

Original Research

The Effect of Delayed Cord Clamping (DCC) on Haemoglobin Levels and Oxygen Saturation Levels in Newborns



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Article Info	Abstract
<p>Article history: Received: 18 May 2023 Accepted: 27 July 2023</p>	<p><i>Introduction:</i> The case of iron deficiency anaemia in infants is a serious health problem because it interferes with mental and cognitive development. DCC prolongs blood flow from the placenta to the baby through the umbilical cord, increases blood volume, and optimizes oxygen transfusion which might prevent anaemia and promote effective self-breathing. Objective: To determine the effect of DCC on Haemoglobin Levels and Oxygen Saturation Levels in Newborns.</p> <p><i>Methods:</i> Experimental research with Post-test Only Control Group design. The Total Sampling method was used on 30 newborns as the samples, with 15 newborns in the intervention group and 15 newborns in the control group. Data collection used the Delayed Cord Clamping procedure, observation sheets, Easy Touch GCHb tool and Baby SpO₂. An Independent T-test was used to process the data.</p> <p><i>Results:</i> Based on the experiment on 30 infants, it was found that the average haemoglobin level of newborns with the Delayed Cord Clamping treatment was 22.07 gr/dL higher than the haemoglobin level of newborns without the Delayed Cord Clamping treatment of 17.79 gr/dL. In addition, the average oxygen saturation level of new-borns with the Delayed Cord Clamping treatment was 87.4% more than the oxygen saturation level of new-borns without the Delayed Cord Clamping treatment of 77.4%.</p> <p><i>Conclusion:</i> There is an effect of DCC on Haemoglobin Levels and Oxygen Saturation Levels in Newborns in the Work Area of the Aikmel Regional Health Centre. There is a need to increase information about the benefits of DCC among health workers.</p>
<p>Keywords: visual distraction, infusion, preschool children</p>	

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INTRODUCTION

Iron deficiency anaemia is the most common nutrient deficiency problem in children worldwide, especially in developing countries such as Indonesia. This health problem is caused by the lack of iron in the patient's body. Based on the data from Household Health Survey in 2012, the prevalence of anaemia in toddlers in Indonesia was still 40.5%. The prevalence of the incidence of Iron Deficiency Anaemia in children under five in Indonesia is around 40-45% [1].

The iron deficiency anaemia in infants is a serious health issue because it might interfere with mental and cognitive development for further development in their adulthood. The timing of clamping and cutting the umbilical cord plays an important role in determining the adequacy of iron in newborns. Several studies have proven the various benefits of delaying the cutting of the umbilical cord in newborns both in terms of preventing anaemia and long-term effects for further development of newborns[2]. The Ministry of Health in Indonesia has stated that one of the indicators of the Sustainable Development Goals (SDGs) is the Neonatal Mortality Rate (NMR). It is one of the indicators of the third SDGs goal, which is to reduce NMR to 12 per 1000 births in 2030 [3].

In Indonesia, there is 40.8% of the occurrence rate of iron deficiency anaemia in infants of 0-6 months. One effort to reduce anaemia in infants and toddlers is by ensuring that the baby gets adequate blood from the placenta through the umbilical cord. During the delivery process, there is a shift in oxygenation from the heart to the lungs from

8-10% of the foetal period to 50% in neonates [4].

The optimal timing of cord clamping has been debated in the scientific literature for the past century, and the timing of cord clamping continues to vary according to policy and clinical practice. *Early* clamping is generally performed during the first 60 seconds after birth. Meanwhile, delayed cord clamping is generally done 1-3 minutes after birth or when the umbilical cord pulse stops. For mothers, delayed clamping of the umbilical cord is one of the procedures that help reduce the risk of postpartum haemorrhage [5].

WHO as the world health authority, has designed recommendations for Southeast Asian countries regarding delaying cord clamping until the umbilical cord stops beating to ensure that the amount of blood flowing to the baby is maximized to prevent anaemia in newborns. Delays in cutting the umbilical cord can provide an additional 80-100 ml of blood in newborns which contains 75 mg of iron as haemoglobin which is sufficient for iron needs during the first 3 months of the infant's life [6]. The Ministry of Health of the Republic of Indonesia has recommended delaying umbilical cord clamping for up to 3 minutes for normal babies since 2007 [7].

Delaying the umbilical cord clamping after the baby cries loudly and until the umbilical cord no longer pulsates in *at term* babies might increase the amount of blood by about 50 ml/kg and contain 100 mg of iron as haemoglobin, which is sufficient for the baby's iron needs in the first 6 months of their life. Conversely, clamping the umbilical cord early (approximately 10-15 seconds after birth) can

block most of the amount of iron that enters the baby's body [2].

