and stereotypes against minoritised groups) within the context of the health-care system might negatively influence medical decisions, affecting the quality of care delivered to Black women. This bias could, partially, explain delays in diagnosis and inadequate treatment observed in this study. It is important to emphasise that in Brazil, screening for syphilis is mandatory for all individuals during pregnancy and treatment is available without charge in the Brazilian Public Unified Health System.[32]

Our findings indicate a lower prevalence of maternal and congenital syphilis among Indigenous women and their offspring compared with their White counterparts, which is not aligned with previous studies.[33,34] This finding could be related to under-reporting of syphilis cases among Indigenous groups, partly due to historical and contemporaneous physical and cultural barriers to accessing health systems.[33,34] Recent data have shown that only 16% of pregnant Indigenous women in Brazil have adequate prenatal care and, of those, 57·6% are screened for syphilis.[32] A wide range of studies focused on Indigenous health consistently emphasise the poor health of this group in Brazil due to systematic violation of their rights, exacerbated by the increased invasion of their lands, a problem that is still ongoing.[33]

To our knowledge, this is the most extensive study to estimate ethnoracial inequities associated with the risk of maternal and congenital syphilis. Although measuring racism through race and skin colour is complex, the strong evidence of the effects of racial inequities on health is indisputable, even in studies that use race and skin colour self-classification variables as a proxy for racism.[12,13] Moreover, it is important to discuss epidemiological study frameworks related to racism and its manifestations to better understand the roots of ethnoracial inequities on health outcomes. Furthermore, to capture the multidimensional aspects of racism, we analysed the intersection between race and education, which emphasised the importance of including an intersectionality lens on the analysis of the burden of syphilis to better understand possible pathways and interventions to ensure racial equity.

A strength of our study was the large sample, which included more than 144 000 cases of maternal syphilis. However, there are some limitations. First, the study was based on registry data, and the surveillance system might

not capture all the cases; one recent study estimated that 13% of all maternal syphilis cases in Brazil were not registered in SINAN.[34] Under-reporting of syphilis cases can lead to underestimating prevalence, particularly among the lower income areas of the country, where most Indigenous communities live. Although the data quality has been improving, poor data can limit linkage quality. Issues with data quality can lead to linkage errors that underestimate the prevalence of maternal and congenital syphilis in some groups compared with others. Depending on the situation, these errors could have resulted in either underestimation or overestimation of our findings. For example, if data are poor among Black individuals, the prevalence of maternal and congenital syphilis and the attributable fraction will be underestimated for this population. We excluded several individuals (7·7%) due to missing information on maternal race and gestational age at birth. In the analyses of the secondary outcomes, more individuals were excluded due to a lack of information on maternal syphilis treatment and partner treatment. Moreover, we did not include more recent years due to delays in accessing and linking data, and lags in notifications of syphilis cases. Despite the limitations of this study, syphilis remains uncontrolled in Brazil, with more than 65 000 cases of maternal syphilis and 23 000 cases of congenital syphilis registered in 2020.[35] Finally, our population data come from SINASC, which only registers livebirths; therefore, we could not include miscarriages and stillbirths in our study.

See Online for appendix 3

This study sheds light on ethnoracial disparities in the burden of maternal and congenital syphilis among Black and Parda/Brown women and their offspring in Brazil. Recognising that racism affects the lives of minoritised groups and advocating for interventions to guarantee health equity is a challenge that needs to be addressed. These interventions need to use the lens of intersectionality and consider the interconnection among social markers of oppression, such as race, education, class, and land ownership. Moreover, improvements in syphilis surveillance among Indigenous groups to better account for the real burden of syphilis will be another important step to dismantling this structure and will be required to achieve the WHO goal of worldwide elimination of mother-to-child syphilis transmission by 2030. Only through effective control of the infection among populations at higher risk such as Black and Parda/Brown populations can the elimination of mother-to-child transmission of syphilis be made feasible.

Contributors

ESP, AJFF, and LCR developed the study concept. MLB and MYI acquired the data. ESP, AJFF, KLMW, EG, RF, GLdO, PR, AMC, JMP, and LS contributed to the data analyses and interpretation of results. ESP and AJFF accessed and verified the data. ESP and AJFF wrote the first draft. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Declaration of interests

ESP reports grants from the Wellcome Trust. MYI declares grants from the Bill and Melinda Gates Foundation, Wellcome Trust, and the National Council for Scientific and Technological Development CNPq-Brazil. All other authors declare no competing interests.

Data sharing

All data supporting the findings presented here were obtained from CIDACS. Importantly, restrictions apply to the availability of these data. However, upon reasonable request and provided all ethical and legal requirements are met, the institutional data curation team can make the data available. Information on how to apply to access the data can be found at https://cidacs.bahia.fiocruz.br/en/.

Equitable partnership declaration

The authors of this paper have submitted an equitable partnership declaration (appendix 3). This statement allows researchers to describe how their work engages with researchers, communities, and environments in the countries of study. This statement is part of *The Lancet* journals' broader goal to decolonise global health.

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