Original Article

Effects of Dengue Infection on Maternal and Neonatal Outcomes in Thai Pregnant Women: A Retrospective Cohort Study

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Objective: To investigate the impact of dengue infection on pregnancy outcomes in pregnant women at a tertiary care hospital in Thailand.

Materials and Methods: Using a retrospective cohort study design, the authors reviewed hospital medical records to obtain socio-demographic, obstetric data, maternal, and neonatal outcomes of 48 pregnant women with dengue infection and randomly selected 500 pregnant women without dengue infection. Data on infection-related variables were also collected for those diagnosed with dengue infection. The association of dengue infection with maternal and neonatal outcomes was examined using multivariate logistic regression.

Results: Among 48 dengue infected pregnant women, 57% were Grade I dengue infection, and dengue infection affected pregnant women throughout the three trimesters. The most common presenting symptoms were fever, myalgia, and headache. Dengue-infected pregnant women had more preterm labor than non-dengue-infected pregnant women (25.0% in dengue group versus 11.6% in non-dengue group, p=0.008). There was no difference between the two groups in maternal mortality and other maternal outcomes as well as neonatal outcomes. In a multivariate logistic regression, maternal dengue infection doubled the risk of preterm labor, while severe preeclampsia increased the risk by almost four folds (adjusted odds ratio 2.099; 95% CI 1.005 to 4.384 and 3.763; 95% CI 1.480 to 9.569, respectively).

Conclusion: Dengue infection was associated with a two-fold increased risk of preterm labor in Thai pregnant women. However, it did not increase risk of maternal mortality nor adverse neonatal outcomes.

Keywords: Dengue infection in pregnancy, Pregnancy outcomes, Neonatal outcomes

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Dengue infection is one of major infection found in tropical region especially in Southeast Asia. Thailand is an endemic area of dengue virus and two to three epidemics of dengue per year had been reported[(1)]. The incidence of dengue infection in the last decade was very high. During the 2013 outbreak, an incidence of 241.03 per 100,000 individuals with a mortality of 0.09% in Thai population were reported[(2)].

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Although, deaths from dengue infection have declined, the rate of dengue infection in adults has increased considerably over the last few decades. Pregnant women are also susceptible to dengue infection[(3)]. Dengue infection, which can affect pregnant women in any trimester and in postpartum period, has been reported to cause many undesirable pregnancy outcomes such as abortion, preterm labor, antepartum hemorrhage, and postpartum hemorrhage[(4-8)]. However, previous studies were relatively small and done in a limited number of tropical countries. Little evidence exists to systematically describe the impact of clinical dengue infection on maternal and neonatal outcomes in a Thai population[(9-11)], given the fact that vertical transmission could happen[(8)]. Therefore,

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the current study aimed to compare maternal and neonatal outcomes between pregnant women with and without dengue infection in a tertiary care hospital in northeastern Thailand.

Materials and Methods

A retrospective cohort study was conducted to compare pregnancy outcomes between pregnant women with and without dengue infection. Medical records of patients diagnosed with viral infection during pregnancy (International classification of diseases [ICD] 10 code O985/A90/A919) admitted in Sunpasitthiprasong Hospital between January 2013 and December 2016 were reviewed and those with confirmed dengue infection according to the 2009 World Health Organization (WHO) criteria[12] were included. Data on randomly selected pregnant women without dengue infection admitted to the hospital for problems other than dengue fever (ICD-10 code O030/O069/O800-O849) during the same period were collected to form a retrospective cohort with a ratio of dengue infected and non-infected subjects of 1:10.

For those dengue-infected women who delivered at Sunpasitthiprasong Hospital, socio-demographic, obstetric data, pregnancy, and neonatal outcomes were collected from their hospital medical records. For those with dengue infection that delivered elsewhere, the above data were obtained from other hospitals' medical records and by telephone call. The socio-demographic data included age, occupation, marital status, postal address, and types of health insurance. Obstetric data including gravidity, parity, gestational age at diagnosis, route of delivery, gestational age at delivery, and pregnancy outcomes (miscarriage, preterm labor, fetal growth restriction, amniotic fluid amount, preeclampsia, and postpartum hemorrhage) were also collected. Data on neonatal outcomes, such as birthweight, Apgar scores, neonatal jaundice, respiratory distress, neonatal intensive care unit (NICU) admission, and neonatal death, were also obtained. For those with confirmed dengue infection, data on infection-related variables were collected. These included clinical manifestation of dengue infection, dengue diagnoses (dengue fever, dengue hemorrhagic fever, and dengue shock syndrome), grading, serologic results (NS1 antigen [NS1Ag], dengue immunoglobulin [Ig] M, and IgG), complete blood counts, renal, and liver function test results.

