ORIGINAL ARTICLE

Impact of delayed cord clamping on newborn haemoglobin levels in vaginal deliveries at Women and Newborn Hospital and Public First-Level Hospitals, Lusaka, Zambia

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ABSTRACT

Background: Delayed cord clamping (DCC) is a recommended practice for all births, significantly improving neonatal outcomes by increasing haemoglobin levels and reducing neonatal anaemia. It enhances iron stores through additional placental blood transfer, supporting long-term developmental benefits. Despite these advantages, only 40% of midwives and obstetricians practice DCC, falling short of WHO's recommendation. Given its low cost and effectiveness, underutilization in Zambia is concerning. This study assessed the impact of DCC on newborn haemoglobin levels, examined associations with maternal and neonatal factors, and determined its prevalence in vaginal deliveries at selected public health facilities in Lusaka, Zambia.

Methodology: This analytical cross-sectional study included 489 mother-infant pairs at the Women and Newborn Hospital and public first-level hospitals in Lusaka. Data were collected using a structured questionnaire and medical records. Participants were categorized into DCC (cord clamping ≥1 minute) and Early Cord Clamping (ECC) (<1 minute) groups. Descriptive analysis and multivariate logistic regression evaluated DCC's effect on neonatal haemoglobin levels and associated factors.

Results: DCC was practiced in 71.4% of cases. No significant differences were found in maternal, obstetric, or neonatal characteristics between ECC and DCC groups. Newborns in the DCC group had significantly higher haemoglobin levels. They were nearly five times more likely to have levels of 13–14.9 g/dL (AOR = 4.97, p = 0.009) or ≥15 g/dL (AOR = 4.56, p = 0.015***)***.

Conclusion: DCC is associated with significantly higher newborn haemoglobin levels, supporting its routine implementation in clinical protocols to improve neonatal health outcomes.

INTRODUCTION

Umbilical cord clamping is a routine procedure performed after birth to separate the newborn from

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the placenta. The WHO defines delayed cord clamping (DCC) as the practice of waiting for 1–3 minutes or until the cessation of cord pulsation before clamping the umbilical cord. Research has demonstrated that DCC enhances neonatal haemoglobin levels and reduces the risk of iron deficiency anaemia in both preterm and term infants.. Delaying clamping the cord for 3 min provides an additional blood volume of 20–35 ml/kg of body weight, can contribute approximately 45?mg of additional iron to the infant's iron stores, an amount theoretically adequate to meet iron requirements for over three months.

Despite its well-documented benefits, the implementation of delayed cord clamping (DCC) remains inconsistent, particularly in low- and middle-income countries such as Zambia. The World Health Organization recommends universal DCC to improve neonatal haemoglobin levels and reduce iron deficiency anaemia, yet uptake remains limited.

Globally, DCC practices vary widely. In the Netherlands, it is performed in about 97% of uncomplicated term births, with midwives more likely to practice DCC than obstetricians; cessation of cord pulsations was used as a guide in approximately half of the cases. In contrast, DCC is practiced in only 48% of deliveries in Nepal, where the lack of clear guidelines is cited as a key barrier. Similarly, local studies report DCC rates of around 40%, with many midwives attributing low uptake to the absence of standardized protocols. In sub-Saharan Africa, existing research has primarily focused on the effects of early cord clamping rather than the prevalence of DCC. In Tanzania, it was reported that although birth attendants understood the benefits of DCC, they did not apply it consistently. However, the study did not quantify DCC usage among participants.

In Zambia, there was limited research on the prevalence of DCC and its effect on neonatal haemoglobin levels. A local survey indicated that ECC remains more common, with DCC facing challenges due to the lack of clear guidelines and negative attitudes among birth attendants. Despite these obstacles, the benefits of DCC are well-established, including reduced need for blood transfusions, improved cardiovascular function, and a lower risk of necrotizing enterocolitis in preterm infants.

This study aimed to evaluate the prevalence of DCC, its effect on newborn haemoglobin levels, and associated maternal and neonatal factors at the Women and Newborn Hospital (WNH) and public first-level hospitals in Lusaka District. Addressing these gaps will contribute valuable insights to the limited literature on DCC in Zambia and may lead to the wider adoption of this beneficial, low-cost practice to improve neonatal health outcomes.

