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The Correlation between Hemoglobin Concentration during Pregnancy with the Maternal and Neonatal Outcome

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Abstract

BACKGROUND: The prevalence of anaemia is higher among women, including pregnant women. The estimation was about 24.8% of the population in the world suffering anaemia. Anaemia during pregnancy is a big problem because it can contribute morbidity and mortality, either in mother or newborn. The impacts of anaemia during pregnancy included post-partum haemorrhage, low birth weight (LBW), preterm delivery, and low Appearance, Pulse, Grimace, Activity, Respiration (APGAR) score.

AIM: This study aimed to determine the correlation between haemoglobin concentration during pregnancy and the outcome of mothers and newborns.

METHODS: It was a cohort study that included 200 pregnant women in second or third trimester at antenatal care of Sundari General Hospital Outpatient Clinic on February until September 2018. The participants were interviewed using a questionnaire, and their blood was checked to measure haemoglobin concentration using portable Easy Touch Hemoglobinometer. In the next three until six months, the following investigation was conducted to assess the maternal and neonatal outcome.

RESULTS: The result of this study showed among the maternal outcome, only antepartum haemoglobin concentration had a statistically significant correlation with the haemoglobin concentration during pregnancy ($p < 0.05$), meanwhile, among the neonatal outcome. LBW was the only factor that statistically significantly correlated to the haemoglobin concentration during pregnancy ($p < 0.05$).

CONCLUSION: We can conclude that once anaemia occurs in pregnant women, then the women kept suffering from anaemia with its correlation was statistically significant.

Introduction

In all over the world, anaemia has been a global health burden since it can affect anyone without considering age or gender group [1]. However, the prevalence of this nutritional disorder is higher among women, including pregnant women. About 24.8% of the population in the world suffers from anaemia [2], [3].

Anaemia during pregnancy has become a widespread nutritional disorder either in developing or even developed countries. According to the World Health Organization (WHO), the proportion of the population suffering from anaemia in pregnancy was 14% in developed countries and 51% in developing countries. WHO also estimated that among the population, the cases were the most frequently found in Africa and Southeast Asia. Indonesia is a part of Southeast Asia. Thus, anaemia in pregnant women is frequently found here. It is proven by the data from Basic Health Research Ministry of Health of the Republic of Indonesia in 2013 showing that the prevalence was about 37.1% [1], [2], [4].

Anaemia during pregnancy is defined as the haemoglobin criteria is less than 11 g/dL. Once pregnant women suffer from anaemia, iron deficiency becomes the most common cause that should be considered [3]. Other risk factors related to maternal anemia are unhealthy lifestyle, poor socio-economic

status, malnutrition, hemoglobinopathies, age (under 20 years or above 35 years), early marriage or teenage pregnancy, decreasing period of pregnancy interval, smoking or alcohol use, history of menstrual disorder or infection, and gemelli or multiple pregnancies [5].

Anaemia is a big problem especially when it occurs during pregnancy because it may contribute to morbidity and mortality, either in mothers or newborns. Anaemia (regardless the severity) accounts 12.8% maternal death which is the second leading cause of the death. In Indonesia, the national Maternal Mortality Rate (MMR) is still so high with 307/100.000 live births. Anaemia during pregnancy becomes an indirect cause of postpartum haemorrhage and results in maternal mortality in the latter [4], [5]. Meanwhile, the national Neonatal Mortality Rate is much higher with 987/100.000 live births. Moreover, the fetal or neonatal complication can include prematurity, low birth weight, and low APGAR Score. All complications were significantly ended with maternal and neonatal mortality [4], [6], [7].

Although anaemia during pregnancy may lead to many adverse effects, actually anaemia can be the most preventable cause of maternal and neonatal mortality. In the upcoming years, anaemia in pregnant women should be eradicated to improve maternal and neonatal health status. Hence, this study was aimed to investigate the correlation between haemoglobin concentration during pregnancy and the outcome of mothers and newborns. In the future, hopefully, this study can be the reference to counsel pregnant women, especially in Indonesia, to be more aware of how threatening anaemia is and to decrease the prevalence of anaemia itself.

Material and Methods

This study was conducted at antenatal care of Sundari General Hospital Outpatient Clinic. It was a prospective randomised study that included 200 pregnant women in the second or third trimester who met the inclusion and exclusion criteria.

