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Association between Anemia in Pregnancy and Preterm Birth at Sunpasitthiprasong Hospital

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ABSTRACT

Objectives: To determine the association between anemia in pregnancy and preterm birth, maternal and neonatal complications.

Materials and Methods: A retrospective cohort study was conducted in pregnant women having a hemoglobin level at their first antenatal care and who delivered at Sunpasitthiprasong Hospital from January 2015 to December 2016. A total of 300 medical records of pregnant women were randomized from the database, of which 150 women were anemia (hemoglobin < 11 g/dL) and 150 women who were non-anemia (hemoglobin ≥ 11 g/dL). Maternal characteristics, gestation age of delivery, route of delivery, maternal and neonatal complications were recorded.

Results: Preterm birth in the anemic group (n = 11, 7.3%) was higher than those in non-anemic group (n = 7, 4.7%) but there were no significant differences (p = 0.332). Maternal complications showed no significant differences between the groups (postpartum hemorrhage p = 0.442 and pregnancy induce hypertension p = 0.759). With respect to neonatal complications, there were no significant differences between the groups (low birth weight p = 0.821, birth asphyxia at 1 minute p = 0.315, neonatal unit admission p = 0.143 and respiratory distress syndrome p = 0.570). There were no birth asphyxia at 5 minutes, necrotizing enterocolitis and intraventricular hemorrhage in the relevant groups.

Conclusion: There was no significant difference of preterm births between the anemic group and the non-anemic group. Regarding the maternal and neonatal complications, there were no significant differences between the groups.

Keywords: maternal anemia, preterm birth, pregnancy outcomes.

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ความสัมพันธ์ระหว่างภาวะโลหิตจางในหญิงตั้งครรภ์กับการคลอดก่อนกำหนดที่โรงพยาบาลสรรพสิทธิประสงค์

สุธินี สลักเพชร, พงษ์สันต์ พันธะไชย

บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาความสัมพันธ์ระหว่างภาวะโลหิตจางในหญิงตั้งครรภ์กับการคลอดก่อนกำหนด รวมถึงภาวะแทรกซ้อนของมารดาและทารก*

วัสดุและวิธีการ: *การศึกษานี้เป็นการศึกษาแบบย้อนหลังในผู้หญิงตั้งครรภ์เจาะฮีโมโกลบินเมื่อมาฝากครรภ์ครั้งแรก และคลอดที่โรงพยาบาลสรรพสิทธิประสงค์ ระหว่างเดือนมกราคม พ.ศ.2558 ถึงเดือนธันวาคม พ.ศ.2559 หญิงตั้งครรภ์จำนวนทั้งหมด 300 คน แบ่งเป็น 2 กลุ่ม โดยสุ่มจากฐานข้อมูลของโรงพยาบาลสรรพสิทธิประสงค์ คือ กลุ่มที่มีภาวะโลหิตจาง (ฮีโมโกลบิน < 11 g/dL) จำนวน 150 คน และกลุ่มที่ไม่มีภาวะโลหิตจาง (ฮีโมโกลบิน ≥ 11 g/dL) จำนวน 150 คน ข้อมูลที่เก็บประกอบไปด้วยข้อมูลพื้นฐานของมารดา, อายุครรภ์ที่คลอด, วิธีการคลอด, ภาวะแทรกซ้อนของมารดาและทารก*

ผลการศึกษา: *การคลอดก่อนกำหนดในกลุ่มที่มีภาวะโลหิตจาง (n = 11, 7.3%) พบมากกว่าในกลุ่มที่ไม่มีภาวะโลหิตจาง (n = 7, 4.7%) แต่ไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ (p = 0.332) ส่วนภาวะแทรกซ้อนของมารดาไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ ทั้งภาวะตกเลือดหลังคลอด (p = 0.442) และภาวะความดันโลหิตสูงขณะตั้งครรภ์ (p = 0.759) ภาวะแทรกซ้อนของทารกไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ ในเรื่องทารกแรกเกิดน้ำหนักน้อย (p = 0.821), ภาวะพร่องออกซิเจนในนาทีที่ 1 หลังคลอด (p = 0.315), ทารกนอนหอผู้ป่วยเด็ก (p = 0.143) และกลุ่มอาการหายใจลำบากในทารกแรกเกิด (p = 0.570) โดยทั้ง 2 กลุ่ม ไม่พบภาวะพร่องออกซิเจนในนาทีที่ 5 หลังคลอด, ภาวะลำไส้เน่าในทารกแรกเกิด และเลือดออกในโพรงสมองในทารกแรกเกิด*

