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Disparities in Antenatal Care Utilization but Not Treatment Coverage Between Migrant and Local Pregnant Women with Syphilis: A Retrospective Cohort Study in Taizhou, China

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Research Article

Keywords: Syphilis, Migrant pregnant women, Antenatal care, Benzathine penicillin, Congenital syphilis, Retrospective cohort study

Posted Date: November 1st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11084037/v1

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Additional Declarations: No competing interests reported.

Abstract

Objective

To compare demographic characteristics, antenatal care utilization, treatment coverage, and adverse pregnancy outcomes between migrant and local pregnant women with syphilis, and to identify factors associated with non-standardized treatment and adverse outcomes.

Methods

This retrospective cohort study included 773 syphilis-infected pregnant women registered in the National Prevention of Mother-to-Child Transmission (PMTCT) Management Information System in Taizhou, China, between 2020 and 2025. The cohort comprised 438 migrant women and 335 local women. Demographic characteristics, antenatal care utilization, standardized treatment, and adverse outcomes were compared. Multivariable logistic regression was used to identify factors associated with adverse neonatal outcomes, preterm birth/low birth weight, and non-standardized treatment.

Results

Migrant women were younger and had lower educational attainment than local women. The proportion aged ≤ 24 years was 30.8% in migrant women versus 16.1% in local women (P < 0.001); 72.1% of migrant women had junior high school education or below versus 43.0% of local women (P < 0.001). Migrant women had a lower rate of first-trimester antenatal registration (72.8% vs. 88.1%, P < 0.001) and a higher proportion of high TRUST titer (≥ 1:8) (16.9% vs. 11.1%, P = 0.030). Standardized treatment rates were similar between groups (78.5% vs. 79.1%, P = 0.846). After adjustment, migrant status was associated with lower odds of adverse neonatal outcome (aOR = 0.59, 95% CI: 0.39–0.89), while late antenatal registration was consistently associated with adverse outcomes.Third-trimester first antenatal visit was associated with higher odds of preterm birth/low birth weight (aOR = 2.96, 95% CI: 1.26–6.96) and non-standardized treatment (aOR = 5.66, 95% CI: 2.78–11.54).

Conclusions

Migrant pregnant women with syphilis had greater socioeconomic disadvantage and later antenatal registration than local women, but standardized treatment coverage was similar. Late antenatal registration, rather than migrant status itself, was the main modifiable factor associated with non-standardized treatment and preterm birth/low birth weight. The primary actionable target is early antenatal registration, not migrant status per se.

Introduction

Syphilis is a chronic systemic sexually transmitted infection caused by Treponema pallidum. It can be transmitted vertically during pregnancy and may lead to congenital syphilis, stillbirth, preterm birth, neonatal malformations, and long-term neurodevelopmental impairment [1]. The World Health Organization (WHO) estimates that approximately 7 million new syphilis infections occur globally each year, including about 1 million among pregnant women, with an estimated 270,000 newborns affected by congenital syphilis annually [2, 3]. Although syphilis is preventable and curable, congenital syphilis remains an important cause of adverse pregnancy outcomes and neonatal mortality worldwide.

To eliminate mother-to-child transmission (EMTCT) of syphilis, WHO launched the global initiative for the elimination of congenital syphilis in 2007, with core targets of ≥ 95% antenatal syphilis screening coverage and ≥ 95% treatment completion among seropositive pregnant women [4]. Evidence shows that timely and complete benzathine penicillin treatment during pregnancy can interrupt vertical transmission and reduce the risk of congenital syphilis by more than 97% [5]. Therefore, improving screening coverage and ensuring prompt, complete penicillin treatment are central to EMTCT.

China's national PMTCT program, launched in 2010, has progressively scaled up syphilis screening and intervention [6]. After more than a decade of effort, the incidence of congenital syphilis in China decreased from 69.9 per 100,000 live births in 2013 to 11.9 per 100,000 live births in 2019 [7]. Zhejiang Province, an economically developed region, has been at the forefront of PMTCT implementation. From 2015 to 2020, early antenatal registration (< 13 weeks) increased from 55.27% to 77.82%, standardized treatment increased from 66.92% to 83.37%, and the incidence of congenital syphilis declined by 26.55% annually [8]. Despite these overall improvements, disparities in service utilization persist, and migrant pregnant women remain a major challenge in EMTCT efforts [9, 10].

