

# Incidence of Congenital Syphilis and Adverse Pregnancy Outcomes among Syphilitic Pregnant Women According to the Treatment Adequacy in Tertiary Care Hospital, Thailand

Jiraporn Luengmettakul, MD<sup>1</sup>, Suttanaratt Apiwantana, MD<sup>1</sup>, Nattapong Jitrungruengnij, MD<sup>2</sup>

<sup>1</sup> Maternal Fetal Medicine Unit, Department of Obstetrics and Gynecology, Charoenkrung Pracharak Hospital, Division of Medical Service, Bangkok Metropolitan Administration, Bangkok, Thailand; <sup>2</sup> Department of Pediatrics, Charoenkrung Pracharak Hospital, Division of Medical Service, Bangkok Metropolitan Administration, Bangkok, Thailand

**Objective:** To investigate the incidence of congenital syphilis and adverse pregnancy outcomes between maternal adequate treatment and inadequate treatment.

**Materials and Methods:** The present study was a retrospective cohort study involving pregnant women who underwent delivery between January 2015 and December 2021. The study included 212 pregnant women with a confirmed syphilis infection. Of these, 106 were in the adequate treatment group and received a full course of penicillin injections at least 30 days prior to delivery, and 106 were in the inadequate treatment group. The authors investigated the incidence of congenital syphilis and adverse pregnancy outcomes according to the adequacy of penicillin treatment.

**Results:** Between 2015 to 2021, 28,849 pregnant women underwent delivery. The incidence of congenital syphilis was 104 cases per 100,000 live births, and 212 syphilitic pregnant women were enrolled. The mean age for mothers in the adequate group and the inadequate group was 21.87±5.42 and 23.31±5.68, respectively. The inadequate treatment group had a significantly higher rate of congenital syphilis at 28.3% versus 0% ( $p<0.001$ ), low birth weight of 27.4% versus 15.1% ( $p=0.031$ ), birth asphyxia at 11.3% versus 0% ( $p<0.001$ ), late preterm delivery at 18.9% versus 9.4% ( $p=0.017$ ), and stillbirth at 7.5% versus 0% ( $p=0.007$ ) than the adequate group. The syphilitic mother who received treatment after 28 weeks' gestation had a significantly higher risk of congenital syphilis (OR 26.98, 95% CI 3.56 to 204.15) and preterm labor (OR 3.74, 95% CI 1.66 to 8.40) compared to those received treatment before 28 weeks' gestation.

**Conclusion:** Adequate penicillin treatment before 28 weeks' gestation can prevent congenital syphilis and preterm delivery. It is crucial to implement a prevention and control strategy for syphilis before pregnancy, as well as an antenatal care follow-up protocol during pregnancy.

**Keywords:** Adequacy of treatment; Syphilis; Pregnancy; Congenital syphilis

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The spirochete *Treponema pallidum*, which causes syphilis, transmits the infection through sexual activity and vertically from a mother to a fetus. Untreated syphilis causes substantial morbidity and mortality. Syphilis in pregnancy is the leading cause of stillbirth, preterm birth, low birth weight, neonatal

death, and congenital syphilis in newborns<sup>(1,2)</sup>.

Syphilis is a worldwide public health problem. In 2012, the global prevalence of syphilis in adult men and women was 0.49% and 0.48%, and there were 350,000 adverse pregnancy outcomes in infected pregnant women<sup>(3)</sup>. The World Health Organization (WHO) has set a goal to eliminate congenital syphilis since 2007, with the primary objective of reducing mother-to-child transmission to 50 cases per 100,000 live births<sup>(4)</sup>. In 2022, the WHO launched a new global health strategy on sexually transmitted infections. This strategy includes a global target for syphilis, defined as the percentage of pregnant women attending antenatal care who are screened for syphilis. The target includes the percentage treated if positive, which is more than 95 out of 95, and the number of cases of congenital syphilis per 100,000 live births<sup>(5)</sup>. Screening for pregnant women during

## Correspondence to:

Luengmettakul J.

Maternal Fetal Medicine Unit, Department of Obstetrics and Gynecology, Charoenkrung Pracharak Hospital, Division of Medical Service, Bangkok Metropolitan Administration, 8 Charoenkrung Road, Bangkoklaem, Bangkok 10120, Thailand.