สรุป: *ไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ของการคลอดก่อนกำหนดระหว่างกลุ่มที่มีภาวะโลหิตจาง และกลุ่มที่ไม่มีภาวะโลหิตจาง ส่วนภาวะแทรกซ้อนของมารดาและทารกทั้ง 2 กลุ่ม ไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ*

คำสำคัญ: *ภาวะโลหิตจางในหญิงตั้งครรภ์, การคลอดก่อนกำหนด, ผลลัพธ์ของการตั้งครรภ์*

Introduction

Anemia in pregnancy is a global health problem in developed and developing countries. It affects social and economic development. Anemia may result from several causes, with the most significant contributor being iron deficiency[1]. World Health Organization (WHO) defined anemia in pregnancy as hemoglobin (Hb) < 11 g/dL all trimesters[2]. The prevalence of anemia in pregnancy aged 15-49 years in 2011 was 17-63% (average 38.2%) worldwide[1]. In Thailand, the data from the Ministry of Public Health concluded that the rate of anemia during pregnancy was 10-20% between 1994 and 2010. Moreover, the trend of the prevalence increased to 39-45% between 2011 and 2013[3]. The record of first antenatal care (ANC) visits at Sunpasitthiprasong Hospital, Ubon Ratchathani, Thailand, the prevalence of anemia during pregnancy was 20-30%. The goal of the Ministry of Public Health is to reduce the rate of anemia in pregnancy to 10%.

Anemia in pregnancy increased the risk of low birth weight (LBW), preterm birth, small for gestational age (SGA) newborns, maternal and perinatal mortalities[4-9]. However, another study found no association between anemia in pregnancy and LBW & preterm birth[10]. Anemia resulting from iron deficiency adversely affects cognitive and motor development, causes fatigue and low productivity[1]. Children who were born to women classified as iron deficiency in the third trimester without iron supplementation had lower mental development at 12, 18, and 24 months of age, suggesting that prenatal iron deficiency is associated with mental development[4]. Anemia in the first trimester has been associated with a limited increased risk of preterm birth. However, third trimester anemia was associated with reduced risk for preterm birth[11].

The rate of preterm birth in 2010 ranged from 5% to 60% of babies born (11.1% of all live births worldwide)[12]. The preterm infant is susceptible to various serious medical complications during the newborn period as well as morbidities and mortalities. These complications, consequence of immature organs, are hypoglycemia, intraventricular hemorrhage (IVH), retinopathy of prematurity (ROP), necrotizing enterocolitis (NEC), hypotension especially respiratory distress syndrome (RDS). RDS results from immature lungs that are unable to sustain necessary oxygenation and resulting hypoxia is an underlying associated cause of neurological damage such as cerebral palsy. In addition, hyperoxia, a side effect of RDS treatment, causes bronchopulmonary dysplasia and ROP[4]. These morbidities are a significant cost to the health-care system, such as treatment of physical development, mental development and psychological care. Moreover, these problems affect physical and psychological health of caregivers.

We aimed to determine the association between anemia in pregnancy and preterm birth, maternal and neonatal complications.

Materials and Methods

A retrospective cohort study was conducted in pregnant women having Hb level at their first ANC and who delivered at Department of Obstetrics and Gynecology in Sunpasitthiprasong Hospital, Ubon Ratchatani, Thailand from January 2015 to December 2016. This study was approved by the Research Ethic Committee of Sunpasitthiprasong Hospital. Inclusion criteria were Hb level at first ANC visit, children born in Sunpasitthiprasong Hospital and singleton pregnancy. Those with fetal anomaly or fetal aneuploidy were excluded. Sample size was calculated based on a research question “whether anemia has impact on risk of preterm birth?”. According to a study by Okunade and colleagues (2014)[5], 21.0% of mothers with anemia had preterm births (p_1 = 0.210), while 9.4% of those without anemia had preterm births (p_2 = 0.094). At 80% power and 95% confidence level and with a ratio of exposed and non-exposed being 1:1 using n4Studies application, the sample size of 150 pregnant women were required for each group. 150 medical records of pregnant women were randomly selected from all pregnant women with and without anemia receiving

ANC and delivered at Sunpasitthiprasong Hospital during the study period.