Migrant pregnant women are defined as those whose registered residence (hukou) is outside their current place of residence and who have lived in the current locality for at least six months. Because of high mobility, unstable housing, relatively low health literacy, and barriers to accessing local healthcare services, migrant pregnant women are at increased risk of syphilis infection and are more likely to experience delayed diagnosis and treatment [11]. Studies from China have shown that migrant women have lower rates of antenatal care utilization, early registration, standardized treatment, and postpartum follow-up adherence than local women [12, 13]. In Taizhou City, official statistics from 2024 indicate a permanent resident population of 6.729 million, of whom approximately 709,700 (10.55%) were migrants [14]. In 2025, 187 pregnant women with syphilis were reported in Taizhou, of whom 105 (56.15%) were migrants, indicating a marked disparity. These data suggest that migrant pregnant women may be a particularly vulnerable subgroup in PMTCT of syphilis in this setting.

In early 2026, a national special inspection of Taizhou’s PMTCT program identified gaps in syphilis management among the migrant population and called for targeted interventions. However, systematic local research on the epidemiological characteristics, risk factors, and intervention barriers among migrant women with syphilis remains limited. Most existing studies have focused on descriptive rates of

service utilization, with insufficient attention to structural barriers such as hukou-related restrictions, fragmented inter-provincial health insurance portability, and residential instability [15].

Therefore, this study used routinely collected data from the Taizhou PMTCT information system to compare demographic characteristics, antenatal care utilization, treatment coverage, and pregnancy outcomes between migrant and local women with syphilis, and to identify factors associated with non-standardized treatment and adverse outcomes. These findings may inform strategies to promote early antenatal care and improve treatment completion among migrant women.

Materials and Methods

1. Study Design and Data Source

This was a retrospective cohort study. Data were extracted from the National Prevention of Mother-to-Child Transmission of HIV, Syphilis, and Hepatitis B Management Information System (PMTCT MIS) of Taizhou City. This system collects information on screening, diagnosis, treatment, follow-up, and pregnancy outcomes of pregnant women with syphilis and their exposed infants across all obstetric and maternal and child health institutions in the city. Data were retrieved in June 2026 and covered all syphilis-infected pregnant women registered in Taizhou City between January 1, 2020, and December 31, 2025.All eligible cases registered in the PMTCT MIS during the study period were included. No a priori sample size calculation was performed.

2. Study Population and Grouping

Inclusion criteria were: (1) pregnant women registered or delivered in a medical institution in Taizhou City; (2) diagnosed with syphilis during pregnancy or at delivery; and (3) complete clinical data. Exclusion criteria were missing key variables, including registered residence, treatment information, or pregnancy outcomes.

Migrant pregnant women were defined according to the National Health Commission PMTCT program standard: women whose registered residence (hukou) was outside Taizhou City, including all counties, districts, and county-level cities, and who had lived in Taizhou for at least 6 months. Operationally, the “registered address” and “current address” fields combined with “length of residence in Taizhou” were used. Women with registered residence in Taizhou were classified as local pregnant women. Women with registered residence outside Taizhou and length of residence ≥ 6 months were classified as migrant pregnant women. Those with registered residence outside Taizhou and length of residence < 6 months were recorded as “short-term migrants” and were not included in the main comparative analysis.

The final analytic cohort included 773 women: 438 migrant women and 335 local women.

