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ORIGINAL RESEARCH

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## THE CORRELATION BETWEEN LEVEL OF HEMOGLOBIN, HEMATOCRIT, AND THROMBOCYTES OF MOTHER AND ASPHYXIA IN NEWBORN

Norwidya Priansiska<sup>1\*</sup>, Abkar Raden<sup>2</sup>, Dewi Rokhanawati<sup>2</sup>

<sup>1</sup>Muhammadiyah Midwifery Academy Kotawaringin Timur, Indonesia

<sup>2</sup>Aisyiyah University of Yogyakarta, Indonesia

### \*Corresponding author:

Norwidya Priansiska

Muhammadiyah Midwifery Academy Kotawaringin Timur  
Jalan Pramuka, No.100 Sampit, Kalimantan Tengah Indonesia  
Email: [wiwid.cia@gmail.com](mailto:wiwid.cia@gmail.com)

### Abstract

**Background:** Infant mortality in Indonesia is at the highest level among the countries in South East Asia. Asphyxia in newborn has become the second risk factor for infant mortality.

**Objective:** The objective of this study was to investigate the correlation between the level of hemoglobin, hematocrit, and thrombocytes of the mothers and asphyxia in the newborns at Panembahan Senopati Bantul Hospital, Indonesia.

**Methods:** The study employed case-control method with 282 samples, which 141 assigned in the case and control group. This study used medical record of the patients as the secondary data. Chi-square, multiple logistic regression, and Odds Ratio Calculation (OR) were used for data analysis.

**Results:** There was a meaningful correlation between the level of hemoglobin (OR=2.3, 95%CI=1.3-4), hematocrit (OR=4.3, 95%CI=1.4-13.4, and thrombocytes (OR=5.3, 95%CI=1.14-24.6) of the mothers and asphyxia in newborns. Thrombocytes was the most dominant factor related to asphyxia in newborns.

**Conclusion:** Mothers who have hemoglobin, hematocrit and thrombocytes levels under the normal have more than two times risk of asphyxia in their newborn than mothers who have normal hemoglobin, hematocrit and thrombocytes levels.

**Keywords:** hemoglobin; hematocrit; thrombocytes; asphyxia; newborn

## INTRODUCTION

According to World Health Organization, every year about 3% (3.6 million) of 120 million newborn infants get birth asphyxia (WHO, 2009). Almost 1 million infants are dying because of this case (Gollogly, 2009). Birth asphyxia occurs in some countries. In the developed country, the percentage is 8 to 35 %, whereas in the developing country is 31 to 56.5%. In the first minute of asphyxia, 47/1000 infants are alive and 15.7/10000 infants are alive for all neonates in the fifth minutes.

The incidence of asphyxia in newborn infants is more than 40/ 1000 living birth in Indonesia (Manuaba, 2012).

Infants Mortality Rate in Indonesia occupies the fourth place among ASEAN countries. The causes of infant mortality are neonatal asphyxia (37 %), premature birth (34 %), sepsis (12%), hypothermic (7%), blood disorder (6%), post maturity (3%), and congenital disorder (1%) (Risksedas, 2007).

The Data Coverage of Infant Health Services in Special Region of Yogyakarta in 2014 is in the amount of 78.1% while Target Strategy Plan in 2014 is in the amount of 90% ([MOH, 2015](#)).

The result of Survey Democracy and Health Indonesia ([BPS, 2013](#)) shows that Infants Mortality Rate in Special Region of Yogyakarta occupies the fifth best nationally followed by East Kalimantan, Jakarta, Riau, and South Sulawesi. Special Region of Yogyakarta cannot meet the target of MDGs (The Millennium Development Goals) because Infants Mortality Rate 2012 is still in the position of 25/1000 living birth. The general causes of infant mortality in Special Region of Yogyakarta are low birth weight and sepsis. The other cause of infant mortality that often happens in Special Region of Yogyakarta is shortness of breath when the baby is too long in the birth canal (birth asphyxia). Based on Public Health Services Bantul, Infants Immortal Rate in 2015 is about 8.35/1000 living birth better than in 2014 is about 8,75/1000 living birth. The case of the infant mortality in 2015 is 105 cases in Bantul and it happens in almost all Bantul's sub-districts. The most cause of Infants Mortality Rate in 2015 is low birth weight (30%), and then asphyxia in newborn infants (27%) ([DinKes Bantul, 2016](#)). Asphyxia in the newborn is the condition when the infants cannot breathe spontaneously, so it can decrease O<sub>2</sub> and increase CO<sub>2</sub> which raise the bad effect in a further life. Asphyxia can cause hypoxia progressive and has a correlation with retention of carbon dioxide, and metabolic acidosis ([Stark, 2013](#)). An estimated 1 million children who survived after birth asphyxia now live with long-term morbidity such as cerebral palsy, mental retardation and learning disabilities ([DepKes, 2008](#)). There are several factors that influence neonatal asphyxia in newborns, both from maternal and fetal factors. Fetal factors are such as prematurity, hypoxia, acidosis, umbilical cord, umbilical cord, and others. While the mother factors are pregnancy (infection, preeclampsia / eclampsia, diabetes, heart disease) and labor