This study took a period of 7 months — February until September 2018. After obtaining the consent, we interviewed the pregnant women who consumed Fe tablets, consist of ferrous sulfate 200 mg which contains 60 mg elemental iron for 90 days after the first trimester using a questionnaire to know their characteristics including age, gestational age, education background, and occupation. Then, the haemoglobin measurement was conducted by using Easy Touch portable hemoglobinometer. The data was collected during their antenatal care in the second or third trimester.

In the next three until six months, following investigation was conducted by asking the pregnant women to come again before giving birth. Then, we assessed the second haemoglobin measurement during their antepartum by the same portable measurement.

A few weeks later, the data about the outcome of maternal and neonatal was collected from the medical record if the subjects are giving birth in Sundari General Hospital. Unless they did not give birth in the same hospital, follow up was done by the phone. The maternal outcome includes the estimation of haemoglobin antepartum, bleeding volume while giving birth, and the initial breastfeeding. The neonatal outcome includes the data whether the newborn alive or not. Among the alive and healthy newborn, other data was collected, including preterm birth, low birth weight, and APGAR score. In this study, low birth weight defined as the infant birth weight which less than 2500 gram and preterm birth was considered as gestational age under 37 weeks. Because of our limitation, APGAR score was measured by only asking whether the newborn cried spontaneously or not. The newborn crying spontaneously was considered as good APGAR Score, but if they did not, it probably showed poor APGAR Score

Statistical Analysis

All data collected and recorded using the Statistic Product and Service Solution (SPSS) program 21st version. Values were expressed with the mean ± SD or percentage as appropriate. The analysis of the correlation between haemoglobin concentration during pregnancy and the outcome of mother and newborn were computed statistically using Chi-Square Test. A difference was considered significant at the p-value < 0.05.

Results

There were 200 pregnant women involved with their newborns that evaluated in this study. There was found no maternal mortality. In this study, the mean of haemoglobin (Hb) concentration was 10.73 ± 2 g/dl, the median was 10.6 g/dl, the maximum was 15.8 g/dl, and the minimum was 7.8 g/dl. The mean birth weight was 3015 ± 584 gram.

The subject characteristics were shown in Table 1. The mean age of all participants was 29 ± 5.5 years. For all characteristics, except birth method, either anaemia or normal group, had the similar result of majority variable. The most common age was 20 – 35 years. The majority of participants were in the third trimester of gestational age. Most of the participants were housewives. The majority education background

was senior high school. Most of the participants gave birth in a hospital. Otherwise, for the birth method, the anaemia group had different result compared to the normal group. The majority birth method in anaemia group was spontaneous birth. Meanwhile, cesarean birth was most commonly conducted in the normal group. By using Chi-Square Test, there were no characteristics which had a significant correlation with the hemoglobin during pregnancy (p-value > 0.05).

Table 1: Demographic of subject characteristics

Characteristics	Haemoglobin concentration during pregnancy		Total	P value
	Anemia (52.5%)	Normal (47.5%)		
Age	Mean 29 ± 5.5 years			0.218
< 20 years	0 (0%)	2 (2.1%)	2 (1%)	
20 – 35 years	88 (83.8%)	79 (83.2%)	167 (83.5%)	
> 35 years	17 (16.2%)	14 (14.7%)	31(15.5%)	
Gestational Age				0.267
2nd Trimester	28 (26.7%)	19 (20%)	47 (23.5%)	
3rd Trimester	77 (73.3%)	76 (80%)	153 (76.5%)	
Occupation				0.974
Housewife	77 (73.3%)	72 (75.8%)	149 (74.5%)	
Civil servant	9 (8.6%)	7 (7.4%)	16 (8%)	
Private servant	9 (8.6%)	7 (7.4%)	16 (8%)	
Entrepreneur	10 (9.5%)	9 (9.5%)	19 (9.5%)	
Education background				0.453
Elementary school	4 (3.8%)	2 (2.1%)	6 (3%)	
Junior high school	13 (12.4%)	14 (14.7%)	27 (13.5%)	
Senior high school	59 (56.2%)	57 (60%)	116 (58%)	
Diploma	6 (5.7%)	9 (9.5%)	15 (7.5%)	
Undergraduate	23 (21.9%)	13 (13.7%)	36 (18%)	
Mode of Delivery				0.121
Normal vaginal	76 (72.4%)	36 (37.9%)	112 (56%)	
Cesarean	29 (27.6%)	59 (62.1%)	88(44%)	
Birth location				0.210
Hospital	56 (53.3%)	59 (62.1%)	115 (57.5%)	
Midwifery unit	49 (46.7%)	36 (37.9%)	85 (42.5%)	

Chi-Square Test. p-value < 0.05 were considered as statistically significant.