3. Variable Definitions

3.1 Demographic and Clinical Characteristics

Age was categorized as ≤ 24, 25–34, and ≥ 35 years. Educational level was categorized as junior high school or below and high school or above. Occupation was categorized as housework/unemployed, farmer, worker, and other. Marital status was categorized as first marriage and other. Health insurance type was categorized as local insurance and non-local/no insurance. Initial non-treponemal antibody titer was measured by TRUST or RPR. A high titer was defined as ≥ 1:8, consistent with the Chinese national diagnostic standard for syphilis (WS 273—2018) and the Chinese STI treatment guideline[16, 17], which identify this threshold as indicative of active infection. Adverse pregnancy history was defined as previous spontaneous abortion, stillbirth, fetal death, preterm birth, or birth defect.

3.2 Antenatal Care and Treatment Indicators

Gestational week at first antenatal visit was categorized as first trimester (≤ 12 weeks), second trimester (13–27 weeks), and third trimester (≥ 28 weeks). Early antenatal registration was defined as first visit ≤ 12 weeks.Standardized treatment was defined according to the Chinese National PMTCT program [18], which recommends 2.4 million units of benzathine penicillin G intramuscularly once weekly for 3 consecutive weeks for all syphilis-infected pregnant women, regardless of disease stage. This definition differs from the CDC and WHO recommendations, which specify a single dose for early syphilis and three doses for late latent or unknown duration. We adopted the Chinese national definition because it reflects the operative standard in the study setting and was the basis for clinical management and program monitoring in Taizhou. For penicillin-allergic patients, ceftriaxone (1 g daily for 10 days) or erythromycin (500 mg four times daily for 15 days) was used as an alternative according to the same national guideline [19].

3.3 Outcomes

Adverse neonatal outcome was defined a priori as any of the following: preterm birth/low birth weight, stillbirth, neonatal death, or congenital syphilis, based on the PMTCT MIS. Preterm birth was defined as gestational age at delivery < 37 weeks. Low birth weight was defined as birth weight < 2500 g. Congenital syphilis was diagnosed according to the Diagnostic Criteria for Syphilis (WS273-2018) [20].

3.4 Statistical Analysis

Missing data

Of the 789 Taizhou-origin records, 16 (2.0%) were excluded because of missing key variables, including registered residence (n = 6), treatment information (n = 8), and pregnancy outcomes (n = 2). The remaining 773 records had complete data for all variables included in the multivariable models. Missing data were handled by complete-case analysis. RPR results were available for only 5% of the cohort; therefore, TRUST was used as the primary non-treponemal titer measure for all analyses.

Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as numbers (percentages) and compared using the χ^2 test or Fisher's exact test. Continuous variables were tested for normality using the Kolmogorov–Smirnov test. Normally

distributed data were expressed as mean ± standard deviation and compared using the independent-samples t-test; non-normally distributed data were expressed as median (interquartile range) and compared using the Mann–Whitney U test.

Multivariable logistic regression models were constructed for adverse neonatal outcome, preterm birth/low birth weight, and non-standardized treatment. Adjusted variables included migrant status, age group, educational level, timing of first antenatal visit, standardized treatment, and TRUST titer. Results were presented as adjusted odds ratios (aOR) with 95% confidence intervals (CI). Model discrimination was assessed by the area under the receiver operating characteristic curve (AUC). A two-sided α level of 0.05 was considered statistically significant.Variables were selected for multivariable models based on clinical relevance and univariate $P < 0.10$, and collinearity was assessed using variance inflation factor.

Results

3.1 Baseline Characteristics

A total of 773 pregnant women with syphilis were included, comprising 438 migrant women (56.7%) and 335 local women (43.3%). Baseline characteristics are shown in Table 1. Migrant women were younger than local women: 30.8% were aged ≤ 24 years, compared with 16.1% of local women ($\chi^2 = 22.24$, $P < 0.001$). Migrant women also had lower educational attainment; 72.1% had junior high school education or below, compared with 43.0% of local women ($\chi^2 = 67.00$, $P < 0.001$). The proportion of first marriage was lower among migrant women (62.3% vs. 76.4%, $\chi^2 = 17.52$, $P < 0.001$). In addition, migrant women had a higher proportion of high TRUST titer (≥ 1:8) than local women (16.9% vs. 11.1%, $\chi^2 = 4.73$, $P = 0.030$). No statistically significant difference was observed in adverse pregnancy history between groups.