Data on a main exposure, anemia and other risk factors at first ANC visit were obtained by careful medical record reviews. Anemia in pregnancy was classified according to the WHO as Hb less than 11 g/dL in all trimesters. WHO[2] defined severity of anemia as mild anemia is Hb 10.0-10.9 g/dL, moderate anemia is Hb 7.0-9.9 g/dL and severe anemia is Hb < 7.0 g/dL. If Hb level was < 11 g/dL, the woman received ferrous fumarate. If Hb level was < 8 g/dL, blood transfusions were given. Other risk factors included maternal age, ethnicity, body mass index (BMI) before pregnancy, occupation and education as well as gestational age (GA) at first ANC visit, parity, and Hb during pregnancy and interpregnancy interval (interval from one child's birth until the next pregnancy). Maternal and neonatal complications were obtained by medical record reviews. Neonatal complications were evaluated by pediatrician. GA was corrected based on last menstrual period and ultrasonography performed. Using logistic regression, risk factors of preterm birth applied from previous studies, Committee on Practice Bulletin No.130 (ACOG) : Prediction and prevention of preterm Birth, Williams Obstetrics 24th ed., interpregnancy interval in Scotland, risk for preterm delivery and severity of maternal anemia in Tanzania, maternal education and preterm birth in Michigan and characteristics and risk factors of preterm births in a tertiary center in Lagos, Nigeria[4, 13-17], including anemia (mild, moderate, severe anemia), teenage pregnancy, advance maternal age, interpregnancy interval < 18 months, BMI before pregnancy (normal 18.5-22.9 kg/m^2, underweight < 18.5 kg/m^2, overweight 23.0-24.9 kg/m^2, and obesity ≥ 25.0 kg/m^2)[18], below Bachelor degree and pregnancy induce hypertension (PIH).

Primary outcome was preterm birth (birth at GA 28-36^{+6} weeks). Secondary outcomes included maternal and neonatal complications. Maternal complications were postpartum hemorrhage (PPH, blood loss > 500 ml in vaginal delivery or > 1,000 ml in cesarean section) and PIH. Neonatal complications were LBW (birth weight < 2,500 grams), birth asphyxia at 1 and 5 minutes (Apgar score < 7), neonatal unit admission, RDS, IVH and NEC.

Statistics analyses were performed using IBM SPSS Statistics Version 22. Characteristics of the samples were described as number (%), mean (standard deviation, SD) and median (interquartile range, IQR) for categorical, normally and non-normally distributed continuous variables. Comparison of characteristics and outcomes between groups were done using chi-square test, independent sample t-test and Mann-Whitney U test for categorical, normally and non-normally distributed continuous variables, respectively. The association of anemia with preterm birth and secondary outcomes were examined using logistic regression with odds ratio (ORs) and 95% confidence interval (95% CI). A p value of < 0.05 was considered statistical significance.

Results

Table 1 shows maternal characteristics of 300 pregnant women participating in the present study, stratified by anemic status. Pregnant women with and without anemia were similar regarding age, ethnicity, occupation, parity and interpregnancy interval. In addition to lower Hb level at first ANC and lower last Hb level during pregnancy, those with anemia had lower BMI before pregnancy than those without anemia. Moreover, they were more likely to have more GA at first ANC than those without anemia and education below high school than those without anemia. Pregnant women in non-anemic group came to the hospital earlier for their first ANC than those women in the anemic group, so they received earlier folic acid or multivitamin supplementation than in the pregnant women with anemia. Then, these affected last Hb levels during pregnancy, pregnant women in non-anemic group had no anemia more than anemic group [median (IQR) 11.3 (10.6, 12.0)] and pregnant women in anemic group had anemia more than non-anemic group [median (IQR) 10.4 (9.7, 11.0)].

Table 1. Maternal characteristics.