The indication of cesarean birth can be seen in Table 2. The most common indication was the previous cesarean delivery. The other indications related to pregnancy problems, such as obstructed labour, placenta previa, abnormal fetal presentation, and cephalopelvic disproportion.

Table 2: The indications of cesarean birth

Factors	Anaemia	Non-anemia
Previous cesarean birth	21 (72.4%)	20 (58.8%)
Obstructed labor	3 (10.3%)	5 (14.7%)
Placenta previa	2 (6.9%)	1 (2.9%)
Cephalopelvic disproportion	1 (3.4%)	2 (5.8%)
Abnormal fetal presentation	2 (6.9%)	5 (14.7%)
Others	0 (0%)	1 (2.9%)

Table 3 showed how maternal outcome related to haemoglobin concentration during pregnancy. Among the three variables, only antepartum haemoglobin concentration that significantly associated with haemoglobin concentration during pregnancy (p < 0.05).

Table 3: The correlation between haemoglobin concentration during pregnancy and maternal outcome

Maternal outcome		Haemoglobin concentration during pregnancy		P value
		Anaemia	Normal	
Antepartum hemoglobin concentration	Anemia	89 (84.8%)	57 (60%)	0.000*
	Non-anemia	16 (15.2%)	38 (40%)	
Postpartum hemorrhage (PPH)	< 500 cc	85 (81%)	78 (82.1%)	0.834
	≥ 500 cc	20 (19%)	17 (17.9%)	
Initial breastfeeding	Yes	27 (25.7%)	27 (28.4%)	0.791
	No	74 (74.3%)	68 (71.6%)	

Chi-Square Test *p-value < 0.05 were considered as statistically significant.

It means that the pregnant women in either second or third trimester kept suffering from anaemia until the antepartum period.

Table 4 showed that among all participants, unfortunately, stillbirth (3.8%) was found. All stillbirth cases occurred in the anaemia group. There was no significant correlation between haemoglobin concentration during pregnancy and neonatal condition (p > 0.05).

Table 4: The correlation between hemoglobin concentration during pregnancy and neonatal condition

Neonatal condition	Hemoglobin concentration during pregnancy		P value
	Anemia	Normal	
Alive newborn	101 (96.2%)	95 (100%)	0.157
Stillbirth	4 (3.8%)	0 (0%)	

Chi Square Test.

To analyse the correlation between haemoglobin concentration during pregnancy and fetal outcome, participants with stillbirth were excluded. We found four cases of stillbirth. Thus, there were only 196 participants involved in this analysis. The result showed in Table 5. Among all variables of neonatal outcome, low birth weight was the only outcome that significantly related to the haemoglobin concentration during pregnancy (p < 0.05).

Table 5: The Correlation between haemoglobin concentration during pregnancy and fetal outcome

Neonatal outcome		Haemoglobin during pregnancy		P value
		Anaemia	Non-anemia	
Spontaneous cry	Yes	92(96.8%)	86 (90.5%)	0.892
	No	9(3.2%)	9 (9.5%)	
Preterm delivery	Yes	4 (4%)	10 (10.5%)	0.074
	No	97 (96%)	85 (89.5%)	
Low birth weight	Yes (< 2500 gram)	4 (81%)	11 (82.1%)	0.045*
	No (≥ 2500 gram)	97 (19%)	84 (17.9%)	

Chi-Square Test *p-value < 0.05 were considered as statistically significant.

Discussion

Out of 200 pregnant women in this study, more than half (52.5%) of them were suffering from anaemia. It is relevant to the previous study which stated that half population of pregnant women in the world affected by anemia. Meanwhile, the proportion of anemic pregnant women varies in each countries, such as 58% in China, 50% in Southeast Asia, and 40% in Istanbul [8].

Based on Chi-Square Test, this study showed that no significant correlation between hemoglobin concentration during pregnancy with any characteristic variables, included maternal age (p-value = 0.218), gestational age (p-value = 0.267), education background (p-value = 0.974), occupation (p-value = 0.453), mode of delivery (p-value = 0.121) and place of birth (p-value = 0.210). It was relevant to

the previous study conducted by Vural *et al*., showing that there was a statistically significant correlation between anaemia prevalence and mode of delivery. Otherwise, in Vural *et al.,* study, the correlation between maternal age and anaemia prevalence was statistically significant [8].