3.2 Antenatal Care Utilization and Treatment Coverage

Antenatal care utilization is shown in Table 1. The rate of first-trimester antenatal registration was lower among migrant women (72.8% vs. 88.1%, $\chi^2 = 28.13$, $P < 0.001$). Accordingly, higher proportions of migrant women had their first antenatal visit in the second trimester (20.5% vs. 10.1%) or third trimester (6.6% vs. 1.8%). The standardized treatment rate was 78.5% in migrant women and 79.1% in local women, with no statistically significant difference ($\chi^2 = 0.04$, $P = 0.846$).

3.3 Factors Associated with Adverse Outcomes and Non-standardized Treatment

Univariate analysis is presented in Table 2. The crude OR for adverse neonatal outcome was 0.71 (95% CI: 0.49–1.03, $P = 0.070$) for migrant women compared with local women. In multivariable analysis (Table 3), Model 1 and Model 2 were adjusted for migrant status, age group, educational level, timing of first antenatal visit, standardized treatment, and TRUST titer. The model for non-standardized treatment was adjusted for migrant status, age group, educational level, and timing of first antenatal visit.Migrant status was associated with lower odds of adverse neonatal outcome after adjustment (aOR = 0.59, 95%

CI: 0.39–0.89, P = 0.012). Older age (≥ 35 vs. ≤24 years: aOR = 2.47, 95% CI: 1.39–4.38, P = 0.002) was associated with higher odds, whereas high school education or above was associated with lower odds (aOR = 0.52, 95% CI: 0.34–0.80, P = 0.003). For preterm birth/low birth weight (Table 3, Model 2), third-trimester first visit was associated with higher odds compared with first-trimester visit (aOR = 2.96, 95% CI: 1.26–6.96, P = 0.013).

3.4 Factors Associated with Non-standardized Treatment

Factors associated with non-standardized treatment are shown in Table 4. Compared with first-trimester first visit, second-trimester first visit (aOR = 2.41, 95% CI: 1.54–3.76, P < 0.001) and third-trimester first visit (aOR = 5.66, 95% CI: 2.78–11.54, P < 0.001) were independently associated with non-standardized treatment. Migrant status was not independently associated with non-standardized treatment after adjustment (aOR = 0.84, 95% CI: 0.56–1.25, P = 0.389). Age and education were not significantly associated with non-standardized treatment. The model's discriminatory ability was limited (AUC = 0.642), indicating that factors not captured in the PMTCT database contribute substantially to non-standardized treatment.

Tables for Manuscript

Table 1
Baseline characteristics of migrant and local pregnant women with syphilis (n = 773)

Characteristic	Local (n = 335)	Migrant (n = 438)	Total (n = 773)	χ^2	P value
Age group, n (%)				22.24	< 0.001
≤ 24 years	54 (16.1)	135 (30.8)	189 (24.4)		
25–34 years	187 (55.8)	199 (45.4)	386 (49.9)		
≥ 35 years	94 (28.1)	104 (23.7)	198 (25.6)		
Education, n (%)				67.00	< 0.001
Junior high school or below	144 (43.0)	316 (72.1)	460 (59.5)		
High school or above	191 (57.0)	122 (27.9)	313 (40.5)		
Occupation, n (%)				31.94	<0.001
Housework/unemployed	192 (57.3)	276(63.0)	468 (60.5)		
Farmer	54 (16.1)	96(21.9)	150 (19.4)		
Worker	17 (5.1)	32 (7.3)	49(6.3)		
Other	72 (21.5)	34(7.8)	106 (13.7)		
First marriage, n (%)	256 (76.4)	273 (62.3)	529 (68.4)	17.52	<0.001
TRUST titer ≥ 1:8, n (%)	37 (11.1)	74 (16.9)	111 (14.4)	4.73	0.030
Adverse pregnancy history, n (%)	56 (16.7)	58(13.2)	114 (14.7)	1.82	0.177
First antenatal visit, n (%)				28.13	< 0.001
First trimester	295 (88.1)	319 (72.8)	614 (79.4)		
Second trimester	34 (10.1)	90 (20.5)	124 (16.0)		
Third trimester	6 (1.8)	29 (6.6)	35 (4.5)		
Standardized treatment, n (%)	265 (79.1)	344 (78.5)	609 (78.8)	0.04	0.846
Adverse neonatal outcome, n (%)	68(20.3)	67(15.3)	135(17.4)	3.29	0.070
Preterm birth/low birth weight	43(13.4)	48(11.2)	91(11.7)	0.78	0.377
Stillbirth	15	13	-	-	-
Neonatal death	1	3	-	-	-
Congenital syphilis	2	1	-	-	-

