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Maternal, obstetric, and behavioral determinants of gestational syphilis: Evidence from pregnant women attending the Pichari health center

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Abstract

The present study hat as objective: determine the factors associated with an increased risk of syphilis in pregnant women treated at the Pichari Health Center in Cusco, 2023. The research was observational, and analytical with cases and controls. The population sample consisted of 30 pregnant women with syphilis and 30 pregnant women without syphilis. A collection form was used to measure the study variables. The chi-square test was used for bivariate analysis; each exposure was evaluated independently to determine its association with the dependent variable. Variables showing a significant association ($p<0.05$) were selected for inclusion in the multivariate logistic regression model for further analysis. The 95% confidence intervals for the odds ratios were calculated, and a statistical significance level of $p<0.05$ was set. The variables that remained associated with syphilis in pregnant women in the multivariate analysis were self-employment (p=0.029; OR=18.9; CI=1.3-26.3); having more than 2 sexual partners (p=0.035; OR=17.9; CI=1.2-26.2); not using a condom (p=0.003; OR=3.2; CI=1.0-18.1); and finally having an obstetric history (p=0.011; OR=14.3; CI=1.8-114.2). Maternal, obstetric, and behavioral factors are significantly associated with syphilis in pregnant women.

Keywords: Risk factors, Syphilis, Pregnant women

Introduction

Syphilis is a systemic infectious disease caused by Treponema pallidum, a spirochete transmitted mainly through sexual contact. When acquired during pregnancy, it can cross the placenta and infect the fetus, leading to congenital syphilis, which is associated with miscarriage, stillbirth, prematurity, and severe sequelae such as neurological impairment, blindness, or deafness [1–3]. Although the infection is preventable and curable with penicillin, it continues to be a major public health challenge due to persistent gaps in early detection and treatment [4,5,55].

On a global scale, the World Health Organization estimates more than one million new sexually transmitted infections (STIs) occur daily, including approximately 7.1 million cases of syphilis annually, of which two million affect pregnant women [6]. More than half of these maternal cases transmit to newborns, resulting in an estimated 650,000 perinatal deaths each year [7,8]. In Latin America, the prevalence of gestational syphilis is estimated at 3.9%, equivalent to nearly 460,000 cases per year [6]. Despite the Pan American Health Organization's goal of reducing congenital syphilis to less than 0.5 cases per 1,000 live births, incidence remains well above target levels in many countries [6,9].

Recent epidemiological data from Brazil and Argentina reveal a growing trend. In Brazil, gestational syphilis rates rose from 3.5 to 21.4 cases per 1,000 pregnancies between 2010 and 2018, with congenital syphilis increasing from 2.4 to 9 cases per 1,000 live births. Argentina documented similar growth, reporting an increase from 11 to 38 gestational syphilis cases per 1,000 pregnancies between 2013 and 2018 [10,11]. In Peru, official reports indicate 9,170 cases of maternal syphilis from 2016 to 2021, with Lima, Junín, and Cusco registering the highest prevalence [12,13]. Cusco alone recorded 584 confirmed cases between 2019 and 2023, particularly concentrated in La Convención, where incidence reached 6.62 maternal cases per 1,000 pregnant women and 3.03 congenital cases per 1,000

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inhabitants in 2023 [13].

Multiple studies have identified factors associated with maternal syphilis. International research points to low education, unstable housing, unemployment, and lack of health insurance as relevant determinants [14–16]. Inadequate or delayed antenatal care and incomplete maternal treatment also contribute to adverse neonatal outcomes [17,18]. Case–control analyses in Colombia and Peru further highlight adolescent pregnancy, fewer than six prenatal visits, early sexual initiation, and substance use as significant risk factors [19–22]. Behavioral determinants, such as multiple sexual partners, irregular condom use, and failure to treat sexual partners, consistently emerge as drivers of reinfection and vertical transmission [20,23,24,56].