(sectio caesarian, vacuum extraction, forceps extraction, APB) ([Syafudin, 2011](#)).

Another maternal factor that may affect the occurrence of asphyxia in newborns is maternal blood chemistry such as increase or decrease in hemoglobin levels, hematocrit, and thrombocyte, which cause impaired uteroplacental blood circulation so that the supply of oxygen to the baby decreased resulting in baby hypoxia in the uterus and may progress to asphyxia in newborns ([Gomella, Cunningham, Eyal, & Tuttle, 2013](#)). Based on Health Act No. 36 of 2009 on Health, then health services in children directed to realize a comprehensive child health services include promotive, preventive, curative and rehabilitative ([Undang-Undang Republik Indonesia, 2009](#)). Efforts to reduce child mortality in achieving target of SDGs should be accompanied by improvements in the quality of life of children which one of the efforts is to do health detection as early as possible even since the newborn. Midwives should examine and assess newborns to ensure spontaneous breathing prevents secondary hypoxia, discovers abnormalities, and performs acts or refers according to need. Midwives should also prevent and treat hypothermia, asphyxia in newborns. Preliminary study results conducted in RSUD Panembahan Senopati Bantul found that the incidence of asphyxia in newborns in Senopati Bantul Panembahan Hospital is still high. In 2016 of 2,799 babies born, 677 (24.1%) of babies had asphyxia ([RSUD Panembahan Senopati, 2017](#)). As there is a lack of information related to the factors related to birth asphyxia, this study focuses on the level of hemoglobin, hematocrit, and thrombosis of the mothers and its correlation with birth asphyxia.

## METHODS

### *Research design*

This was an observational study using case-control research design. This study used secondary data (patient record medical record)

at Panembahan Senopati Bantul General Hospital from January to December 2016.

### Setting

This research was conducted at Panembahan Senopati Hospital of Bantul from March to September 2017.

### Population dan Sample

In this research, the population is all of the infants born in Panembahan Senopati Hospital of Bantul from January to December 2016 in the amount of 2.799 living birth. The samples were selected using consecutive sampling in the case and control group (1:1). The total of the number of samples is 256, while to avoid drop out, 10% (26 samples) was added, then the total samples were 282 samples, with 141 assigned in the case and control group. The inclusion criteria were Babies born in Panembahan Senopati Bantul General Hospital recorded on medical record, and the baby whose mother do chemical blood clinic checkup last 7 days before delivery at the hospital. The exclusion criteria were: (i). Infants with condition (baby born physical disability, premature baby, baby gamelli), (ii) Placenta previa marginalist, placental abruption, (iii) Cord coil, (iv) Pregnancy

(infection, preeclampsia / eclampsia) and (v) Birth process (APB, bleeding, prolonged labor).

### Ethical Consideration

This study has been approved by Research Ethics Committee of The University of Aisyiyah Yogyakarta, with approval number: 02/KEP-UNISA/Exe./VI/2017.

### Data Analysis

Data were analyzed using computerization system with univariate, bivariate, and multivariate analysis. Chi-square, multiple logistic regression, and Odds Ratio Calculation (OR) were employed.

## RESULTS

A number of newborns in Panembahan Senopati Hospital of Bantul in 2016 were 2.799. The occurrence of asphyxia in 2013 was 339 cases, in 2014 was 503 cases, in 2015 was 908 cases, and in 2016 was 677 cases. **Table 1** shows that from 2.799 infants born in Panembahan Senopati Hospital of Bantul, 677 infants got asphyxia and 2.112 infants had no asphyxia.