OR, odds ratio; CI, confidence interval. Crude ORs and P-values were derived from univariate logistic regression. Cases with missing key variables were excluded from the analysis. Event counts: adverse neonatal outcome 135 (17.4%; local 68, migrant 67); preterm birth/low birth weight 91 (11.7%; local 43, migrant 48); stillbirth 28; neonatal death 4; congenital syphilis 3. Adverse neonatal outcome was a composite outcome; individual components may overlap. χ^2, chi-square test.The crude association for adverse neonatal outcome was 0.71 (95% CI 0.49–1.03, P = 0.070), which became significant after adjustment (aOR = 0.59, P = 0.012), suggesting confounding by age and other covariates.

Table 2
Univariate analysis of factors associated with adverse outcomes

Outcome	Variable	Crude OR (95% CI)	P value
Adverse neonatal outcome	Migrant vs. local	0.71 (0.49–1.03)	0.070
	Age group (trend)	1.59 (1.22–2.09)	0.001
	High school or above vs. junior high school or below	0.59 (0.39–0.87)	0.009
	First antenatal visit (trend)	1.20 (0.86–1.68)	0.273
	Standardized treatment vs. non-standardized	0.72 (0.47–1.11)	0.142
	High vs. low TRUST titer	1.27 (0.76–2.11)	0.364
Preterm birth/low birth weight	Migrant vs. local	0.84 (0.54–1.30)	0.423
	Age group (trend)	1.32 (0.96–1.80)	0.085
	High school or above vs. junior high school or below	0.82 (0.52–1.29)	0.382
	First antenatal visit (trend)	1.58(1.11–2.26)	0.011
	Standardized treatment vs. non-standardized	0.77(0.46–1.28)	0.314
	High vs. low TRUST titer	1.27(0.70–2.30)	0.438
Non-standardized treatment	Migrant vs. local	1.03 (0.73–1.47)	0.849
	Age group (trend)	0.84 (0.66–1.08)	0.175
	High school or above vs. junior high school or below	1.02 (0.72–1.45)	0.915
	First antenatal visit (trend)	2.26 (1.70–3.02)	< 0.001
	High vs. low TRUST titer	1.16 (0.71–1.88)	0.558

OR, odds ratio; CI, confidence interval. Crude ORs and P-values were derived from univariate logistic regression. Event counts: adverse neonatal outcome 135 (17.4%; local 68, migrant 67); preterm birth/low birth weight 91 (11.7%; local 43, migrant 48); stillbirth 28; neonatal death 4; congenital syphilis 3. The crude association for adverse neonatal outcome was 0.71 (95% CI 0.49–1.03, P = 0.070).

Table 3
Multivariable logistic regression for adverse neonatal outcome and preterm birth/low birth weight