Postpartum hemorrhage was defined as estimated blood loss more than 500 ml for vaginal delivery or more than 1,000 ml for Cesarean delivery. Preterm labor was defined as regular uterine contraction and cervical change occurred before 37 weeks of gestation. Miscarriage was defined as a pregnancy termination before 28 weeks of gestation that baby could survive. Fetal growth restriction was defined as ultrasonography estimated fetal weight less than ten percentile for gestational age accompanied with Doppler change in umbilical artery or middle cerebral artery. Low birth weight was defined as birth weight of lower than 2,500 g. Hemoconcentration was defined as a rising hematocrit of 3% or more compared to the baseline value in early febrile phase. Leukopenia was defined as white blood count of lower than 5,000 cells/mm^3. Thrombocytopenia was defined as platelet count of lower than 100,000/mm^3. Elevated liver enzyme was defined as enzyme aspartate aminotransferase (AST) of more than 40 U/L or alanine aminotransferase (ALT) of more than 41 U/L. Renal insufficiency was defined as creatinine level of more than 0.8 mg/dL.

The study was performed after the approval of Institutional Ethic Committee (002/2560). The funding source had no involvement in research preparation, collection, analysis, interpretation of data, writing of the report, and decision to submit the article for publication. Wuttikonsammakit P and Singkibutr T had full access to all the data and Wuttikonsammakit P had final responsibility for the decision to submit for publication.

Statistical analysis

The sample size was calculated based on a research question "whether dengue infection increases mortality in pregnant women". According to a study by Adam et al, the maternal mortality rate of 21% was observed in mothers with dengue infection[5], while maternal mortality in general pregnant women in Sunpasitthiprasong Hospital was 0.16%. Using 80% power and 95% confidence interval, to form a retrospective cohort with 1:10 ratio of infected and non-infected pregnant women, 49 dengue infected cases and 500 pregnant women without dengue infection were required. In addition, a sample size for a research question "whether dengue infection increases risk of preterm labor in pregnant women" was also computed. With the occurrence rate of preterm delivery was approximately 11% and data from a meta-analysis by Paixão et al[13] suggested dengue infection had a relative risk of 2.5, 42 dengue and 420 non-dengue pregnant women were required. With the limited number of pregnant women with dengue infection in Sunpasitthiprasong Hospital, the authors decided to use all available dengue cases of

Table 1. Baseline characteristics of pregnant women participating in the study

Characteristics	Total (n=548) n (%)	Dengue (n=48) n (%)	Control (n=500) n (%)	p-value
Age (year); median (IQR)	26 (21, 31)	23 (20, 27.75)	26 (22, 31)	0.008
Occupations				0.631
Student	112 (20.4)	13 (27.1)	99 (19.8)	
Self-employ	25 (4.6)	2 (4.2)	23 (4.6)	
Employee	232 (42.3)	16 (33.3)	21.6 (43.2)	
Government official	29 (5.3)	2 (4.2)	27 (5.4)	
Others	150 (27.4)	15 (48.0)	135 (27)	
Marital status				0.091
Single	190 (34.7)	23 (47.9)	167 (33.4)	
Married	352 (64.2)	24 (50.0)	328 (65.6)	
Divorced	6 (1.1)	1 (2.1)	5 (1.0)	
Area of living				0.407
Urban area	140 (25.5)	13 (27.1)	127 (25.4)	
Rural area	390 (71.2)	35 (72.9)	355 (71.0)	
Other countries	18 (3.3)	0 (0.0)	18 (3.6)	
Type of health insurance				0.015
Universal coverage	334 (60.9)	36 (75.0)	298 (59.6)	
Social welfare	64 (11.7)	8 (16.7)	56 (11.2)	
Government official welfare	33 (6.0)	2 (4.2)	31 (6.2)	
Self-payment	117 (21.4)	2 (4.2)	115 (23.0)	
Gravidity; median (IQR)	2 (1, 2)	1 (1, 2)	2 (1, 2)	0.705
Parity; median (IQR)	0 (0, 1)	0 (0, 1)	0 (0, 1)	0.443
Gestational age				<0.001
First trimester	40 (7.3)	12 (25.0)	28 (5.6)	
Second trimester	32 (5.8)	19 (39.6)	13 (2.6)	
Third trimester	476 (86.9)	17 (35.4)	459 (91.8)	
Abortion; median (IQR)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0.757

IQR=interquartile range

48 and 500 pregnant women without dengue infection as the study sample.