Characteristics	Anemic group (150 cases)	Non-anemic group (150 cases)
Age* (years)	24.0 (19.0, 21.0)	26.0 (22.0, 31.0)
Ethnicity†		
Thai	149 (99.3%)	149 (99.3%)
Laos	1 (0.7%)	1 (0.7%)
Parity†		
0	67 (44.7%)	67 (44.7%)
1	51 (34.0%)	65 (43.3%)
≥ 2	32 (21.3%)	18 (12.0%)
Hemoglobin at first ANC* (g/dL)	10.2 (0.7)	12.3 (2.7)
Severity of anemia†		
# Mild anemia	109 (72.7%)	-
# Moderate anemia	40 (26.7%)	-
# Severe anemia	1 (0.6%)	-
Last hemoglobin during pregnancy‡ (g/dL)	10.4 (9.7, 11.0)	11.3 (10.6, 12.0)
Gestational age at first ANC‡ (weeks)	15.0 (11.0, 20.0)	10.0 (7.0, 12.0)
BMI before pregnancy‡ (kg/m^2)	20.4 (18.3, 20.9)	21.5 (19.2, 24.5)
Interpregnancy interval‡ (months)	43.0 (24.0, 74.3)	53.0 (36.0, 88.0)
Occupation†		
Housewife	72 (48.0%)	61 (40.7%)
Employee	39 (26.0%)	49 (32.7%)
Business owner	18 (12.0%)	15 (10.0%)
Government official	10 (6.7%)	14 (9.3%)
Others¶	11 (7.3%)	11 (7.3%)
Education†		
Primary school	16 (10.6%)	9 (6.0%)
High school	70 (46.7%)	58 (38.7%)
Vocational certification & high vocational certification	28 (18.7%)	30 (20.0%)
Bachelor & Master degree	36 (24.0%)	53 (35.3%)

BMI: Body mass index, * Mean (standard deviation) , † Number (%), ‡ Median (Interquartile range), ¶ Others were farmer, student and prisoner.

Table 2 shows causes of anemia in pregnancy at first ANC visit, iron deficiency anemia was the most significant cause of anemia (n = 111, 74.0%) in pregnant women in this study. In this study, thalassemia was Hb H disease. There were 2 pregnant women with Hb H received blood transfusion 1 year ago and were supplemented with folic acid, at that time. Other cause of anemia was normocytic anemia.

Table 2. Causes of anemia in pregnancy at first antenatal care visit.

Causes of anemia	Number (%)
Iron deficiency	111 (74.0%)
Thalassemia	2 (1.3%)
Other	37 (24.7%)

Comparisons of maternal outcomes, maternal and neonatal complications between pregnant women with and without anemia are shown in Table 3. Pregnant women with and without anemia had similar maternal outcomes and maternal complications, including GA at delivery (GA 38 weeks in anemia group vs 39 weeks in non-anemic group, p = 0.075), route of delivery (p = 0.071) as well as preterm birth [11 (7.3%) vs 7 (4.7%), p = 0.332], PPH (p = 0.442) and PIH (p = 0.759). Also, pregnant women with and without anemia had comparable rates of neonatal complications regarding LBW, birth asphyxia to neonatal unit admission. There were no birth asphyxia at 5 minutes, IVH and NEC in these two groups. Severe anemia did not associate with preterm birth because baby (n = 1) was born at term (GA 39 weeks). There was a still birth in the non-anemic group because the pregnant woman came to the hospital due to decreased fetal movement for 2 days and transabdominal ultrasound found no fetal heart movement. The cause of the stillbirth was unknown and the parents denied an autopsy.

Table 3. Maternal outcomes, maternal and neonatal complications.

Outcomes	Anemic group (150 cases)	Non-anemic group (150 cases)	p value
Maternal outcomes			
GA at delivery* (weeks)	38.0 (37.0, 39.0)	39.0 (38.0, 39.0)	0.075
Route of delivery†			0.071
Normal delivery	89 (59.4%)	73 (48.7%)	
Vacuum extraction	8 (5.3%)	8 (5.3%)	
Forceps extraction	0 (0.0%)	4 (2.7%)	
Cesarean section	53 (35.3%)	65 (43.3%)	
Preterm birth†	11 (7.3%)	7 (4.7%)	0.332
Mild anemia	7 (4.7%)	-	
Moderate anemia	4 (2.7%)	-	
Severe anemia	0 (0.0%)	-	
Maternal complications†			
Postpartum hemorrhage	17 (11.3%)	13 (8.7%)	0.442
Pregnancy induce hypertension	6 (4.0%)	5 (3.3%)	0.759
Neonatal complications			
Stillbirth	0 (0.0%)	1 (0.7%)	0.317
Low birth weight	11 (7.3%)	10 (6.7%)	0.821
Birth asphyxia at 1 minute	1 (0.7%)	2 (1.3%)	0.315
Birth asphyxia at 5 minutes	0 (0.0%)	0 (0.0%)	1.000
Neonatal unit admission	43 (28.7%)	32 (21.4%)	0.143
Newborn wards	40 (26.7%)	28 (18.7%)	0.081
NICU	3 (2.0%)	4 (2.7%)	0.703
Respiratory distress syndrome	17 (11.3%)	14 (9.3%)	0.570
Intraventricular hemorrhage	0 (0.0%)	0 (0.0%)	1.000
Necrotizing enterocolitis	0 (0.0%)	0 (0.0%)	1.000

GA: Gestational age, * Median (Interquartile range), † Number (%), NICU: neonatal intensive care unit

The associations of anemia and other factors with risk of preterm birth using logistic regression are shown in Table 4. In both the univariate and multivariate logistic regression models, either anemia or other risk factors did not associate with the risks of preterm birth in this cohort of pregnant women.