Clinical and public health guidelines underscore the importance of universal antenatal screening, timely treatment, and partner management. Non-treponemal tests (e.g., RPR, VDRL) followed by treponemal confirmation remain the standard diagnostic pathway [25–27]. Treatment with benzathine penicillin, when administered in complete regimens, is highly effective in preventing congenital syphilis [4,5,28]. However, incomplete dosing, late diagnosis, and gaps in partner treatment continue to undermine programmatic success [3,17,18].

From a biological perspective, T. pallidum exhibits mechanisms of immune evasion, including a sparsely antigenic outer membrane that allows systemic dissemination and placental invasion. This stealth capacity explains why vertical transmission may occur at any stage of pregnancy if the infection is untreated [29,30]. These scientific insights, coupled with persistent social and systemic barriers, explain the ongoing incidence of congenital syphilis in both high- and low-resource settings.

Given this background, the present study seeks to determine the maternal, obstetric, and behavioral factors associated with syphilis among pregnant women attending the Pichari Health Center in Cusco during 2023. By generating locally grounded evidence, the study aims to inform strategies that strengthen antenatal screening, guarantee complete and timely therapy, and incorporate sexual health education and partner services, thereby contributing to the prevention of preventable adverse outcomes for mothers and newborns in La Convención and beyond [12,13,18,21].

Theoretical Framework

Gestational and congenital syphilis: epidemiology and risk factors

Gestational syphilis remains a critical public health issue because of its ability to cause severe maternal and neonatal outcomes. Studies conducted in Latin America and other regions confirm an increasing prevalence of maternal syphilis and a persistent gap in controlling vertical transmission [1,5,6]. For instance, epidemiological analyses in Colombia, Brazil, and Argentina demonstrate that the incidence of gestational syphilis and congenital syphilis has steadily risen in the past decade, underscoring the limitations of current prevention programs [13,14,15]. Case–control studies in Peru and Colombia further emphasize maternal age, parity, limited antenatal visits, and alcohol consumption as significant risk factors [16–20]. Additional evidence highlights adolescent pregnancy, multiple sexual partners, and inadequate prenatal care as determinants of maternal infection and vertical transmission [21, 22].

Beyond maternal variables, neonatal factors such as prematurity, low birth weight, and perinatal mortality have been directly linked to congenital syphilis [18,19]. Systematic evaluations indicate that the combination of delayed diagnosis and incomplete maternal treatment contributes substantially to neonatal morbidity and mortality [30,31,39]. Evidence from southern Brazil and other Latin American regions corroborates that maternal sociodemographic conditions, particularly low education and unemployment, reinforce vulnerability to infection [41,47]. Together, these findings demonstrate that epidemiological determinants of gestational syphilis are multifactorial, integrating biomedical, behavioral, and structural dimensions.

Protocols, guidelines, and systematic reviews

International and national health authorities have issued protocols to standardize syphilis screening and treatment in pregnancy. The Brazilian Protocol

for Sexually Transmitted Infections provides comprehensive recommendations for both maternal and neonatal management, emphasizing early testing and complete penicillin regimens [3,33]. Similarly, the World Health Organization guidelines highlight the necessity of universal syphilis screening at the first antenatal visit, recommending treponemal and non-treponemal tests as standard practice [34].
Systematic reviews reinforce the effectiveness of such interventions. Evidence shows that antenatal screening and early antibiotic treatment significantly reduce vertical transmission [25,26]. However, missed opportunities in treating pregnant women and their partners remain a recurrent issue, weakening programmatic outcomes [12,35]. National technical standards, such as those issued by the Peruvian Ministry of Health, mandate rapid plasma reagin (RPR) testing during the first antenatal contact and immediate initiation of treatment when results are reactive, ensuring universal access across healthcare levels [35,36]. Clinical practice guidelines across Latin America, including Ecuador's prenatal care manual, also stress the integration of partner evaluation and preventive education [43,46].