Variable	**Model 1: Adverse neonatal outcome aOR (95% CI)**	**P**	**Model 2: Preterm birth/low birth weight aOR (95% CI)**	**P**
Migrant vs. local	0.59 (0.39–0.89)	0.012	0.70 (0.43–1.13)	0.144
Age 25–34 vs. ≤24 years	1.45 (0.84–2.51)	0.178	0.88 (0.48–1.60)	0.674
Age ≥ 35 vs. ≤24 years	2.47 (1.39–4.38)	0.002	1.63 (0.88–3.04)	0.122
High school or above vs. junior high school or below	0.52 (0.34–0.80)	0.003	0.80 (0.49–1.29)	0.360
Second-trimester first visit vs. first trimester	1.09 (0.64–1.86)	0.739	1.40 (0.77–2.53)	0.265
Third-trimester first visit vs. first trimester	1.69 (0.72–3.93)	0.226	2.96 (1.26–6.96)	0.013
Standardized treatment vs. non-standardized	0.72 (0.46–1.13)	0.153	0.85 (0.50–1.45)	0.547
High vs. low TRUST titer	1.50 (0.86–2.61)	0.149	1.21 (0.64–2.29)	0.562
AUC	0.650	—	0.631	

Model 1 and Model 2 were adjusted for migrant status, age group, educational level, timing of first antenatal visit, standardized treatment, and TRUST titer. AUC, area under the receiver operating characteristic curve.

Table 4
Multivariable logistic regression for non-standardized treatment

Variable	aOR (95% CI)	P value
Migrant vs. local	0.84 (0.56–1.25)	0.389
Age 25–34 vs. ≤24 years	1.13 (0.73–1.75)	0.591
Age ≥ 35 vs. ≤24 years	0.75 (0.44–1.28)	0.292
High school or above vs. junior high school or below	1.03 (0.70–1.52)	0.878
Second-trimester first visit vs. first trimester	2.41 (1.54–3.76)	< 0.001
Third-trimester first visit vs. first trimester	5.66 (2.78–11.54)	< 0.001
AUC	0.642	—

The model was adjusted for migrant status, age group, educational level, and timing of first antenatal visit. AUC, area under the receiver operating characteristic curve.

Discussion

Principal Findings

This study showed that migrant pregnant women with syphilis had lower educational attainment, were younger, and were more likely to register for antenatal care after the first trimester than local women. However, standardized treatment coverage was similar between groups, and migrant status was not associated with higher odds of adverse neonatal outcomes or preterm birth/low birth weight after adjustment. Late antenatal registration was the strongest modifiable factor associated with non-standardized treatment and preterm birth/low birth weight.

Comparison with Previous Studies

Previous studies from China have reported that migrant women have lower antenatal care utilization and higher risk of adverse pregnancy outcomes [9–13]. In contrast, our cohort showed comparable standardized treatment coverage between migrant and local women (78.5% vs. 79.1%). This discrepancy may reflect differences in PMTCT program maturity, local policy implementation, definitions of ‘migrant’, case mix, outcome definitions, and adjustment strategies across studies.

Possible Explanations for the Inverse Association Between Migrant Status and Adverse Neonatal Outcome

The crude association between migrant status and adverse neonatal outcome was not statistically significant (OR = 0.71, 95% CI 0.49–1.03, P = 0.070), but became significant after adjustment (aOR = 0.59, 95% CI 0.39–0.89, P = 0.012). This shift suggests that the crude estimate was confounded by differences in age distribution and other covariates between groups. The inverse association should therefore be interpreted cautiously; it does not necessarily indicate that migrant status is protective. Several explanations are possible. First, local women were older; maternal age ≥ 35 years was independently associated with adverse neonatal outcomes (aOR = 2.47). Second, migrant women may have been more likely to enter care through PMTCT screening programs, which may have facilitated timely treatment once they were registered. Third, residual confounding and selection effects cannot be excluded, as women who remain in the PMTCT system may differ from those lost to follow-up. Fourth, the definition of adverse neonatal outcome may influence the direction of association. Therefore, this finding should be viewed as hypothesis-generating rather than causal.

Late Antenatal Registration as a Key Modifiable Factor

The most consistent finding was the association between late antenatal registration and adverse outcomes. Women who first attended antenatal care in the third trimester had higher odds of preterm birth/low birth weight (aOR = 2.96) and non-standardized treatment (aOR = 5.66). This suggests that early antenatal registration is a critical entry point for timely syphilis diagnosis, treatment initiation, and completion. Interventions that focus only on migrant status may be less effective than those that directly promote early antenatal care.