Phone: +66-86-3850781

Email: [jjiraporn02@gmail.com](mailto:jjiraporn02@gmail.com)

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the first prenatal visit is a recommended practice, as it rapidly identifies syphilitic pregnant women and serves as a strategy for the elimination of mother-to-child transmission (EMTCT) of HIV and syphilis.

The prevalence of confirmed syphilis in pregnancy varies in various places and populations. In the country where the sexually transmitted disease has not been controlled, they have faced the high prevalence of congenital syphilis<sup>(6)</sup>. The prevalence of confirmed syphilis screening in Thailand in the year 2009 was 0.14%, and the prevalence of congenital syphilis was 0.1%<sup>(7)</sup>. Between 2018 and 2020 in Thailand, the prevalence of mothers infected with syphilis during pregnancy was 0.78%<sup>(8)</sup>. Furthermore, the incidence of congenital syphilis in Thailand between 2013 and 2018 was 115 cases per 100,000 live births. The factors associated with congenital syphilis included inadequate treatment of maternal syphilis and preterm birth<sup>(9)</sup>. The data above indicate a rapid increase in syphilis infection during pregnancy and congenital syphilis over the past 10 years in Thailand. Pregnancy with untreated syphilis infection was at higher risk of stillbirth, preterm birth, and low birth weight compared to treated syphilitic pregnancy<sup>(1,2,10)</sup>. Furthermore, inadequate treatment for maternal syphilis also showed a higher risk for congenital syphilis and adverse pregnancy outcomes<sup>(10-13)</sup>.

Few studies in Thailand have examined the effects of an adequate or inadequate syphilis infection on pregnancy outcomes. Therefore, the objectives of the present study were to study the association of congenital syphilis and adverse pregnancy outcomes between mothers who received adequate treatment and those who received inadequate treatment. Additionally, the authors wanted to determine whether there was a relationship between initiation of adequate syphilis treatment and adverse pregnancy outcomes.

## Material and Methods

The present study was a retrospective cohort study that involve reviewing the medical records of pregnant women underwent delivery at Charoenkrung Pracharak Hospital between January 2015 and December 2021. The authors consecutively collected the medical records of pregnant women diagnosed with syphilis during pregnancy, provided there were no missing important data, until the specified number was reached. The Medical Service Department's Ethical Committee of the Bangkok Metropolitan approved the study protocol (BMAHREC S012h/64\_EXP).

In Thailand, the hospitals implement the policies and guidelines of the WHO<sup>(4)</sup> by conducting two examinations of sexually transmitted diseases, which are HIV, syphilis, and hepatitis B, during pregnancy. The first examination occurs during the initial antenatal care, and the second examination occurs at 28 to 32 weeks' gestation. Furthermore, the authors investigated the couple's STD infection during the same visits. With this strategy, the system could find more new cases and provide treatment quickly. Before 2017, the authors used the old method of diagnosing syphilis infection, which included a non-treponemal test, as a rapid plasma regain, or RPR, and then confirmation with a treponemal test (*Treponema pallidum* hemagglutination, or TPHA). Since 2017, the authors had changed the method of diagnosing syphilis during pregnancy to a reverse screening algorithm, as a treponemal test screening followed by non-treponemal test confirmation. Treatment of syphilis infections during pregnancy used benzathine penicillin therapy. Pregnant women allergic to penicillin might use penicillin sensitization or alternative medications, depending on the patient's preference. The authors treat early syphilis with benzathine penicillin intramuscularly (IM) for one or two doses. The late syphilis was treated with benzathine penicillin IM weekly for three doses. Adequate treatment for syphilis infection during pregnancy means receiving a complete course of penicillin injection at least 30 days before delivery. Inadequate treatment is defined as receiving a complete course of penicillin but less than 30 days before delivery, or receiving an incomplete injection, or not receiving treatment during pregnancy.

The inclusion criteria were pregnant women with syphilis infections who underwent delivery in the hospital. The exclusion criteria included incomplete medical records related to pregnancy outcomes and non-penicillin treatment. The authors divided pregnant women into two groups to study pregnancy outcomes, the group receiving adequate penicillin treatment and the group receiving inadequate penicillin treatment. For the study on treatment initiation time, the authors divided the groups based on gestational age, initiating treatment at 13 weeks and 28 weeks.