Clinical aspects, diagnosis, and treatment

From a clinical perspective, syphilis manifests in progressive stages—primary, secondary, latent, and tertiary—with each stage carrying different implications for maternal and neonatal health [29]. In pregnancy, diagnosis typically relies on a two-step process: non-treponemal tests such as RPR or VDRL for screening, followed by confirmatory treponemal assays [2,33]. Despite these protocols, diagnostic challenges persist due to false positives in non-treponemal testing and delays in confirmatory results [51].

Treatment remains centered on benzathine penicillin, which is safe and effective for both mothers and fetus. Timely and complete regimens, administered as weekly intramuscular doses, are essential to prevent congenital transmission [19,36]. Nevertheless, incomplete adherence and late initiation of therapy remain prevalent barriers [11,23]. Recent immunological studies underscore the pathogen's ability to evade host immune responses, complicating vaccine development and highlighting the critical role of early treatment [24]. In addition, neurosyphilis remains a rare but severe consequence that can complicate maternal infections and affect long-term outcomes [11,49].

Social determinants, public health, and prevention

Gestational syphilis cannot be understood solely as a biomedical condition; it is strongly shaped by social determinants of health. Empirical studies show that low educational attainment, poverty, and lack of health insurance are consistently associated with maternal infection [13,27]. Vulnerability is compounded in populations living in marginalized urban zones, where structural barriers reduce access to antenatal care and diagnostic services [28,42].

Public health research has also emphasized the behavioral dimension. Early sexual initiation, multiple sexual partners, and inconsistent condom use are recurrently linked to higher rates of syphilis and other STIs [44,45]. Inadequate health literacy, combined with cultural and structural barriers, limits women's ability to seek preventive services. Moreover, failure to diagnose and treat sexual partners perpetuates reinfection and vertical transmission cycles [12,48].

Preventive strategies must therefore integrate comprehensive sexual health education, condom distribution, and partner treatment into routine antenatal care [4,50]. Governmental and municipal initiatives also play a pivotal role. For example, community-level interventions developed in Peru and Ecuador have demonstrated the importance of localized, culturally sensitive health promotion campaigns in reducing STI transmission [42,52]. Ultimately, the persistence of gestational syphilis highlights the need for multifaceted approaches that combine biomedical interventions with policies addressing social inequities and behavioral risk factors.

Methodology

Study setting

The research was conducted in the district of Pichari, Province of La Convención, located in the Cusco region of Peru. Pichari lies in the Amazon fringe, on the right bank of the Apurímac River, at 624 meters above sea level. According to the 2017 National

Census, the district has a population of 22,691 inhabitants, of which 46.5% are women, and over half of them are of reproductive age. Indigenous groups such as the Machiguenga and Asháninka are also present in the area [52]. The study was carried out at the Pichari Health Center, located on Aviación Avenue, Mariscal Cáceres sector.

Research type and level

This was a quantitative, observational, case–control study. The quantitative design allowed for the measurement and statistical analysis of risk factors related to syphilis in pregnant women [53]. Being observational, data were obtained without intervention, relying on retrospective records and clinical histories. The level of research was analytical and explanatory, aiming to identify causal relationships and explain the conditions under which syphilis is associated with maternal, obstetric, and behavioral variables [54].

Units of analysis and population

The units of analysis were all pregnant women diagnosed with syphilis and those without syphilis who attended the Pichari Health Center in 2023. The study population included 252 pregnant women who received care between January and December 2023.

- ***Inclusion criteria (cases):*** pregnant women diagnosed with syphilis, with complete clinical records.
- ***Inclusion criteria (controls):*** pregnant women without syphilis during the same period, with complete clinical records.
- ***Exclusion criteria:*** pregnant women attended outside 2023, those referred from other centers, and those with incomplete clinical histories.