Statistical analyses were performed using SPSS, version 17.0 (SPSS Inc., Chicago, Ill, USA). Characteristics of participants were described using number (percentage), mean (standard deviation), and mean (interquartile range). Comparisons between those with and without dengue infection were done using chi-square test, student t-test, and Man-Whitney U test for categorical and normally- and non-normally distributed continuous variables respectively. Logistic regression was used to examine the association between dengue infection, other risk factors and pregnancy outcomes. A p-value of less than 0.05 was considered statistically significant.

Results

Among 75 dengue-infected pregnant women admitted in Sunpasitthiprasong Hospital during four years of the study period (2013 to 2016), only 48 pregnant women had outcome data available, either through hospital medical records or confirmation by telephone call. Five hundred pregnant women admitted to Sunpasitthiprasong Hospital for problems other than dengue infection during the study period were randomly selected by computer and served as non-dengue infected individuals. Table 1 shows the baseline characteristics of pregnant women with and without dengue infection. Those with and without dengue infection were similar with regard to gravidity, parity, previous abortion, occupation, marital status,

Table 2. Characteristics of pregnant women with dengue virus infection (n=48)

	n (%)
Gestational age exposed	
First trimester	12 (25.0)
Second trimester	19 (39.6)
Third trimester	17 (39.4)
Diagnosis	
Dengue fever	14 (29.2)
Dengue hemorrhagic fever	27 (56.3)
Dengue shock syndrome	7 (14.6)
Grading of dengue infection	
Grade I	20 (56.8)
Grade II	6 (17.6)
Grade III	7 (20.6)
Grade IV	1 (2.9)
Serologic diagnosis	
NS1Ag (n=45)	31 (68.9)
Dengue IgM (n=46)	10 (21.7)
Dengue IgG (n=45)	21 (46.7)
Presenting symptoms	
Fever	48 (100)
Myalgia/headache	28 (58.3)
Bleeding per gum	5 (10.4)
Epistaxis	3 (6.3)
Petechiae	1 (2.1)
Nausea/vomiting	9 (18.8)
Abdominal pain	9 (18.8)
Bleeding per vagina	0 (0.0)
Laboratory findings	
Thrombocytopenia	34 (70.8)
Leukopenia	34 (70.8)
Presence of atypical lymphocyte	30 (62.5)
Hemoconcentration	20 (41.7)
Elevated liver enzyme (n=37)	31 (83.8)

NS1Ag=NS1 antigen; IgM=immunoglobulin M; IgG=immunoglobulin G

and geographical areas. Dengue-infected women were significantly younger than non-dengue pregnant women (median age of 23 in dengue group and 26 in control group, p=0.008). There was difference in type of health insurance between the two groups. In addition, there was significant difference between the two groups in gestational age at the time of admission, 91.8% of non-dengue pregnant women were admitted in the third trimester (mostly with spontaneous labor), while only 35.4% of dengue-infected pregnant women were admitted in the third trimester.

Table 2 shows disease-related characteristics of dengue infected women. Dengue infection affected pregnant women in all three trimesters similarly. Fifty-six percent of all cases were dengue hemorrhagic fever, most of which were Grade I. For those whom serological tests were done to confirm diagnosis, almost 70% had positive NS1Ag and only 22% had positive dengue IgM. The three most common clinical presentations were fever, myalgia or headache, and nausea, vomiting, or abdominal pain. While bleeding occurred in a few pregnant women, no bleeding per vagina was reported. Most of these patients had thrombocytopenia, leucopenia, and elevated liver enzymes.

Pregnancy outcomes in all pregnant women and by dengue infection status are shown in Table 3. There was no difference between pregnant women with and without dengue infection in miscarriage, fetal growth restriction, amniotic fluid amount, gestational age at delivery, postpartum hemorrhage, and maternal death. Pregnant women with dengue infection had more preterm labor than those without (25.0% versus 11.6%, respectively; p=0.008). Severe preeclampsia was found in 10.4% of non-infected women and only 3.4% in dengue-infected pregnant women (p=0.035). As pregnant women with dengue infection generally presented to the hospital in earlier trimesters than those without, the authors did a subgroup analysis in those with gestational age of more than 24 weeks. It showed no difference in development of severe pre-eclampsia between the two groups (3.7% and 8.0% in non-dengue and dengue groups, respectively; p=0.253). The two groups were modestly, but statistically significant, different regarding routes of delivery.