During the foetal period, the placenta serves to oxygenate the brain, and after birth, the lungs will take over this function. In the period after the baby is born and before the placenta is born, there is a shift in the role of oxygenation from the placenta to the baby's lungs. During this time, the baby's oxygenation through the placenta is still running, blood is still being transfused to the baby. It might influence haemoglobin to increase blood volume, preventing hypovolemia and hypotension in newborns thus the brain still gets an adequate supply of oxygen [8].

Every cell of the human body requires oxygen to carry out metabolic functions, hence oxygen is the most important substance in human life. Maintaining oxygenation is an effort to ensure adequate oxygen supply to tissues or cells. Oxygen saturation is a measure of how much oxygen haemoglobin can carry. Measurement of oxygen saturation levels is something that needs to be done so that it can be known whether there is a lack of oxygen that can be carried by the blood throughout the body [9].

The results of Batlajery study (2014) are also in line with Nouraie et al. (2019) which stated that haemoglobin levels in newborns whose umbilical cord was delayed to be clamped for 2 minutes were higher by 17.8 g/dl compared to immediate cord clamping for 15 seconds with 15.9 g/dl [8] [10]. Based on the results of research conducted by Rafika (2018), the results of the study showed that the average haemoglobin level in the 2-minute group was 14.5 gr/dl and the 3-minute

group was 15.9 gr/dl., suggested that there is a difference in haemoglobin levels between 3 minutes than 2 minutes [11].

Based on the results of research conducted by Carolin and Damayanti (2020), the results showed that the average value of haemoglobin levels in newborns in the intervention group after Delayed Cord Clamping (DCC) was 22.253 g/dl., while the average haemoglobin level of newborns in the control group without delayed cord clamping was 18,600 gr/dl. An independent statistical *T-Test* obtained a *p*-value of 0.000 <0.05. The results showed that Delayed Cord Clamping (DCC) could increase the haemoglobin level of newborns, thereby preventing anaemia in newborns [12].

Based on research by Singhal et al. (2019), babies who breathe spontaneously and undergo Delayed Cord Clamping (DCC) have oxygen saturation that is higher up to 10 minutes after birth compared with those who underwent Early Cord Clamping (ECC). Babies who breathe spontaneously with Delayed Cord Clamping (DCC) have a lower heart rate compared to Early Cord Clamping (ECC) up to 390 seconds. Spontaneously breathing infants who received Delayed Cord Clamping (DCC) had earlier respiratory development compared to Early Cord Clamping (ECC) [13].

METHODS

This research used an analytic approach, which is aimed at knowing the relationship between two variables in a situation or a group of subjects. This is done to see the relationship between one variable and another. The instrument in this study used a

standard questionnaire with an assessment of the Face, Legs, Activity, Cry, and Consolability (FLACC) to measure the pain scale and used the infusion method with visual distraction using media. The population in this study were preschool children who were treated in the emergency room of Cut Mutia Hospital. The number of samples in this study was 108 children with the criteria of subjects being 3-6 years old school children, being treated in the emergency room. This study used an accidental sampling technique with a total of 108 people. Data analysis of this study used univariate and bivariate analysis. This research has passed the ethical clearance with the number 065/KEPK/UNPRI/VII/2023.

RESULTS

Univariate Analysis

Table 1 shows the data gathered from 30 newborn respondents, where 15 respondents from the Intervention Group (100%) were given the Delayed Cord Clamping (DCC) treatment and 15 respondents in the Control Group (100%) were not given the Delayed Cord Clamping (DCC) treatment.

Table 2 shows the Haemoglobin level of 30 newborn respondents, where 15 respondents from the Intervention Group (100%) were given the Delayed Cord Clamping (DCC) treatment, and 15 respondents in the Control Group (100%) were not given the Delayed Cord Clamping (DCC) treatment, hemoglobin levels of newborns who were given the DCC treatment was higher (73,3%) compared to newborns who were not given the DCC treatment with normal hemoglobin levels (100%).

Table 3 displays the oxygen saturation level of 30 newborn respondents, where 15 respondents from the Intervention Group (100%) were given the Delayed Cord Clamping (DCC) treatment, and 15 respondents in the Control Group (100%) were not given the Delayed Cord Clamping (DCC) treatment, newborns who were given the DCC treatment had oxygen saturation above 88 % (53,3%) and newborns who were not given DCC treatment had oxygen saturation below 88%.