Sample and sampling technique

The sample included 30 cases (pregnant women with syphilis) and 30 controls (pregnant women without syphilis), in a 1:1 ratio. Sampling was non-probabilistic and by convenience, based on the availability of complete and comparable medical records. This strategy was considered adequate given the restricted size of the population and the specificity of the condition under study.

Data collection

Technique

Data were collected through documentary review and observation, using the clinical records of pregnant women attended at the Pichari Health Center during 2023.

Instrument

A structured data collection form was designed with 15 items addressing maternal, obstetric, and behavioral risk factors.

Validity and reliability

The instrument underwent expert judgment validation to assess sufficiency, clarity, coherence, and relevance. Four evaluators confirmed high reliability, with scores ranging from 37 to 45, yielding an average of 41, rated as “good.” Statistical concordance among evaluators ($p < 0.05$) confirmed the adequacy of the tool.

Variables

The study considered two main variables:

- ***Independent variable:*** Risk factors, grouped into three dimensions:
- ***Maternal factors:*** age, residence, education, marital status, occupation.
- ***Obstetric factors:*** gestational age, prenatal care onset, number of prenatal visits, trimester of diagnosis, obstetric history.
- ***Behavioral factors:*** age at sexual initiation, number of sexual partners, condom use, harmful habits, and treatment compliance.
- ***Dependent variable:*** Gestational syphilis, confirmed by serological and clinical records.

Data analysis

The analysis was carried out in two phases:

1. Descriptive statistics: Frequencies, percentages, means, medians, and standard deviations were calculated to describe maternal, obstetric, and behavioral characteristics. Tables and graphs were constructed to illustrate distributions among cases

and controls.

2. *Inferential statistics:*

- ***Chi-square test*** was applied to evaluate associations between categorical variables and syphilis status.
- ***Odds Ratios (OR)*** with 95% confidence intervals were calculated to estimate the strength of association between each risk factor and gestational syphilis.
- ***Logistic regression*** analysis was performed to identify independent predictors while controlling for confounding variables.
- ***Statistical*** significance was established at $p < 0.05$.

Ethical consideration

The study adhered to the fundamental principles of biomedical ethics: respect for persons, beneficence, and justice. The autonomy and confidentiality of participants were protected by using anonymized clinical records. Approval was granted by the Institutional Research Ethics Committee of the Universidad Nacional San Antonio Abad del Cusco. Moreover, originality was ensured through plagiarism detection software (Turnitin), reinforcing the integrity of the work.

Results

This chapter presents the findings derived from the analysis of maternal, obstetric, and behavioral risk factors associated with syphilis in pregnant women treated at the Pichari Health Center, Cusco, during 2023. The results are organized into descriptive statistics, bivariate associations, and multivariate regression models to provide a comprehensive understanding of the determinants of syphilis in this population. Each section is supported with statistical tests, Odds Ratios (OR), and confidence intervals (95% CI) to ensure robustness and scientific rigor.

Table 1. Sociodemographic and obstetric characteristics of pregnant women (cases vs. controls)

Variable	Cases (n=30)	Controls (n=30)	Test	p-value
Age (mean ± SD)	23 ± 6.5	27 ± 5.3	Mann–Whitney U	0.012
Education: Primary	17%	7%	Chi-square	0.228
Education: Secondary	73%	60%	Chi-square	0.273
Education: Higher	10%	33%	Ref.	-
Marital status: Single	37%	3%	Chi-square	0.001*
Marital status: Cohabiting	57%	77%	Chi-square	1.000
Marital status: Married	6%	20%	Ref.	-
Occupation: Housewife	80%	50%	Chi-square	0.015*
Occupation: Student	10%	7%	Chi-square	0.640
Occupation: Salaried/Independent	10%	43%	Chi-square	0.004*
Residence: Urban	90%	80%	Chi-square	0.278
Residence: Rural	10%	20%	Ref.	-

The descriptive analysis reveals that pregnant women with syphilis tend to be younger than those without the disease (23 vs. 27 years). Educational attainment was predominantly secondary in both groups, although women without syphilis had a higher representation in higher education. Being single was significantly associated with cases, whereas cohabitation was more frequent among controls. Regarding occupation, housewives predominated among cases, while salaried or independent work was more common among controls. Residence in urban areas was the most frequent in both groups, showing no significant difference.