As shown in Table 4, there was no significant difference between women with and without dengue infection in neonatal outcomes, such as birth weight, Apgar score at 1 and 5 minutes, neonatal jaundice, respiratory distress, low birth weight, NICU admission, and neonatal death. Vertical transmission was not identified in any cases.

In univariate logistic regression (Table 5), there were only three factors that were associated with preterm labor. These included dengue infection, severe pre-eclampsia, and maternal age. In multivariate logistic regression, factors independently associated with the risk of preterm labor were dengue infection and severe pre-eclampsia. Dengue infection doubled the risk of preterm labor (adjusted odds ratio [OR] 2.1,

Table 3. Comparison of pregnancy outcomes between pregnant women with and without dengue infection

Pregnancy outcomes	Total (n=548) n (%)	With dengue infection (n=48) n (%)	Without dengue infection (n=500) n (%)	p-value
Miscarriage	39 (7.1)	1 (2.1)	38 (7.6)	0.238
Fetal growth restriction	2 (0.4)	1 (2.1)	1 (0.2)	0.168
Preterm labor	70 (12.8)	12 (25.0)	58 (11.6)	0.008
Amniotic fluid amount				0.804
Adequate	530 (96.9)	46 (95.8)	484 (97)	
Oligohydramnios	15 (2.7)	2 (4.2)	13 (2.6)	
Polyhydramnios	2 (0.4)	0 (0.0)	0 (0.0)	
Gestational age at delivery; median (IQR)	38 (37, 39)	38 (36, 39)	38 (37, 39)	0.229
Route of delivery				0.003
Spontaneous vertex delivery	237 (46.6)	30 (63.8)	207 (44.8)	
Cesarean delivery	222 (43.6)	17 (36.2)	205 (44.4)	
Forceps extraction	9 (1.8)	0 (0.0)	9 (1.9)	
Vacuum extraction	41 (8.1)	0 (0.0)	41 (8.9)	
Postpartum hemorrhage	36 (6.6)	33 (6.6)	3 (6.3)	1.00
Mild preeclampsia	4 (0.7)	4 (0.8)	0 (0.0)	1.00
Severe preeclampsia	22 (4.0)	17 (3.4)	5 (10.4)	0.035
Maternal death	1 (0.2)	1 (2.1)	0 (0.0)	0.088

IQR=interquartile range

Table 4. Comparison of neonatal outcomes between pregnant women with and without dengue infection

Neonatal outcome*	Total (n=548) n (%)	Dengue (n=48) n (%)	Control (n=500) n (%)	p-value
Birth weight (gram); median (IQR)	2,960 (2,700, 3,325)	2,865 (2,326, 3,404)	2,986 (2,439, 3,531)	0.065
Apgar 1; median (IQR)	9 (9, 9)	9 (9, 9)	9 (9, 9)	0.747
Apgar 5; median (IQR)	10 (10, 10)	10 (10, 10)	10 (10, 10)	0.933
Respiratory distress	93 (17.0)	10 (20.8)	83 (16.6)	0.455
Low birth weight <2,500 gram	62 (11.3)	7 (14.6)	55 (11.0)	0.454
Neonatal jaundice	18 (3.3)	12 (25.0)	143 (28.6)	0.597
NICU admission	28 (5.1)	2 (4.2)	26 (5.2)	0.548
Neonatal death	4 (0.7)	1 (2.1)	3 (0.6)	0.308

IQR=interquartile range; NICU=neonatal intensive care unit

Table 5. Factors associated with the risk of preterm labor

	Crude OR	Adjusted OR*
Dengue infection	2.540 (1.251 to 5.158)	2.099 (1.005 to 4.384)
Severe preeclampsia	4.276 (1.725 to 10.605)	3.763 (1.480 to 9.569)
Maternal age	0.96 (0.921 to 0.998)	0.96 (0.926 to 1.005)

OR=odds ratio

* Adjusted with dengue infection, severe preeclampsia, and maternal age

95% CI 1.0 to 4.4, p=0.049) and severe pre-eclampsia was associated with an almost 4-fold increased risk of preterm labor (adjusted OR 3.8, 95% CI 1.5 to 9.6, p=0.005).