Public Health Implications

Our findings support several policy recommendations. First, community-based health education should target migrant women of reproductive age to promote early antenatal registration. Second, cross-provincial health insurance reimbursement should be further simplified to reduce financial barriers. Third, PMTCT programs should use multi-sectoral data sharing to identify and follow migrant pregnant women. Fourth, case management should be strengthened for women who register late or have high TRUST titers. For example, integrating ANC registration reminders into the existing PMTCT case management workflow, with automatic alerts for women who have not registered by 12 weeks, could operationalize the early-registration target.

Limitations

This study has several limitations. First, it was a retrospective study using routinely collected data, and some variables had missing or incomplete records. Second, the definition of standardized treatment should be interpreted with caution if it differs from international criteria.Our definition of standardized treatment followed the Chinese National PMTCT program, which requires three doses of benzathine penicillin G for all stages of syphilis. This differs from CDC and WHO guidelines, which recommend a

single dose for early syphilis. As a result, women with early syphilis who received a single dose—consistent with international guidelines—were classified as non-standardized in our analysis. This may have led to an underestimation of treatment coverage relative to international benchmarks. However, because the same definition was applied to both migrant and local women, the between-group comparison of treatment coverage remains valid. Third, the lack of association between migrant status and adverse outcomes may be influenced by residual confounding, including partner infection status, previous syphilis history, and socioeconomic factors not captured in the database. Fourth, RPR results were available for only 5% of the cohort; therefore, non-treponemal titer analyses relied exclusively on TRUST, which may limit comparability with studies using RPR.Fifth,follow-up data for infants were incomplete, which may have led to underestimation of congenital syphilis. Sixth, this was a single-city study, and generalization to other regions should be cautious.Seventh, the definition of adverse neonatal outcome was based on routinely collected data, and some components, such as congenital syphilis, may have been under-ascertained.Some records were excluded because of missing key variables; if missingness was not at random, this may have introduced selection bias.

Conclusions

Migrant pregnant women with syphilis had greater socioeconomic disadvantage and later antenatal registration than local women, but standardized treatment coverage was similar. Late antenatal registration, rather than migrant status itself, was the main modifiable factor associated with non-standardized treatment and preterm birth/low birth weight. Interventions should focus on promoting early antenatal care among migrant women.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Taizhou Women and Children's Hospital (approval number: 2026L-04-104).

All methods were performed in accordance with the relevant guidelines and regulations. Because of the retrospective nature of the study and the use of de-identified routinely collected data, the requirement for informed consent was waived by the Ethics Committee.

Consent for publication

Not applicable.

This manuscript does not contain any individual person's data in any form.

Availability of data and materialsThe datasets generated and/or analysed during the current study are not publicly available due to privacy and ethical restrictions.

Competing interests

The authors declare that they have no competing interests.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions

Xiaolin Li and Yan Ji conceived and designed the study. Xiaolin Li acquired and curated the data. Xiaolin Li conducted the statistical analyses. Xiaolin Li drafted the manuscript. Xiaolin Li and Tianyou Xu critically revised the manuscript for important intellectual content. All authors read, reviewed, and approved the final version of the manuscript.

Acknowledgements

The authors thank the staff of the Taizhou PMTCT Management Information System for their assistance with data collection and management.

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Figures

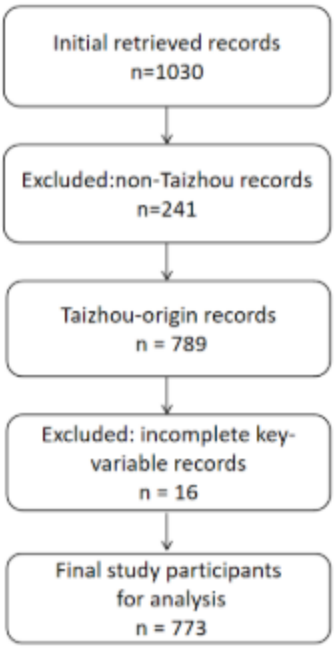


Figure 1

Unnumbered image in the Materials and Methods section.