METHODOLOGY

This was an analytical cross-sectional study for a period of six (6) months from January 2024 to June 2024. The study was conducted at the Women and Newborn Hospital and public first level hospitals in Lusaka district, Zambia. The University Teaching Hospital is the largest tertiary hospital in the country and is a highest national referral centre for nearly all patients in the country and those from all the 24 local clinics in the Lusaka district (including those from private health facilities). Women and Newborn Hospital has a bed capacity of 531. The study included five First Level Hospitals: Chawama 74 beds, Chilenje 92 beds, Chipata beds, Kanyama 139 beds and Matero 135 beds. In Zambia, these hospitals serve as district-level referral centres, primarily located in Lusaka's peri-urban areas. They offer general medical, surgical, maternal, and neonatal services, including skilled birth attendance and delivery care.

Inclusion Criteria

The study considered for inclusion, pregnant women who were delivering vaginally at the WNH-UTH and public first level Hospitals, with singleton pregnancies at term (37 completed weeks) and women who had provided informed consent to participate in the study.

Exclusion Criteria

The study excluded neonates requiring resuscitation, neonates born with congenital malformations anticipated to affect the outcome of the study, and pregnancies with complications that would prevent DCC such as placenta praevia and suspected foetal distress etc.

Sample Size Calculation

Cochran's formula for comparing two proportions was used to calculate the required sample size, yielding a total of 572 participants, with 40% recruited from the Women and Newborn Hospital and 60% from the level-one hospitals.

Sampling Method

Consecutive sampling was utilized to recruit study participants over a six-month period, from January 2024 to June 2024. To achieve the desired sample size of 572, all eligible participants present during the study period were recruited until the target sample size was met. The current study included two groups determined during analysis: the Delayed Cord Clamping (DCC) group and the Early Cord Clamping (ECC) group. The DCC group consisted of participants with a cord clamping duration of one minute or more, while the ECC group included those with a cord clamping duration of less than one minute.

Study Procedure

Eligible mothers were recruited from the labour ward, after information about the study was given and an informed consent obtained. A standardized and pretested questionnaire was used to collect maternal demographic and clinical information. The tool was adapted and modified from a previously validated questionnaire employed in a similar study conducted in Egypt, ensuring contextual relevance and clarity for the target population. Additional data was obtained from the mothers' and babies' medical records as required. The participants were interviewed at the time of admission in the labour ward. To measure the duration of cord clamping on newborns, a stopwatch was used. To minimize bias from the individuals performing the clamping procedure, a one-sided blinding approach was employed. Once the baby was delivered through vaginal birth, a stopwatch was started immediately after delivery and stopped once the cord was clamped. The time taken was recorded as an absolute count rounded to the nearest second. To prevent bias, the clinicians involved in the study were not aware of the research hypothesis or the study's design.

Determination of the Neonatal Haemoglobin

To determine the haemoglobin values for newborns, the following steps were followed: First, the newborns were in the postnatal wards, and a quick haemoglobin (Hb) test was conducted using a Hemocue device. This test was performed approximately 6 hours after the birth of the infant. Six (6) hours after birth was chosen because during the first hours of life venous haematocrit and haemoglobin values increase by nearly 10%, hence it was considered clinically appropriate to perform newborn haemoglobin levels at 4 - 6 hours after birth to allow this physiological process to take place. To collect the blood sample, the operator used the heel of the infant. The operator wore protective gloves throughout the procedure.

RESULTS

A total of 598 eligible participants were enrolled, of whom 489 obstetric patients were successfully interviewed. The remaining 109 participants were excluded from the study due to various reasons, including undergoing a caesarean section or developing complications, such as antepartum haemorrhage or foetal distress, that prevented delayed cord clamping (DCC).

Cord Clamping time

The median cord clamping time was 120 (IQR: 102) seconds ranging from 18 to 601.2 seconds. Most, 349 (71.4%) study infants had delayed cord clamping (more than 1minute) while 140 (28.6%) study infants had early cord clamping (less than 1minute) after delivery.