Table 2. Bivariate analysis of maternal, obstetric, and behavioral risk factors associated with syphilis

Risk Factor	Cases (n=30)	Controls (n=30)	OR (95% CI)	Test	p-value
Single marital status	37%	3%	17.0 (2.0–140.0)	Chi-square	0.001*

Housewife	80%	50%	4.0 (1.2–12.5)	Chi-square	0.015*
Salaried/Independent	10%	43%	0.1 (0.0–0.5)	Chi-square	0.004*
<14 weeks gestation	68%	100%	2.5 (1.7–3.5)	Chi-square	0.001*
<6 prenatal visits	30%	3%	0.0 (0.0–0.6)	Chi-square	0.006*
Late prenatal care	27%	0%	0.4 (0.3–0.5)	Chi-square	0.002*
Obstetric history	70%	20%	9.3 (2.0–30.6)	Chi-square	0.000*
>2 sexual partners	33%	13%	7.4 (2.0–26.5)	Chi-square	0.001*
No condom use	100%	60%	2.6 (1.8–3.8)	Chi-square	0.000*

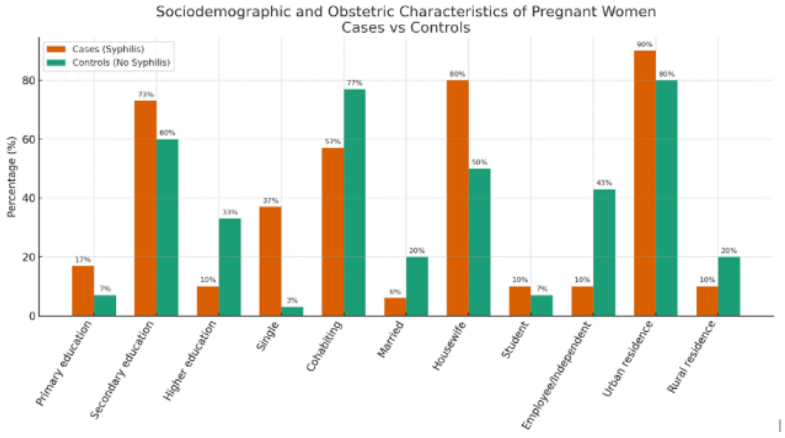

Figure 1. Sociodemographic and obstetric characteristics of pregnant women with and without syphilis, Pichari Health Center, 2023.

Note. The figure illustrates the distribution of sociodemographic and obstetric characteristics between cases (syphilis) and controls (no syphilis). Percentages are based on data from medical records.

The crude analysis demonstrated that several factors were strongly associated with syphilis. Single marital status, being a housewife, having fewer than six prenatal visits, late initiation of prenatal care, and adverse obstetric history all showed significant associations.

Among behavioral variables, having more than two sexual partners and not using condoms were consistently linked to higher risk. These findings highlight the multidimensional vulnerability of women affected by syphilis, involving social, clinical, and behavioral determinants.

Table 3. Multivariate logistic regression of risk factors associated with syphilis

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Salaried/Independent	0.1 (0.0–0.5)	0.004	18.9 (1.3–26.3)	0.029*
>2 sexual partners	7.4 (2.0–26.5)	0.001	17.9 (1.2–26.2)	0.035*
No condom use	2.6 (1.8–3.8)	0.000	3.2 (1.0–18.1)	0.003*
Obstetric history	9.3 (2.0–30.6)	0.000	14.3 (1.8–114.2)	0.011*

When adjusting for potential confounders, only a subset of variables remained significantly associated with syphilis. Being salaried or independent was linked with nearly 19 times higher odds of infection. Similarly, women reporting more than two sexual partners had almost 18 times the risk.