Table 4. Factors associated with preterm birth using logistic regression.

Factors	Crude ORs (95% CI)	Adjusted ORs (95% CI)
Anemia of first antenatal care visit		
Mild anemia	1.13 (0.42-2.99)	1.52 (0.50-4.67)
Moderate anemia	0.71 (0.24-2.10)	2.78 (0.73-10.64)
Severe anemia	0	0
Maternal age		
Teenage pregnancy	1.13 (0.36-3.56)	1.18 (0.32-4.39)
Advance maternal age	0.84 (0.18-3.75)	0.62 (0.13-3.09)
Interpregnancy interval < 18 months	1.04 (0.13-8.40)	0.74 (0.09-6.52)
BMI before pregnancy		
Normal	Reference	Reference
Underweight	0.97 (0.19-2.45)	0.73 (0.20-2.69)
Overweight	0.46 (0.13-1.64)	0.37 (0.10-1.40)
Obesity	0.77 (0.19-3.11)	0.67 (0.16-2.79)
Below Bachelor degree	1.61 (0.60-4.29)	0.49 (0.17-1.47)
PIH	1.21 (0.36-4.05)	2.00 (0.23-17.39)

ORs: Odd ratios, CI: confidence interval, BMI: Body mass index, PIH: Pregnancy induce hypertension
Odd ratios were adjusted for all factors in the table.

Discussion

Both groups found a few preterm births. The preterm birth in the anemic group was 7.3% (n = 11) and in non-anemic group was 4.7% (n = 7) similar to previous two studies. One study, perinatal outcomes among thalassaemia carriers in Hong Kong[7], preterm birth in anemic pregnant women was 3.4% and in the healthy group was 1.9%. 4.9% of thalassemia trait with anemia in pregnant women and 1.0% of thalassemia trait without anemia in pregnant women had preterm births. According to the study, anemia was defined as Hb level of < 11.0 g/dL in the first trimester and 10.5 g/dL in the second trimester which is in line with the current Centers for Disease Control guideline. In another study, disparities and relative risk ratio of preterm birth in six Central and Eastern European centers in 2007-2009[9], the study in the Czech Republic found 7.4% of preterm births in anemic group. In contrast, a Thai study, correlation of maternal anemia during pregnancy and low birth weight infant at Chonburi Hospital in 2004-2007[10], found approximately 15% of preterm births in pregnant women with and without anemia. According to the study, anemia was defined as hematocrit < 33% following the criteria of Department of Public Prosecution, Thailand. Similarly, studies of Okunade and colleagues (2014)[5], Bakhtiar and colleagues (2007)[6], Arora and colleagues (2015)[9], Kidanto and colleagues (2009)[15], Yuan and colleagues (2010)[19] and Rahman and colleagues (2016)[20], preterm birth in anemic group was 15-21% that they studied in developing (Nigeria, Pakistan, Romania, Ukraine and Tanzania) and

developed countries (Hungary, Slovakia and the United Kingdom). The definitions of anemia during pregnancy in those studies has shown anonymize. Okunade and colleagues[5]: anemia in pregnancy was defined as the pregnant women in which maternal packed cell volume fell below 30% because this definition of anemia is used in most parts of Africa. Bakhtiar and colleagues[6], Arora and colleagues[9] and Kidanto and colleagues[15]: anemia was classified according to the WHO standards as the Hb level < 11 g/dL which is as same as this study. Yuan and colleagues[19] used Hb < 10.5 g/dL as definition of anemia in pregnancy. Rahman and colleagues[20]: anemia was defined as the exposure variable with Hb concentrations < 11 g/dL or hematocrit < 33%.