The primary outcome was the rate of congenital syphilis according to the adequacy of treatment of syphilis. Congenital syphilis is defined by the Centers for Disease Control and Prevention (CDC)<sup>(15)</sup> as 1) a neonate or fetus with an abnormal physical examination that was consistent with congenital

syphilis, 2) a serum nontreponemal serologic titer that was fourfold higher than the mother's titer, or 3) a pathological placenta confirmed for syphilis infection. The secondary outcomes were 1) postpartum hemorrhage of 500 mL or more in vaginal delivery, or 1,000 mL or more in cesarean delivery, 2) preeclampsia with systolic blood pressure of 140 mmHg or higher, diastolic blood pressure of 90 mmHg or higher, and urine protein to creatinine (UPCR) of 0.3 or more, 3) small for gestational age defined as birthweight less than tenth percentile of gestational age at day of delivery, 4) low birth weight defined as birth weight less than 2,500 g, 5) preterm delivery as overall preterm, early preterm, late preterm delivery defined as delivered between 24 to 36 weeks' gestation, 24 to 33 weeks' gestation, and 34 to 36 weeks' gestation, respectively, 6) birth asphyxia defined as 5-minute Apgar score less than 7, 7) still birth defined as intrauterine fetal death at more than 20 weeks' gestation, and 8) neonatal death defined as death of newborn within 28 days after birth.

### Statistical analysis

A pilot study with 89 syphilitic pregnant women calculated the sample size, finding an incidence of congenital syphilis in those receiving adequate treatment at 1/65 (0.015) and in those receiving inadequate treatment at 3/24 (0.125). With a power of 80% and a significant level at p-value less than 0.05, the total sample size, accounting for a 10% loss, was 212 for both groups combined.

The authors performed statistical analyses using IBM SPSS Statistics, version 26.0 (IBM Corp., Armonk, NY, USA). The continuous data expressed in mean and standard deviation and analyzed them using the student t-test. The category data was presented as numbers and percentages and then analyzed them using the Fisher's exact test or chi-square test. The univariable analysis examined treatment adequacy, treatment initiation, RPR titer at first visit, and pregnancy outcomes. It was displayed as an odds ratio (OR) or mean difference with a 95% confidence interval (CI).

### Results

Between 2015 and 2021, there were 28,849 pregnant women who underwent delivery. Out of the 268 pregnant women diagnosed with syphilis infection, 162 mothers received adequate penicillin treatment, 90 received inadequate treatment, and 16 did not receive any treatment for their syphilis infection. The prevalence of confirmed syphilitic

**Table 1.** Baseline characteristics of pregnant women with syphilis infection

Baseline characteristic	Adequate treatment (n=106)	Inadequate treatment (n=106)	p-value
Age (years); mean±SD	21.87±5.42	23.31±5.68	0.060
Age group; n (%)			0.039
<20 years	42 (39.6)	25 (23.6)	
20 to 34 years	58 (54.7)	75 (70.8)	
≥35 years	6 (5.7)	6 (5.7)	
Ethnic; n (%)			0.800
Thai	98 (92.5)	97 (91.5)	
Non-Thai	8 (7.5)	9 (8.5)	
Education; n (%)			0.285
No education	2 (1.9)	4 (3.8)	
Primary school	33 (31.1)	37 (34.9)	
Middle school	50 (47.2)	35 (33.0)	
High school	18 (17)	22 (20.8)	
Vocational certificate	2 (1.9)	5 (4.7)	
Bachelor's degree	1 (0.9)	3 (2.8)	
Occupation; n (%)			0.888
Not working	66 (62.3)	65 (61.3)	
Working	40 (37.7)	41 (38.7)	
Marital status; n (%)			0.344
Single	0 (0.0)	2 (1.9)	
Married	101 (95.3)	98 (92.5)	
Divorced/widow	5 (4.7)	6 (5.7)	
BMI (kg/m <sup>2</sup> ); n (%)			0.246
<25.00	45 (42.5)	57 (53.8)	
25 to 29.99	39 (36.8)	30 (28.3)	
≥30.00	22 (20.8)	19 (17.9)	
Alcohol drinking; n (%)	11 (10.4)	10 (9.4)	0.818
Drug abuse; n (%)	18 (17.0)	28 (26.4)	0.096
Nulliparous; n (%)	50 (47.2)	43 (40.6)	0.333
Mean time at first ANC (weeks)	14.65±5.70	22.58±10.24	<0.001
Time at first ANC; n (%)			<0.001
First trimester	44 (41.5)	22 (20.8)	
Second trimester	62 (58.5)	47 (44.3)	
Third trimester	0 (0.0)	37 (34.9)	
No ANC; n (%)	0 (0.0)	16 (15.1)	<0.001
HIV infection; n (%)	5 (4.7)	7 (6.6)	0.552
Stage of syphilis infection; n (%)			
Primary syphilis	2 (1.9)	12 (11.3)	0.006
Secondary syphilis	0 (0.0)	1 (0.9)	>0.999
Early latent syphilis	0 (0.0)	2 (1.9)	0.498
Late latent syphilis	104 (98.1)	91 (85.8)	0.001