Bivariate Analysis

Table 4 shows the average haemoglobin level of 30 infant respondents as the sample. The average level of haemoglobin in the Intervention Group with the Delayed Cord Clamping (DCC) treatment was 22.07 grams/dL with a difference in haemoglobin levels of 4.28 higher than the average value in the Control Group of 17.79 gram/dL. Statistical test using the Independent T-test obtained a p-value of $0.01 < \alpha 0.05$, meaning that H_1 is accepted, thus there is a significant difference in the average increase in infant haemoglobin levels in the experimental group and the control group. It can be concluded that there is an effect of Delayed Cord clamping (DCC) on haemoglobin levels in newborns.

Table 5 shows the average oxygen saturation level in the Intervention Group which was given the Delayed Cord Clamping (DCC) treatment was 87.4%, 10% higher when compared to the average value in the control group of 77.4%. The statistical test results show that the significance value of p-value = 0.00 Therefore the p-value = 0.00 is

smaller than the α value of 0.05. Then H0 is rejected and H1 is accepted. It can be concluded that there is an effect of Delayed Cord Clamping (DCC) on haemoglobin levels of newborns in the Working Area of the Aikmel Health Centre. Based on table 5, it is evident that the average oxygen saturation level in the Intervention Group which was given the Delayed Cord Clamping (DCC) treatment was 10% higher when compared to

the average value in the control group is 77.4%. Statistical test results using the Independent T-test obtained a p-value of 0.01 $< \alpha$ 0.05, which means that H1 is accepted so that there is a significant difference in the average increase in the baby's oxygen saturation level in the experimental group and the control group, which means there is an influence of Delayed Cord Clamping (DCC) on oxygen saturation levels in newborns.

Table 1

Delayed Cord Clamping (DCC) in Newborns in the Work Area of the Aikmel Health Centre

<i>DCC</i>	New-born infants	
	N	%
Intervention Group	15	100
Control Group	15	100
Total	30	100

Table 2

Average of Haemoglobin Levels in Newborns in the Work Area of the Aikmel Health Centre

Haemoglobin Level	Newborn infants			
	Intervention Group		Control Group	
	N	%	N	%
Low (<14 gr/dL)	0	0	0	0
Normal (14-20 gr/dL)	4	26,7	15	100
High (> 20 gr/dL)	11	73,3	0	0
Total	15	100	15	100

Table 3

Oxygen Saturation Levels in Newborns in the Work Area of the Aikmel Health Centre

Oxygen Saturation Levels	Newborn infants			
	Intervention Group		Control Group	
	N	%	N	%
Low (<88%)	7	46,7	15	100
Normal (88-100%)	8	53,3	0	0
Total	15	100	15	100

Table 4

Effect of Delayed Cord Clamping (DCC) on Haemoglobin Levels of Newborns in the Intervention and Control Groups in the Work Area of the Aikmel Health Centre

Haemoglobin level	New-born infants					<i>p-value</i>
	N	Median	Mean differences	95% CI Deviation		
				Lowest	Highest	
Given <i>DCC</i>	15	22,07	4,28	2,9416	5,6184	0,00
Not given <i>DCC</i>	15	17,79	4,28	2,9296	5,6304	

Table 5

Effect of Delayed Cord Clamping (DCC) on Haemoglobin Levels of Newborns in the Intervention and Control Groups in the Work Area of the Aikmel Health Centre

Oxygen saturation	New-born infants					<i>p-value</i>
	N	Median	Mean differences	95 % CI Deviation		
				Lowest	Highest	
Given <i>DCC</i> treatment	15	87,4	10,00	8,076	11,924	0,00
Not given <i>DCC</i> treatment	15	77,4	10,00	8,057	11,943	

DISCUSSION

Delayed Cord Clamping (DCC) in Newborns

DCC prolongs blood flow from the placenta to the baby through the umbilical cord that has occurred since in the womb (baby's lifetime). At the time of delivery, if the umbilical cord is not clamped, blood continues to flow from the placenta to the newborn during the first minutes of life, allowing the transfer of 25-35 ml/kg of placental blood to the newborn, depending on gestational age, time of cord clamping, the position of the baby at birth, the beginning of breathing, and giving uterotonics to the mother [14].

This is in accordance with Chopra et al. (2018) study about Early Versus Delayed

Cord Clamping In Small For Gestational Age Infant And Iron Stores At 3 Months Of Age which showed that Delayed Cord Clamping (DCC) increases iron stores in preterm infants (gestational age \geq 35 weeks) at 3 months of age without increasing the risk of symptomatic polycythaemia.