**Table 1** Frequency distribution of the newborn

Asphyxia Criteria	N	%
Asphyxia	677	24.1
Non-Asphyxia	2.122	75.9
Total	2.799	100

**Table 2** Description of hemoglobin, hematocrit, and platelets with asphyxia in newborns

Independent Variable	Asphyxia		Non-Asphyxia		Total	
	N	%	n	%	n	%
Hemoglobin						
Abnormal	49	34.8	26	18.4	75	26.6
Normal	92	65.2	115	81.6	207	73.4
Hematocrit						
Abnormal	16	11.3	4	2.8	20	7.1
Normal	125	88.7	137	97.2	262	92.9
Thrombocyte						
Abnormal	10	7.1	2	1.4	12	4.3
Normal	131	92.9	139	98.6	270	95.7

**Table 3** Correlation of hemoglobin, hematocrit, thrombocyte and asphyxia in newborns

Independent Variable	Asphyxia (n=141) %		Non-Asphyxia (n=141) %		OR	95%CI	P-Value
Hemoglobin							
Abnormal	49	34.8	26	18.4	2.3	1.3-4.0	0.003
Normal	92	65.2	115	81.6			
Hematocrit							
Abnormal	16	11.3	4	2.8	4.3	1.4-13.4	0.011
Normal	125	88.7	137	97.2			
Thrombocyte							
Abnormal	10	7.1	2	1.4	5.3	1.14-24.6	0.039
Normal	131	92.9	139	98.6			

**Table 2** shows that the high result of the asphyxia infants is in the abnormal level of maternal hemoglobin, which was 49 cases (34.8%), while the low result of the asphyxia is in the abnormal level of maternal thrombocyte, which was 10 cases (7.1%). **Table 3** shows that there was a meaningful correlation between the level of hemoglobin with the occurrence of asphyxia in newborn with p-value of 0.003 (OR=2.3, 95%CI=1.3-4), which means a mother who has hemoglobin level under the normal has 2 times risk in her newborn to get more asphyxia than mother who has normal hemoglobin. Similar with hematocrit, statistical analysis obtained p-

value of 0.011 (OR=4.3, 95%CI=1.4-13.4), which means that the mother who has hematocrit level under the normal has 4 times risk in her newborn to get more asphyxia than mother who has normal hematocrit. And the level of thrombocyte with asphyxia in newborn also has a meaningful correlation with p-value of 0.039 (OR=5.3, 95%CI=1.14-24.6), which indicated that a mother who has thrombocyte level under the normal has 5 times risk in her newborn to get more asphyxia than mother who has normal thrombocyte. In addition, from three variables as shown in the **Table 4**, the level of thrombocyte has the most dominant correlation to asphyxia in newborn.

**Table 4** The result of multivariate with multiple logistic regression

Variable	P-value	OR	95% C.I
Hemoglobin	0.089	1.7	0.9 – 3.1
Hematocrit	0.075	3	0.8 – 10
Thrombocyte	0.039	5.1	1.08 – 24

## DISCUSSIONS

This study aims to determine the relationship of hemoglobin, hematocrit, thrombocyte levels with asphyxia in newborns at Panembahan Senopati Bantul Hospital in 2017. Bivariable analysis showed that there were 3 variables that had significant relationship with asphyxia in newborn, namely hemoglobin level, hematocrit level, platelet count. The main function of red blood cells is to bind and carry O<sub>2</sub> from the lungs to be circulated and distributed throughout cells in various tissues. The only way is to bind oxygen chemically and for that there must be a compound capable of doing the binding. The need is met by a compound known as hemoglobin (Hb)

(Sadikin, 2001). The amount of oxygen can be bonded and carried by the blood, with the presence of Hb enclosed in red blood cells, the supply of oxygen can be transported to various places throughout the body. As a result, various cells in the body can work with enough energy. Lack of Hb in red blood cells causes the impact of the amount of oxygen carried in the body to be reduced (Cunningham, Leveno, Bloom, Spong, & Dashe, 2014). When the body lacks Hb levels then the oxygen that must be distributed in the body tissues will experience deficiency, if a pregnant woman experiences it, then it will have adverse effects on the fetus because if there is a disturbance in the uteroplacental circulation so that oxygen saturation decreases

further, there are disturbances in the acid-base balance in the fetus, with the effect of paralyzing the fetal breathing center, and the fetus undergoing hypoxia resulting in neonatal asphyxia ([Cunningham et al., 2014](#)).