Lack of condom use and adverse obstetric history also persisted as significant predictors, with adjusted ORs of 3.2 and 14.3, respectively. These results underscore the complexity of risk factors, where behavioral and obstetric dimensions outweigh purely sociodemographic attributes after statistical adjustment.

Table 4. Treatment compliance among pregnant women with syphilis

Treatment compliance	n	%
Yes	27	90.0
No	3	10.0
Total	30	100.0

Encouragingly, 90% of pregnant women diagnosed with syphilis adhered to treatment protocols. Nevertheless, the 10% who did not comply represent a vulnerable group with a heightened risk of vertical transmission, reflecting the importance of strengthening follow-up and support systems during pregnancy.

Age stratification revealed that women under 20 years had the highest relative proportion of syphilis cases (40%), compared with only 6.7% of controls. The group aged 20–35 years accounted for the majority of controls, suggesting protective factors associated with maturity, education, or health-seeking behaviors. Women over 35 years showed a marginal presence, indicating that syphilis disproportionately affects younger and more vulnerable groups.

Table 5. Distribution of cases and controls by maternal age group

Age Group	Cases n(%)	Controls n (%)	Total n (%)
<20 years	12 (40%)	2 (6.7%)	14 (23.3%)
20–35 years	16 (53.3%)	28 (93.3%)	44 (73.4%)
>35 years	2 (6.7%)	0 (0%)	2 (3.3%)
Total	30 (100%)	30 (100%)	60 (100%)

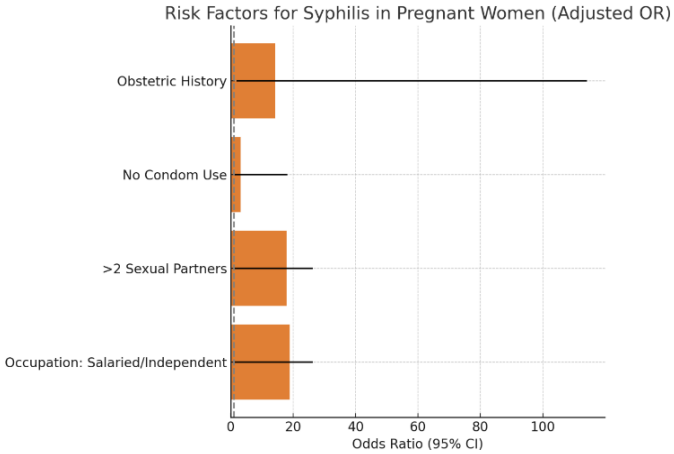

Figure 2. Adjusted odds ratios for significant risk factors of syphilis in pregnant women.

Note. The figure shows adjusted odds ratios (OR) with 95% confidence intervals for maternal, behavioral, and obstetric risk factors significantly associated with syphilis in pregnant women.

Overall, the results demonstrate that syphilis in pregnancy is not randomly distributed but rather conditioned by a constellation of sociodemographic, obstetric, and behavioral risk factors. While univariate analysis highlighted multiple associations, multivariate modeling confirmed that behavioral practices—such as multiple sexual partnerships and condom non-use—together with adverse obstetric history, are the strongest predictors of infection. These findings provide critical evidence to design preventive and intervention strategies tailored to the realities of young, socioeconomically vulnerable women in Cusco, with the aim of reducing congenital syphilis and improving maternal and neonatal health outcomes.