Studies examining the impact of anemia on risk of preterm birth have shown inconsistent results. In this study, anemia did not significantly increase the risk of preterm birth as a few previous retrospective cohort studies. Yuan W and colleagues(19), 18.6% of maternal anemia had term births and 19.7% of maternal anemia had preterm births in Bristol, United Kingdom. The study at Chonburi Hospital[10] found no association between maternal anemic status and preterm birth (anemic group 15.1 % vs non-anemic group 15.2%, p = 0.223). In contrast to previous studies in Pakistan (Bakhtiar and colleagues[6]), Nigeria (Okunade and colleagues[5]) and systematic review and meta-analysis in South Asia, East-West Asia, African and South American regions (Rahman and colleagues[20]) which showed that the risk of preterm birth in anemic pregnant women was 1.5-3.0 times higher than in non-anemic pregnant women. In the perinatal outcomes among thalassaemia carriers in Hong Kong study[7], anemia in pregnancy was significantly associated with preterm deliveries (p = 0.020). A retrospective study in six Central and Eastern Europe[9] showed that in anemic women had preterm births 1.5-4.0 times higher than term birth in Czech Republic, Hungary, Slovakia, and Ukraine except in Romania. Anemic women had 18.5% of preterm birth and 18.8% of term birth (p = 0.820).

Because the anemic group in this study were living with the mild degree of anemia [n (%) = 109 (72.7%)], that it did not significantly increase the risk of preterm birth.

BMI before pregnancy in both groups was within the normal range so it did not increase the risk of preterm birth. Similar to ACOG Practice Bulletin No. 130: prediction and prevention of preterm Birth (2012)[13], Williams Obstetrics 24th ed.[4], Yuan and colleagues (2010)[19] and Di Renzo and colleagues (2011)[21], these studies found that underweight, overweight and obesity in pregnant women (BMI before pregnancy) increased the risk of preterm birth. In the anemic group, there had more pregnant women with below Bachelor degree education than in the non-anemic group [n (%) = 114 (76.0%) vs 97 (64.7%)]. Therefore, the preterm birth was affected by pregnant women with below Bachelor degree education. It is supported by a study of El-Sayed and Galea (2014)[16] which found that low maternal education (< 12 years) increased the risk of preterm birth.

Route of delivery was not significant difference between anemic group and non-anemic group, but this study found 4 forceps extraction in non-anemic group as indication of PIH. There was no forceps extraction in the anemic group. According to the study of Pitchaipraser and Siwadune (2009)[10], the forceps extraction rate in the anemic group was higher than control group and there were significantly differences (p < 0.001).

Both crude ORs and adjusted ORs (adjusted for all factors), all factors did not significantly increase the risk of preterm birth. The risk of preterm birth was 1 time in mild anemia and 2 times in moderate anemia as Kidanto and colleagues (2009)[15]. They found that the risks of preterm delivery increased in proportion to the severity of maternal anaemia. Teenage pregnancy had slightly increased the risk of preterm birth but there was not significant as a study of Kidanto and colleagues (2009)[15]. This study was similar to two studies of Butali and colleagues (2016)[17] and Di Renzo and colleagues (2011)[21] that advance maternal age did not significantly increase the risk of preterm birth. Smith and colleagues (2003)[14] found that there was a significantly increase the risk of preterm birth when interpregnancy interval was less than 6 months. Underweight, overweight or obesity before pregnancy increased the risk of

preterm birth but obesity had no significance[19-20]. Below Bachelor degree education increased the risk of preterm birth as a study of El-Sayed and Galea (2014)[16]. In this study found that PIH was 4%. In addition, a study of Rao and colleagues (2014)[22] found 21.4% of gestational hypertension and it increased significant risk of preterm birth. Similar to a study of Butali and colleagues (2016)[17] found that hypertension was significantly associated with all categories of preterm delivery (hypertension was defined as gestational or chronic hypertension including preeclampsia and eclampsia.).

Thus, all pregnant women should be recovered from anemia before pregnancy, the gap between pregnancy is 18 months or greater and the BMI before pregnancy must be within the normal range. Last, pregnant women must receive early ANC as well as regular follow up appointments to reduce the risk of preterm birth.

The strength of our study were randomly selected data and the first study of anemia in pregnancy and maternal and neonatal outcomes in Ubon Ratchatani. This study had some limitations. First, this study was a randomized study that the maternal characteristics were not similar between groups. So, those affected to increase or decrease the risk of preterm birth. Second, most pregnant women in this study had mild anemia, the preterm birth rate was slightly increased but there were no significant differences. And the lastly, samples were collected in a single hospital and represent only a limited number of patients.

Conclusion

There was no significant difference of preterm births between the anemic group and the non-anemic group. Maternal and neonatal complications showed no significant differences between the groups. All crude ORs and adjusted ORs of the factors which were associated with preterm birth were not statistically significant regarding the risk of the preterm birth.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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