BMI=body mass index; ANC=antenatal care; SD=standard deviation

pregnant women in the present study was 0.93%. The present study collected the data of 106 pregnant women for each group, the adequate treatment group, and the inadequate treatment group.

**Table 2.** Status of syphilis infection/treatment

Syphilis status	Adequate treatment (n=106); n (%)	Inadequate treatment (n=106); n (%)	p-value
RPR at first ANC $\geq$ 1:8	55 (51.9)	40 (37.7)	0.038
RPR at first ANC $\geq$ 1:16	41 (38.7)	31 (29.2)	0.147
Initiation treatment in first trimester (GA <13 weeks)	18 (17.1)	0 (0.0)	<0.001
Initiation treatment in second trimester (GA 13 to <28 weeks)	94 (89.5)	2 (2.1)	<0.001
Complete course of benzathine penicillin	106 (100)	80 (75.5)	<0.001
Documentation of partner			
Testing	80 (75.5)	47 (44.3)	<0.001
Confirmed syphilis infection/treatment	22 (20.8)	15 (14.2)	0.597
HIV infection	0 (0.0)	1 (0.9)	0.333

RPR=rapid plasma regain; ANC=antenatal care; GA=gestational age

Table 1 displayed maternal characteristics, showing no significant age difference between adequate and inadequate treatment. The age classification revealed that the majority of each group's population was between 20 and 34 years old. The group receiving adequate treatment had antenatal care up to 41.5% within 12 weeks' gestation, a significantly higher rate than the other group. The number of pregnant women in the inadequate treatment group who did not receive antenatal care was significantly higher. Ninety-two percent of mothers with syphilis received a diagnosis of late latent syphilis infection. Table 2 showed no significant difference between the two groups in the non-treponemal titer at the first visit. The inadequate treatment group had a significantly lower rate of initiation treatment before 28 weeks' gestation compared to the adequate treatment group ( $p < 0.001$ ). Despite the fact that 75.5% of syphilitic women receiving inadequate treatment completed the course of benzathine penicillin, they were still considered to have started less than 30 days before pregnancy. From the present study, the husbands of the adequate treatment group had a higher rate of documentation of blood tests than the other group at 75.5% versus 44.3%. Nevertheless, it was a low statistic. The rate of confirmed syphilis infection in husbands of pregnant women who received adequate treatment was only 27.5%, and it was only 31.9% in the other group, which was not statistically different.

Based on the adequacy of treatment, the rate of congenital syphilis was statistically higher in the inadequate treatment group compared to the adequate treatment group at 28.3% versus 0% ( $p = 0.001$ ). In the present study, there were 30 cases of congenital syphilis. Among these, eight were stillbirths with hydrops fetalis detected, one had organomegaly with hydrops, nine showed central nervous system