This study found that the mean of haemoglobin concentration was about 10.73 ± 2 g/dl. Based on both the World Health Organization (WHO) and the Center for Disease Controls and Preventions (CDC), the mean is defined as anaemia since the haemoglobin concentration less than 11 g/dl. [9]. Although it was categorised as anaemia according to criteria of WHO and CDC, the concentration of 10 g/dl in the mid-trimester of gestational age seems to reflect the adequate expansion of plasma volume [10].

Although more than half of the population were anaemic, there was found no maternal mortality in this study. It was suggested that the haemoglobin concentration still able to compensate for optimal plasma volume expansion. It was relevant to the previous study stated that the cutoff of extremely low haemoglobin concentration was less than 6.5 g/dl. This condition with other factors can contribute to maternal mortality. Even, the other cutoff with 8.9 g/dl associated with twice risk of maternal mortality [11].

In this study, out of 115 anaemic pregnant women, 20 participants (19%) had bleeding after birth ≥ 500 cc without significant correlation between haemoglobin level during pregnancy and the bleeding volume. The previous study of Frass had similar result showing 29.1% of anaemic pregnant women developed postpartum haemorrhage during cesarean delivery because of the uterine atony [12]. Even, the study of Kayle *et al.* showed that there was a strongly significant correlation between moderate-to-severe anaemia and blood loss severity [13]. Despite the widespread postpartum haemorrhage in all over the world, unfortunately, there is still a lack of data in the literature about contributing factors of it, especially in developing countries where many PPH and maternal death occur. David study stated that weak uterine muscular strength and lower resistance to infectious disease possibly occur due to severe anaemia. Meanwhile, the higher risk of PPH experience related to severity anaemia still needs further studies [13], [14].

This study investigated whether there is a correlation between initial breastfeeding and the haemoglobin concentration during pregnancy. Our study showed that most of the initial breastfeeding failure found in the anaemia group (74.3%). Despite the fact, the correlation was statistically not significant (p-value = 0.791). Another complication of anaemia during pregnancy that still not familiar is breastfeeding failure. However, an article review mentioned breastfeeding failure becoming the impact of anaemia during pregnancy, after puerperal sepsis and sub-involution [15].

Investigation of neonatal outcome was done by analysing three factors, including spontaneous crying to assess APGAR Score, preterm delivery, and low birth weight. Among the factors, only low birth weight had a significant correlation with the haemoglobin level during pregnancy ($p = 0.045$).

Birth weight is a good indicator to evaluate whether the mother supports the fetus adequately or not. Besides, it is the only determinant factor of newborn mortality in the first year of life. Birth weight less than 2500 gram is defined as low birth weight that is most commonly caused by anaemia during pregnancy. Previous meta-analysis literature showed that there was a significant correlation between anaemia during pregnancy and low birth weight in the 3rd trimester. Otherwise, the same study showed no significant correlation between both variables in 1st and 2nd trimester [9], [16]. Haemoglobin concentration of less than 10.5 g/dl was reported to increase the sevenfold risk of low birth weight [17]. Abnormally a previous literature stated that several studies reported low birth weight in anaemic pregnant women, but high haemoglobin concentration in 1st and 3r trimester also correlated with the risk of low birth weight due to similarly poor plasma volume expansion [10], [17].

Besides low birth weight, preterm delivery and low APGAR score were the other impacts of anaemia during pregnancy in neonatal outcome. This study showed that there is no significant correlation between haemoglobin concentration during pregnancy with any factor ($p > 0.05$). It seems relevant with the previous study conducted in Moshi Municipality showing a similar result about no correlation between anaemia and low birth weight and preterm delivery. However, a different study showed that maternal anaemia and preterm delivery had significant correlation statistically. Even, Hb < 10.5 g/dl can increase fivefold risk of preterm delivery [17], [18]. Our study can give more information about how the impact of haemoglobin concentration on the outcome of maternal and neonatal. However, our study had a limitation that did not bring any information about the dietary pattern of the pregnant woman, especially during pregnancy. This study also did not give any intervention for the anaemia correction before the childbirth.

In conclusion, from this study, we can conclude that once anaemia occurs in pregnant women, then the women kept suffering from anaemia with its correlation was statistically significant. Several studies showed that there was a significant correlation between anaemia during pregnancy and postpartum haemorrhage. However, this study found a different result with no significant correlation between haemoglobin concentration with PPH and initial breastfeeding. Therefore, further studies are needed to investigate more about the maternal and neonatal outcome due to anaemia during pregnancy. Moreover, this kind of study is still limited developed in Indonesia.

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