Discussion

The results of this study indicate that gestational syphilis remains strongly associated with maternal age, educational level, and marital status, findings that are consistent with previous epidemiological research in Colombia, Peru, and Brazil [1,5,6,13,14,16,17,18,19,20,21,30,39,41,47]. Younger

women, particularly those under 26 years of age, were more vulnerable to infection, a trend also reported in similar populations in Latin America [15,31]. Educational disadvantage was another key determinant, confirming that limited schooling reduces awareness and access to preventive health measures [2,13,22]. Moreover, cohabiting or single status was identified as a significant risk factor, which echoes findings from other studies highlighting the role of unstable social structures in increased vulnerability to sexually transmitted infections [6,17,20,21].

Obstetric factors such as late initiation of antenatal care and a reduced number of visits (<6) were significantly associated with syphilis, consistent with the evidence from Brazil and Colombia where delays in prenatal screening are major contributors to adverse maternal–fetal outcomes [5,14,19,39]. A previous obstetric history of complications also emerged as a strong predictor of infection, aligning with data that demonstrate the cumulative impact of reproductive morbidity on syphilis risk [13,16,18,22]. These findings highlight the need for proactive screening and early antenatal interventions, particularly in semi-rural health settings where structural and geographic barriers limit timely access to maternal care [42,43].

Behavioral determinants played a decisive role. Women reporting more than two sexual partners exhibited almost 18 times the risk, corroborating international literature that identifies multiple partnerships as a high-risk factor for syphilis transmission [4,27,28,44,45]. The absence of condom use among cases represents a major concern, echoing systematic reviews that emphasize condom promotion as one of the most effective tools to reduce syphilis transmission [12,25,36]. Risk behaviors, including early sexual debut and substance use, are consistently reported across global contexts as drivers of congenital syphilis, yet continue to be insufficiently addressed in maternal health policies [26,33,34,35].

The multivariate analysis further demonstrated that occupation (salaried or independent work), number of sexual partners, lack of condom use, and adverse obstetric history remained independently associated with syphilis. These findings align with global estimates showing that socioeconomic vulnerability and behavioral risk converge to sustain the burden of maternal and congenital syphilis [26,34]. WHO guidelines emphasize the urgent need to scale up universal antenatal screening and treatment as the most cost-effective interventions [34,35]. Moreover, clinical studies reinforce the importance of strengthening diagnostic capacities, as missed opportunities in screening remain widespread in Latin America and other low- and middle-income countries [2,11,23,29,49,51].

Finally, the persistence of syphilis reflects a broader context of social inequities and health system limitations. Determinants such as poverty, cultural barriers, and gaps in sexual health education were confirmed as underlying drivers of vulnerability [13,27,28,42,44,45,48,50,52]. This aligns with global literature linking social determinants of health with the epidemiology of congenital infections [7,8,9,10,37,38]. Strengthening prevention requires an integrated approach that not only ensures timely diagnosis and treatment but also addresses structural inequities through health promotion, sexual education, and community-based interventions [43,46]. In this sense, the evidence presented here reinforces the need to align local health strategies in Pichari with international frameworks and national technical guidelines to reduce maternal and congenital syphilis [34,35,36].

Conclusion

The study confirms that gestational syphilis remains a persistent public health concern, particularly in vulnerable contexts marked by structural limitations. Findings demonstrate that maternal factors such as young age, low educational attainment, and marital status directly influence the likelihood of infection. These conditions reflect not only social inequalities but also gaps in timely care and limited coverage of preventive programs targeting women of reproductive age.

From an obstetric perspective, late initiation of prenatal care, fewer antenatal visits, and a history of complications substantially increase the risk of vertical transmission. The lack of consistent follow-up during pregnancy restricts early detection and the application of effective treatments, perpetuating the burden of disease and its consequences for both maternal and neonatal health.

Finally, behavioral determinants emerge as decisive contributors. The lack of condom use, multiple sexual partners, and high-risk practices reinforce cycles of reinfection that medical care alone cannot break. These results call for an integrated response that combines biomedical strategies with educational, community, and policy interventions to reduce inequities, strengthen sexual health, and ensure a sustainable preventive environment for women and their families.

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