Based on the result of bivariate analysis, it is found that there was a significant correlation between maternal hemoglobin level with asphyxia in newborn in Senembati Bantul Penembahan Hospital in 2017 with p-value = 0.03 (OR = 2.3, 95% CI = 1.3-4 ). This may mean that mothers with normal hemoglobin levels have a risk of asphyxia occurring in infants twice as compared to mothers with normal hemoglobin levels. The statement is in line with research conducted by ([Alizadeh, Raoofi, Salehi, & Ramzi, 2014](#)) with the results of studies suggesting that abnormal Hb concentrations increase the risk of adverse births such as low birth weight (LBW) and low Apgar scores.

The result of bivariate analysis also showed that there was a correlation between maternal hematocrit level with asphyxia in newborns with p-value = 0,011 (OR = 4.3, 95% CI = 1.4 - 13.4). This could mean that mothers with normal hematocrit levels have a risk of asphyxia occurring in infants 4 times compared to mothers with normal hematocrit levels. Hematocrit is used to measure red blood cells, when it occurs (hemodilution) decreased blood levels of hematocrit causes dilution, and accompanied by an increase in plasma volume of 30-40% ([Kosasih & Kosasih, 2008](#)). Hemodilution causes Hb levels in the body to decrease, if a pregnant woman with Hb rate about 11 gr%, then when Hb hemodilution occurs will decrease until 9.5%, so that body oxygen intake becomes reduced, because Hb function of binding oxygen in the body decreased, when the flow of blood that transports oxygen to various parts of the body experience obstacles so that the intake of oxygen which is needed by the body is not met, causing impaired uteroplacental blood circulation so that the supply of oxygen to the baby becomes reduced resulting in hypoxia of the baby in the womb

and may progress to newborn asphyxia ([Kosasih & Kosasih, 2008](#)).

Thrombocytopenia (thrombocyte deficiency) causes obstacles in hemoglobin synthesis, so that the amount of hemoglobin cannot offset the increase in plasma volume, causing oxygen to be transported into body tissues to be inhibited, and with the condition of pregnant, it will affect the fetus that contained the disorder will result in oxygen being drained by the mother's blood to uteroplacental constrains, so that oxygen to the fetus is reduced, it is hypoxic to the fetus and continues to occur asphyxia in the newborn ([Gomella et al., 2013](#)). Previous research ([Wang et al., 2017](#)) of pregnancy related thrombocytopenia and with hypertensive disorders in pregnancy had an effect on the occurrence of postpartum hemorrhage, the rate of stillbirth, and the effect of low Apgar score in the first 5 minutes of birth. Based on the result of bivariate analysis found that there was correlation between maternal platelet counts with asphyxia in newborn with result p-value = 0.039 (OR = 5.3, 95% CI = 1.14 – 24.6). Multivariate analysis showed that most platelet counts were associated with asphyxia in newborns (OR = 5.1, 95% CI 1.08-24, P-value = 0.023). This is in line with previous research ([Kawuryan, 2013](#)) showed that babies were born with low Apgar values in mothers with platelets <150.000. Thrombocytopenia (platelet deficiency) causes obstacles in the synthesis of hemoglobin, so the amount of hemoglobin cannot increase the plasma volume, so that the oxygen that flowed into the body tissue become obstructed and with the condition of pregnant.

Thrombocytopenia is an important prognostic factor for the mother and fetus. A platelet count of <150.000 / mml is usually followed by damage to other organs such as the brain, kidneys, liver and lungs caused by damaged vascular endothelium, increased vascular permeability, macrophage, micro and thrombotic activation, hypoxia and tissue ischemia. When thrombocytopenia is present, then the perinatal mortality was 7.7% - 60%. Perinatal death is largely due to placental

solutio, intrauterine asphyxia, and prematurity ([Leduc, Wheeler, Kirshon, Mitchell, & Cotton, 1992](#)).

## CONCLUSION

It can be concluded that mothers who have hemoglobin level under the normal has 2.3 times risk of asphyxia in their newborn than mothers who have normal hemoglobin. While mothers who have hematocrit level under the normal has 4.3 times risk of asphyxia in their newborn than mothers who have normal hematocrit, and mothers who have thrombocyte level under the normal has 5.3 times risk of asphyxia in their newborn than mothers who have normal thrombocyte. Thrombocyte level is the most dominant factor correlated with the birth asphyxia in newborns.

### Declaration of Conflicting Interest

None declared.

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### Author Contribution

All authors contributed equally in this study.

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