involvement from cerebrospinal fluid, and the remaining six were diagnosed by detecting an RPR titer in the blood that was four times higher than in the mother's blood. The study's overall congenital syphilis rate was 104 cases per 100,000 live births. Table 3 presented the other obstetric outcomes. The inadequate treatment group had a significantly higher incidence of early preterm birth at 14.2% versus 0% ( $p < 0.001$ ) and overall preterm birth at 33% versus 9.4% ( $p < 0.001$ ) than the adequate treatment group. Moreover, only the inadequate treatment group showed a statistically significant difference in the rate of stillbirth at 7.5% versus 0% ( $p = 0.007$ ). Four stillborn diagnosed with proven congenital syphilis were among the 16 untreated syphilitic mothers. There were no differences between the two groups regarding postpartum hemorrhage, route of delivery, or pregnancy-induced hypertension. For the neonatal outcome, the incidence of low birth weight was statistically higher in the inadequate treatment group than the adequate treatment group at 27.4% versus 15.1% ( $p = 0.031$ ). However, in terms of small for gestational age, there were no significant differences between the two groups. Furthermore, the inadequate treatment group presented a significantly higher risk of Apgar score 5 minutes of less than 7 at 11.3% versus 0 ( $p < 0.001$ ).

Table 4 displayed the pregnancy outcomes based on the initiation of treatment before or after 13- and 28-weeks' gestation. The syphilitic mother who received treatment before 28 weeks' gestation had a statistically significant lower risk of preterm birth and congenital syphilis newborns than mother received treatment after 28 weeks' gestation. The authors also studied treatment before and after 13 weeks' gestation but did not find a statistically significant difference between both groups due to the small number of pregnant women receiving treatment before 13

**Table 3.** Pregnancy outcomes of pregnant women with syphilis infection

Maternal outcomes	Adequate treatment (n=106); n (%)	Inadequate treatment (n=106); n (%)	Odds ratio or mean difference (95% CI)	p-value
Gestational age at time of delivery (weeks); mean±SD	38.43±1.45	36.80±3.29	1.63 (0.94 to 2.32)	<0.001
Early preterm delivery (GA <34 weeks); n (%)	0 (0.0)	15 (14.2)	-	<0.001
Overall preterm delivery (GA <37 weeks); n (%)	10 (9.4)	35 (33.0)	4.73 (2.20 to 10.19)	<0.001
All cesarean sections; n (%)	26 (24.5)	25 (23.6)	0.95 (0.51 to 1.78)	0.872
Previous cesarean section	11 (42.3)	16 (64.0)		
Primary cesarean section	15 (57.7)	9 (36.0)		
Estimated blood loss (mL); median (IQR)	240 (150,355)	250 (160, 352.50)	-	0.444
Postpartum hemorrhage; n (%)	3 (2.8)	8 (7.5)	2.80 (0.72 to 10.87)	0.122
Preeclampsia; n (%)	3 (2.8)	3 (2.8)	1.00 (0.20 to 5.07)	>0.999
Gestational diabetes; n (%)	5 (4.7)	5 (4.7)	1.00 (0.28 to 3.56)	>0.999
Still birth; n (%)	0 (0.0)	8 (7.5)	-	0.007
Neonatal body weight (g); mean±SD	2982.45±447.93	2771.42±682.62	211.04 (54.56 to 367.51)	0.008
Neonatal body weight; n (%)				
Less than 2,500 g	16 (15.1)	29 (27.4)	2.13 (1.07 to 4.21)	0.031
2,500 to 4,000 g	88 (83.0)	75 (70.8)	Ref.	
More than 4,000 g	2 (1.9)	2 (1.9)	1.17 (0.16 to 8.53)	0.852
SGA; n (%)	13 (12.3)	12 (11.3)	0.91 (0.40 to 2.11)	0.831
Apgar score 1 minute <7; n (%)	1 (0.9)	16 (15.1)	18.67 (2.43 to 143.53)	<0.001
Apgar score 5 minutes <7; n (%)	0 (0.0)	12 (11.3)	-	<0.001
Neonatal anemia; n (%)	3 (2.8)	4 (4.1)	1.46 (0.32 to 6.70)	0.713
Hypoglycemia; n (%)	5 (4.7)	11 (11.2)	2.55 (0.85 to 7.64)	0.084
Neonatal jaundice; n (%)	17 (16.0)	19 (19.4)	1.26 (0.61 to 2.59)	0.531
Congenital syphilis; n (%)	0 (0.0)	30 (28.3)	-	<0.001
LOS (days); mean±SD	5.41±3.60	12.11±13.94	-6.71 (-9.58 to -3.83)	<0.001