Discussion

In the cohort of Thai pregnant women in Ubon Ratchathani, preterm labor occurred more frequently in pregnant women with dengue infection than those without. Factors independently associated with the risk of preterm labor in these pregnant women population were dengue infection and severe pre-eclampsia, with dengue infection doubling the risk of preterm labor. However, dengue infection did not deleteriously impact other maternal and neonatal outcomes.

Clinical features of dengue infected pregnant women in the present study modestly differed from those in previous studies. Dengue infection equally affected pregnant women in all three trimesters, while the previous studies reported that dengue infection predominately occurred in the third trimester[14,15]. Most of the presenting symptoms were similarly observed in both the present and previous studies[15], except for nausea, vomiting, and abdominal pain, which were reported more frequently in the present study than the other previous studies. Of note, in contrast with a previous study by Friedman et al[14], the present study found that almost two-thirds had positive NS1Ag and only one-fifths had positive dengue IgM. These findings might possibly be explained by different natural history of dengue infection in different countries or regions.

The present study confirmed that dengue infection increases the risk of preterm labor independently of other known risk factors. A recent meta-analysis of four cohorts suggested that dengue infection was associated with a 2.5-fold increase in risk of preterm birth. This is slightly higher than the OR of 2.1 in the present study. The difference might be explained by different outcomes used in the two studies (preterm birth in their study and preterm labor in the present study). This might also suggest that dengue infection possibly alter the effectiveness of treatment for preterm labor[13,16]. That is, risk of preterm birth in women presented with preterm labor may be increased when they had dengue infection.

Due to the nature of dengue infection, many assume that it may increase the risk of post-partum hemorrhage. Nevertheless, the result from the present study was not able to show the deleterious effect of dengue infection on post-partum hemorrhage, although one of pregnant women in the present study died from postpartum hemorrhage and multi-organ failure resulted from severe form of dengue infection. Of note, only a few cases of dengue infection occurred during intra-partum period. This also supports the potential of tocolytics to delay the phase of labor to post-critical period of dengue infection in order to prevent postpartum hemorrhage and maternal mortality. This finding supports the important consideration of postpartum hemorrhage increased in previous studies[17,18]. In particular, in case of severe form of dengue infection in pregnant women during labor, especially premature labor, tocolysis may be another option to delay pregnancy until dengue convalescent phase to avoid postpartum hemorrhage and maternal mortality.

Dengue infection has been reported to increase the risk of a number of other maternal and neonatal outcomes, such as miscarriage, low birthweight and stillbirth. In contrast, the present study did not find the impact of dengue infection on such pregnancy and neonatal outcomes. This might be due to differential proportions of pregnant women affected by dengue infection in the three trimesters and severity of dengue infection in these studies. For example, dengue infection affected more women in their third trimester in previous studies[14,15] than the present study; hence, the risk of stillbirth may be higher in the previous studies. The difference may be explained by the disparity in the severity of dengue infection across studies. However, this could not be officially compared as the present study reported severity of dengue infection, while others did not.

As the result of severe preeclampsia, which usually occurred in late pregnancy (gestational age more than 24 weeks), severe preeclampsia occurred less frequently in dengue-infected patients than non-dengue-infected pregnant women (3.4% and 10.4%, respectively; p=0.035). This may be explained by that most pregnant women (91.8%) in non-dengue group were admitted in hospital in the third trimester, whereas only one-third of dengue-infected pregnant women were admitted in the third trimester. However, in a subgroup analysis in pregnant women with gestational age of more than 24 weeks, the authors found no significant difference of severe pre-eclampsia between the two groups (3.67% in control group versus 8% in dengue group, p=0.253).

Considerably lower maternal mortality was observed in this Thai cohort of pregnant women affected with dengue infection than a previous study in Sudan. Maternal mortality was found in only one

Table 6. Comparison of the clinical features between pregnant women with a gestational age of ≥24 weeks who had dengue infection and SPE

Clinical features	Dengue (n=25) n (%)	SPE (n=17) n (%)	p-value
Fever	25 (100)	0 (0.00)	<0.001
Myalgia or headache	15 (60.00)	4 (23.53)	0.029
Bleeding episode	4 (16.00)	0 (0.00)	0.134
Abdominal pain	4 (16.00)	0 (0.00)	0.134
Hemoconcentration	12 (48.00)	1 (5.88)	0.006
Leukopenia	15 (60.00)	0 (0.00)	<0.001
Thrombocytopenia	17 (68.00)	0 (0.00)	<0.001
Presence of atypical lymphocyte	14 (56.00)	0 (0.00)	<0.001
Elevated liver enzyme	16 (64.00)	0 (0.00)	<0.001
Renal insufficiency	0 (0.00)	1 (5.88)	0.436
Fetal growth restriction	0 (0.00)	0 (0.00)	-