It is also in accordance with the study of Purisch et al. (2019) about Effect Of Delayed Vs Immediate Umbilical Cord Clamping On Maternal Blood Loss In Term Caesarean Delivery. It was found that the average neonatal haemoglobin level was available for 90 neonates (79.6%), individually significantly higher with delayed (18.1 g/dL [95% CI, 17.4 to 18.8]) rather than immediately (16.4 g/dL [95% CI, 15.9 to 17.0]) (mean difference 1.67 g/dL ([95% CI, 0.75 to 2.59]) [16].

Haemoglobin Levels in New-borns

A delay in cutting the umbilical cord (Delayed Cord Clamping) increases the number of erythrocytes transfused to the baby. It was reflected in the increase of the haemoglobin level of the newborn. Delaying the clamping and cutting of the umbilical cord gives the placenta more time to circulate blood and ensures adequate oxygen levels in the baby so that the baby avoids anaemia [17].

This result was in line with Podungge (2019) study about The Effect of Delaying Cord Clamping on New-born Haemoglobin Levels. The results of data analysis obtained p-value = 0.000. The results of this study showed that the average Hb level of newborns who underwent delayed cord clamping (21.80 gr/dL) was higher than the immediate cord clamping group (17.48 gr/dL). During delayed cord clamping, the blood and oxygen are allowed to flow from the placenta to the baby through the umbilical cord in the baby's lifeline to resume the role of supplying oxygenated blood, facilitating pulmonary perfusion, and supporting the baby's transition to effective self-breathing [18].

Furthermore, the research by Shao et al. (2021) study about the effects of delayed cord clamping on neonatal jaundice, phototherapy and early haematological status in term caesarean section showed that there was an increase in neonatal transcutaneous bilirubin level on 796 babies in the intervention group compared to the initial cord clamping group on the day of birth than on the following five days. Delayed cord clamping at 30–60 seconds resulted in neonatal haemoglobin on day 3 and increased the rates of neonatal

polycythaemia without phototherapy rates [19].

The researcher's initial assumption was that Delayed Cord Clamping (DCC) might increase haemoglobin levels in newborns due to the haemoglobin level of newborns. It was expected that the Delayed Cord Clamping (DCC) method might be the physiologically alternative choice of delivery with minimal trauma to the mother and baby.

Oxygen Saturation Levels in Newborns

When the cord clamping is performed, umbilical venous blood supply is deterred by impaired left ventricular preload thus cardiac output remains low. Hence, delayed cord clamping allows time to transfer foetal blood in the placenta to the baby at birth which can give the baby an additional 40% more blood volume. During the foetal period, the placenta plays the role of brain oxygenation. Then after birth, the lungs take over this function. [12].

These results are in accordance with Singhal et al. (2019) which states that spontaneously breathing babies who undergo Delayed Cord Clamping (DCC) have higher oxygen saturation up to 10 minutes after birth compared to those who underwent Early Cord Clamping (ECC). Babies who breathe spontaneously with Delayed Cord Clamping (DCC) have a lower heart rate compared to Early Cord Clamping (ECC) up to 390 seconds. Spontaneously breathing infants who received Delayed Cord Clamping (DCC) had earlier respiratory development compared to Early Cord Clamping (ECC) [13].

Based on the result, the researcher concludes that Delayed Cord Clamping (DCC)

can increase oxygen saturation levels in newborns and have a significant impact on increasing oxygen saturation in newborns, thus supporting the baby's transition to effective self-breathing.

Effect of Delayed Cord Clamping (DCC) on New-born Haemoglobin Levels

During the period after the baby is born and before the placenta is born, there is a shift in the role of oxygenation from the placenta to the baby's lungs. In this period, the baby's oxygenation through the placenta is still running and blood is still being transfused to the baby (called placental transfusion). This process might affect haemoglobin (Hb) and haematocrit (Ht), increase blood volume/erythrocytes, and prevent hypovolemia and hypotension in newborns, hence the brain still gets an adequate oxygen supply [12].

This result is in accordance with WHO recommendations in 2014 stating that it is advisable to delay cutting the umbilical cord 1-3 minutes after delivery. The goal is to keep blood flowing from the placenta to the baby. In a pulsating placenta, there is an additional 30-60% of blood for the baby. In addition, blood that is still flowing from the placenta increases the baby's iron content for up to six months after birth. The flow of stem cells from the placenta is also able to help improve the organs in the baby's body.