GA=gestational age; SGA=small for gestational age; LOS=length of stay; SD=standard deviation; CI=confidence interval

**Table 4.** Association between initiation of treatment and pregnancy outcomes

	GA <13 weeks (n=18); n (%)	GA ≥13 weeks (n=182); n (%)	Odds ratio (95% CI)	p-value	GA <28 weeks (n=96); n (%)	GA ≥28 weeks (n=104); n (%)	Odds ratio (95% CI)	p-value
Still birth	-	6 (3.3)	-	>0.999	1 (1.0)	5 (4.8)	4.80 (0.55 to 41.83)	0.156
Preterm	2 (11.1)	37 (20.3)	2.04 (0.45 to 9.28)	0.355	10 (10.4)	29 (27.9)	3.33 (1.52 to 7.27)	0.003
LBW (≤2,500 g)	4 (22.2)	35 (19.2)	0.83 (0.26 to 2.69)	0.760	17 (17.7)	22 (21.2)	1.25 (0.62 to 2.52)	0.539
Asphyxia	-	5 (2.8)	-	>0.999	-	5 (5.1)	-	0.999
Congenital syphilis	-	24 (13.2)	-	0.137	1 (1.0)	23 (22.1)	26.98 (3.56 to 204.15)	0.001

GA=gestational age; LBW=low birthweight; CI=confidence interval

**Table 5.** Association between RPR titer at first visit and pregnancy outcome

	RPR <1:8 (n=117); n (%)	RPR ≥1:8 (n=95); n (%)	Odds ratio (95% CI)	p-value
Still birth	1 (0.9)	7 (7.4)	9.23 (1.12 to 76.38)	0.039
Preterm	13 (11.1)	32 (33.7)	4.06 (1.99 to 8.32)	<0.001
LBW (≤2,500 g)	11 (9.4)	34 (35.8)	5.37 (2.54 to 11.36)	<0.001
Asphyxia	1 (0.9)	5 (5.7)	6.99 (0.80 to 60.92)	0.078
Congenital syphilis	8 (6.8)	22 (23.2)	4.11 (1.73 to 9.72)	0.001

RPR=rapid plasma regain; LBW=low birthweight; CI=confidence interval

weeks' gestation. The relationship between RPR titers at first visit and pregnancy outcomes (Table 5), found

that RPR titers of 1 to 8 or more were significantly associated with the incidence of preterm birth, low

birth weight, stillbirth, and congenital syphilis.

## Discussion

The present study found that syphilitic pregnant women with inadequate or untreated groups had a significantly higher incidence of congenital syphilis and adverse pregnancy outcomes than the adequate treatment group. Similarly, from the previous studies<sup>(2,8-13)</sup>, it was found that pregnant women with adequate penicillin treatment detected significantly lower rates of congenital syphilis and adverse pregnancy outcomes. *T. pallidum*, the cause of syphilis infection, can transmit from mother to fetus, causing damage to the placenta and umbilical cord. The time that passes in untreated or inadequately treated syphilitic mothers directly correlates with the risk of adverse pregnancy outcomes and congenital syphilis. The study by Qin et al.<sup>(16)</sup> found a 2.82-fold increase in the risk of an adverse pregnancy outcome for every week of treatment delay. Adequate treatment for pregnancy with syphilis infection must be given only with the penicillin group, and the duration of administration must be longer than four weeks to reduce the infection because this drug crosses the placenta, which aims to get rid of maternal infection and to prevent congenital infection<sup>(14,15)</sup>. However, congenital syphilis infection must be considered in all cases, and treatment for all newborns is still necessary.

Early and adequate syphilis treatment plays a key role in preventing adverse pregnancy outcomes and congenital syphilis<sup>(11,17)</sup>. Consistent with previous studies<sup>(2,10-13,17-19)</sup>, it was revealed that the adequate penicillin treatment group demonstrated a significantly lower rate of preterm labor, a 5-minute Apgar score of less than 7, low birth weight, and congenital syphilis. The CDC recommended that syphilitic mothers should be treated as early as possible, with treatment given according to the stage of syphilis<sup>(15,20)</sup>.