SPE=severe preeclampsia

case in the present study (2.1%), while a Sudan study[5] showed a higher mortality rate of 21.7%. This may be explained by hyperendemic conditions in Sudan being associated with increased probability of secondary infections, lack of immunity in the population, and occurrence of virulent strains causing more severe form of the disease. This may also reflect limited access to high quality care for those with dengue infection in this African population. However, due to a very small number of studies in developed countries examining mortality in pregnant women with dengue infection, the authors could not compare this maternal outcome with those countries.

Dengue infection and severe pre-eclampsia may have similar clinical manifestations and laboratory results, which could sometimes lead to misdiagnosis and hence inappropriate treatments. However, our additional analysis (Table 6) found that careful consideration of clinical presentations, laboratory findings, and fetal growth restriction may help distinguish between pregnant women with dengue infection and severe pre-eclampsia. These include a history of most frequent symptoms (fever, myalgia, or headache), abnormal hematologic findings and liver function, as well as seasonal endemic of dengue infection, and dengue serologic testing. Thrombocytopenia and elevated liver enzymes observed in the present study were similar to that of previous studies[4]. In dengue-infected pregnant women, supportive treatments with antipyretics, adequate hydration, and blood component transfusion as indicated until the disease subsides may help reduce the risk of preterm labor, postpartum hemorrhage, and maternal mortality. However, in treating pregnancy with dengue infection, doctors need to be aware of HELLP syndrome, a severe variant of pre-eclampsia, which represents a life-threatening pregnancy complication that requires termination of pregnancy. The delay in diagnosis and treatment of this resembling condition could lead to increased morbidity and mortality of the mothers and neonates.

Effects of dengue infection on risk of low birth weight remain unclear. While some studies[14] found that dengue infection significantly increased the risk of low birth weight, the present study and others did not find such association[13]. This discrepancy might be related to a number of factors such as differences between these studies in rates of preterm delivery, maternal age, gravidity, and other maternal morbidity such as preeclampsia and anemia.

It has been suggested in a few previous studies that there may also be a risk of mother-to-child transmission of dengue infection. A study by Tan et al[19] confirmed the vertical transmission by the increased dengue IgM titers in the umbilical cord blood but found a relatively low vertical transmission rate of 1.6%. As there was no sign and symptom suggestive of dengue infection in the neonates of the dengue-infected pregnant women and dengue virus serological tests in cord blood were not done in the present study, the authors were not be able to determine the extent of the vertical transmission in this Thai population. This warrants large well-designed cohort studies examining dengue vertical transmission in different populations and countries of endemic areas.

The strength of the present study is that it is the largest study examining effects of dengue infection on pregnancy outcomes in a Thai population. However, there were some limitations especially in the retrospective design. The information was mainly obtained from the medical records, so the completeness of the data may vary. Another limitation is that we included only the in-patient while the less severe outcomes in dengue-infected pregnant women treated as out-patient were not included.

Conclusion

In conclusion, dengue infection in pregnant women increased risk of preterm labor but did not increase risk of other pregnancy and neonatal outcomes. Careful consideration should be taken to distinguish between dengue infection in pregnancy

and other severe pregnancy complications with similar manifestations. Prompt treatments including adequate hydration, blood transfusion, early referral, and intensive monitoring are crucial to improve outcomes of dengue infection in pregnancy.

What is already known on this topic?

Dengue infection in pregnant women has been reported to cause many undesirable pregnancy outcomes such as abortion, preterm labor, antepartum hemorrhage, and postpartum hemorrhage. There are few studies that exist to systematically describe the impact of clinical dengue infection on maternal and neonatal outcomes in a Thai population. The previous studies also had a control group to verify the actual dengue-infected effects.

What this study adds?

In Thai population, which is frequently exposed to epidemics of dengue, the maternal mortality of dengue-infection is not as high as in Sudan. The effects of dengue infection on pregnancy outcomes are not as much as previous studies when compared with pregnant women without dengue infection.

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Conflicts of interest

The authors declare no conflict of interest.

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