It is also in line with previous research conducted by Carolin and Damayanti (2020), the results of the study of 30 infants showed that the average value of newborn haemoglobin levels in 15 infants in the

intervention group after Delayed Cord Clamping (DCC) was 22.253 g/dl, while the average new-born haemoglobin level in 15 babies in the control group without delayed cord clamping was 18,600 gr/dl. Independent statistical T-Test obtained a P-value of 0.000 <0.05. The results showed that Delayed Cord Clamping (DCC) have increased the haemoglobin level of newborns, thereby preventing anaemia in newborns [12]. Referring to the result of this research, Rahardjo (2015) has performed the DCC method. There was an effect of delayed cord clamping and cutting clamping for 24 hours period, and the haemoglobin and haematocrit levels of infants with clamping and cutting of the umbilical cord immediately after birth had an average of 15.033 gr/dl and 46.25 gr/dl while the haemoglobin and haematocrit levels of infants with delayed clamping and cutting the umbilical cord 24 has an average of 19.600 gr/dl and 59.11 gr/dl [20].

From the result above, the researcher concludes that Delayed Cord Clamping (DCC) can increase haemoglobin levels in newborns due to the haemoglobin level of newborns. It is hoped that the Delayed Cord Clamping (DCC) method can be a physiologically alternative choice of delivery with minimal trauma to the mother and baby.

Effect of Delayed Cord Clamping (DCC) on New-born Oxygen Saturation Levels

Measurement of oxygen saturation levels is something that needs to be done so that it can be known whether there is a lack of oxygen that is able to be carried by the blood throughout the body. Every cell of the human

body requires oxygen to carry out metabolic functions, so maintaining oxygenation is an effort to ensure adequate oxygen supply to tissues or cells [9].

These results are in accordance with Chopra et al. (2018), the results showed the frequency of delayed umbilical cord cutting on the fitness level of asphyxia babies with an average pre-test value of 6, 78, while the average post-test score was 7.83 [15]. Therefore, it can be concluded that the delay in cutting the umbilical cord affects the fitness level of asphyxia babies at BPM Ernawati.

Furthermore, according to the research by Mukherjee et al. study (2020), it was discovered that newborns with Delayed Cord Clamping (DCC) (n = 170) had significantly higher SpO₂ (3–8%) than new-borns with Early Cord Clamping (ECC) either vaginally (n = 178) or via SC (n = 101). Newborns with Delayed Cord Clamping (DCC) experienced a slower increase in Heart Rate (HR) during the first 2 minutes compared to Early Cord Clamping (ECC). The 5th and 10th percentile SpO₂ values for newborns with Delayed Cord Clamping (DCC) practice were higher than those who practiced Early Cord Clamping (ECC) [21].

Furthermore, Mukherjee et al. study in 2020 revealed that 18 respondents had an APGAR score in the fifth minute of the control group babies with an average of 7.56 and a standard deviation of 0.527 with a Min-Max value (7-8). Meanwhile, the APGAR Value in the fifth minute of the Intervention group babies was an average of 9.75 and a standard deviation of 0.441 with a min-max value (9-10). The results showed that at a p-value of $0.000 < \alpha 0.005$, H_a was accepted, meaning

that there was an effect of delaying the clamping and cutting of the umbilical cord on the APGAR value in newborns at Sembiring General Hospital 2020 [21]. Delaying the clamping and cutting of the umbilical cord provides more time for the process of transferring blood from the placenta to the baby, thus this process of placental transfusion might increase the baby's blood volume by up to 30%.

Furthermore, the study of Satyan Lakshminrusimha et al. in 2021 showed that in newborns, when given DCC + CPAP with 100% O₂ for 60 seconds followed by weaning to 30% has yielded SpO₂ of $92 \pm 11\%$ with all infants were at $>80\%$ at 5 min with 100% survival without severe intraventricular haemorrhage [22].

Therefore, the researcher concludes that the delay in clamping the umbilical cord (Delayed Cord Clamping) increases oxygen saturation in the baby due to the supply of oxygen during the delivery process. Thus, it might prolong the flow of oxygen from the placenta to the baby through the umbilical cord to facilitate lung function, supporting the baby towards effective breathing.

CONCLUSION

There was an effect of Delayed Cord Clamping (DCC) on haemoglobin levels in new-borns in the Aikmel Health Centre, and there was an effect of Delayed Cord Clamping (DCC) on the level of oxygen saturation in newborns in the Aikmel Health Centre. The result of the study can have a significant impact on increasing hemoglobin levels and oxygen saturation in newborns and increasing knowledge about

Delayed Cord Clamping (DCC) in health workers.

CONFLICTS OF INTEREST

This study has no conflict of interest.

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