In 2015, Thailand adopted policies<sup>(20)</sup> from the WHO<sup>(4)</sup> to reach the global target of 50 or fewer cases of congenital syphilis per 100,000 live births. According to a report from the United States of America, between 2013 and 2019, the national rate of congenital syphilis dramatically increased from 9.2 to 48.5 cases per 100,000 live births<sup>(21)</sup>. According to a report in Thailand, the rate of congenital syphilis significantly increased from 0% in 2006 to 0.06% in 2015<sup>(22)</sup>. A study conducted between 2011 and 2018 reported an incidence of 204 cases per 100,000 live births<sup>(9)</sup>. In line with the findings of the current

study, the authors discovered a remarkable incidence of congenital syphilis at 104 cases per 100,000 live births. The reasons for this high rate were 1) two-thirds of syphilitic women received inadequate or no prenatal care, leading to inadequate or no treatment for their syphilis infection, 2) recurrent infection from sexual contact with a partner who did not receive any treatment, resulting in either no treatment or inadequate treatment, 3) the diagnosis of syphilis was made after the second pregnancy test at 28 to 32 weeks of gestation, resulting in inadequate treatment, and 4) risky sexual practices by the mother, including unprotected intercourse, having several partners, and avoiding prenatal and postpartum checkups. Therefore, the strategies for preventing congenital syphilis are 1) early prenatal care within the first trimester, 2) close monitoring of the results of pregnancy blood tests for sexually transmitted infections, 3) providing treatment quickly, and 4) continuous monitoring until syphilis treatment is complete. Adequate penicillin treatment for syphilis can prevent congenital syphilis and adverse pregnancy outcomes.

The trend of maternal syphilis infection in Thailand increased from 0.05% in 2006 to 0.5% in 2015<sup>(22)</sup>. The present study found that the prevalence of maternal syphilis infection was 0.93%, a higher rate than in the past. Since 2017, the reverse sequence screening test, or the treponemal screening test, has been used, which has a higher sensitivity than the traditional algorithm, or non-treponemal screening test. Another reason for the rise in syphilis infection rates among pregnant women is the implementation of a policy that grants privileges in antenatal care to Thai women and establishes guidelines for sexually transmitted infection testing twice during pregnancy.

## Strength and limitation

The strength of the current study lied in the fact that it was one of the few studies in Thailand to report on obstetric outcomes, neonatal outcomes, and congenital syphilis based on the effectiveness of the syphilis treatment provided. Furthermore, this study provided an update on the current state of syphilis in pregnancy. The limitation of the current study is that the authors were only able to follow up infants diagnosed with congenital syphilis for a short period of time. Furthermore, the under detection of congenital syphilis may occur because some infants failed to attend follow-up appointments and were not reachable. Furthermore, the present study excluded women who had miscarriages, potentially

underestimating the prevalence of syphilis in pregnant women.

## Conclusion

The trend of congenital syphilis increases with time that passes in untreated or inadequately treated syphilitic mothers. Adequate penicillin treatment before 28 weeks' gestation can prevent congenital syphilis, preterm delivery, birth asphyxia, and stillbirth. It is crucial to implement a prevention and control strategy for syphilis before pregnancy, as well as an antenatal care follow-up protocol during pregnancy.

## What is already known on this topic?

Syphilis is still a worldwide public health problem. During the past 10 years, the trend of syphilis infection during pregnancy has increased. Untreated or incompletely treated pregnant women with syphilis infections result in adverse pregnancy outcomes.

## What does this study add?

Even after completing three doses of benzathine penicillin, inadequate treatment of pregnant women with syphilis infection significantly increases the incidence of congenital syphilis and other adverse pregnancy outcomes. Adequate penicillin treatment before 28 weeks' gestation can prevent these outcomes. Based on this information, a national policy should be established to promote early prenatal care for all pregnant women during the first trimester. Furthermore, it is crucial to implement a prevention and control strategy for syphilis before pregnancy, establish a follow-up protocol for antenatal care, and ensure treatment compliance during pregnancy.

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## Conflicts of interest

The authors declare no conflict of interest.

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