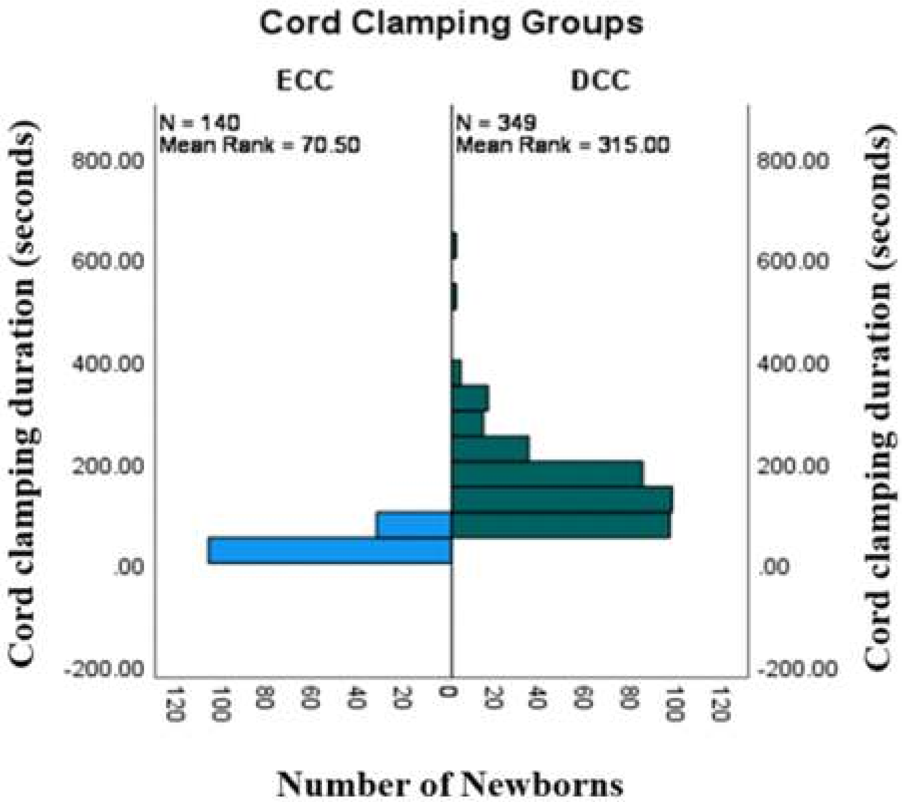

Figure 1. Duration of cord clamping time among study infants

Table 1. Comparison of Newborn haemoglobin level between the early and delayed cord clamping groups

Variable	**Total n (%)**	**Cord clamping**		**p-value**
		ECC n (%)	**DCC n (%)**	
Neonatal Hb				**0.003**
<10 g/dL	12 (2.5)	7 (5)	5 (1.4)	
10 – 12.9g/dL	172 (35.1)	62 (44.3)	110 (31.5)	
13 – 14.9g/dL	170 (34.8)	38 (27.1)	132 (37.8)	
15g/dL	135 (27.6)	33 (23.6)	102 (29.2)	
Time of neonatal Hb				0.698
<4 hrs	41 (8.4)	10 (7.1)	31 (8.9)	
4 – 6 hrs	423 (86.5)	124 (88.6)	299 (85.7)	
6 – 8 hrs	25 (5.1)	6 (4.3)	19 (5.4)	
Total	**489**	**140 (28.6)**	**349 (71.4)**	

**ECC= Early cord clamping, DCC= Delayed cord clamping*

Table 1 showed the distribution of neonatal haemoglobin (Hb) levels and the timing of haemoglobin measurements in relation to cord clamping methods—Early Cord Clamping (ECC) and Delayed Cord Clamping (DCC).

A total of 489 neonates were analysed, revealing a clear correlation between delayed cord clamping (DCC) and higher neonatal haemoglobin levels. Among neonates with Hb levels between 13 and 14.9 g/dL, 132 (37.8%) were in the DCC group compared to 38 (27.1%) in the ECC group. Similarly, for neonates with Hb levels of 15 g/dL or higher, 102 (29.2%) were in the DCC group, while only 33 (23.6%) were in the ECC group. Conversely, a higher proportion of neonates with Hb levels below 10 g/dL were observed in the ECC group (5%) compared to the DCC group (1.4%). These findings suggest that DCC is associated with a significant increase in neonatal haemoglobin levels (p = 0.003).

Table 2. Multivariate regression for neonatal haemoglobin level with effects of cord clamping status shows the results of the multivariate regression for newborn haemoglobin level testing the effects of cord clamping status. The results showed that infants in the DCC group were about five times more likely to have higher initial haemoglobin levels than those in the ECC group [(OR: 4.86; 95% CI: 1.46 – 16.2; p=0.010), and (OR: 4.33; 95% CI: 1.29 – 14.55; p=0.018), respectively].

Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Neonatal Hb				
<10 g/dL	Ref			
10 – 12.9g/dL	2.48 (0.76-8.16)	0.134	2.53 (0.77-8.32)	0.127
13 – 14.9g/dL	4.86 (1.46-16.20)	**0.010**	4.97 (1.49-16.60)	**0.009**
15g/dL	4.33 (1.29-14.55)	**0.018**	4.56 (1.34-15.51)	**0.015**

COR= Crude odds ratio, AOR= Adjusted odds ratio
CI= Confidence interval

DISCUSSION

This study, along with previous research, demonstrates that the timing of umbilical cord clamping plays a critical role in optimizing haematological outcomes in neonates. Specifically, this study examined the effect of delayed cord clamping (DCC) on newborn haemoglobin levels in selected public health facilities in Lusaka District, Zambia. The findings revealed a positive correlation between DCC and higher newborn haemoglobin levels.

The prevalence of delayed cord clamping (DCC) in this study was 71.6%, which is notably higher than the 40% reported in a previous study by Mwamba . The difference in findings may be due to methodological variations between the studies. Mwamba's study relied on participant recall assessing DCC practices, which could have introduced recall bias. In contrast, this study involved direct observation of clinicians, providing more accurate data on DCC implementation. However, this direct observation may have introduced some observer bias. The high prevalence observed may also have been likely due to midwives practice of placing newborns on the mother's abdomen immediately after birth, promoting skin-to-skin contact and bonding. During this period, the newborn was dried, stimulated, and dressed in a head cap and socks, which contributed to the extended time before clamping the umbilical cord. This process not only facilitates maternal-infant bonding but also inadvertently leads to longer DCC durations. It was also noted that certain centres had mentors actively promoting DCC and mother-baby bonding after delivery. One such organization, Seed Global Health, provided mentors who trained and reminded midwives about the importance of delayed cord clamping and skin-to-skin contact after birth. These efforts contributed to the higher adherence to these practices. Data on prevalence of DCC in sub-Saharan Africa is however limited. A study in the Greater Kabale District of Uganda found that only 41% of midwives accepted DCC practices, indicating low acceptance in that region similar to an earlier study in Zambia which 40% accepted DCC practices Additionally, research in South Africa demonstrated that DCC is a safe procedure, even in newborns with low birth weights, and should be promoted in resource-poor settings. Despite these findings, comprehensive data on DCC prevalence across sub-Saharan Africa remain scarce.

This substantial difference in cord clamping duration provided a clear distinction between the two groups, allowing for a robust comparison of newborn haemoglobin levels. Newborn haemoglobin levels were significantly higher in the DCC group compared to the ECC group (Table 1). The data presented in the table highlight a significant association between delayed cord clamping (DCC) and higher neonatal haemoglobin (Hb) levels, which showed a positive effect of DCC on newborn haemoglobin outcomes. Specifically, neonates who underwent DCC had a higher prevalence of Hb levels ≥ 13 g/dL, with 37.8% falling between 13–14.9 g/dL and 29.2% having Hb ≥ 15 g/dL, compared to 27.1% and 23.6% of neonates, respectively, in the early cord clamping (ECC) group. This trend suggests that DCC leads to improved newborn haemoglobin levels, which is consistent with existing literature that emphasizes the benefits of DCC in enhancing neonatal iron stores and reducing the risk of anaemia. The significant p-value (p=0.003) further supports this association, indicating that DCC is likely to be a beneficial practice in improving neonatal haemoglobin status.

In contrast, neonates with lower haemoglobin levels (<10 g/dL) were more prevalent in the ECC group (5%) compared to the DCC group (1.4%), reinforcing the notion that ECC may contribute to suboptimal newborn haemoglobin levels.

Multivariate Regression Analysis

The multivariate regression analysis (Table 2) further confirmed the association between delayed cord clamping and higher neonatal haemoglobin levels. Infants in the DCC group were approximately five times more likely to have higher initial haemoglobin levels compared to those in the ECC group. This association remained significant even after adjusting for gestational age, with adjusted odds ratios (AOR) indicating a strong and significant effect of delayed cord clamping on neonatal haemoglobin levels [(AOR: 4.97; 95% CI: 1.49-16.6; p=0.009), and (AOR: 4.56; 95% CI: 1.34-15.51; p=0.015)].

CONCLUSION

Overall, the findings from this study align with the growing body of evidence supporting the practice of DCC to enhance neonatal haemoglobin levels and reduce the risk of anaemia. The higher haemoglobin levels observed in the DCC group likely result from the additional blood transfer from the placenta to the neonate during the delay in cord clamping. These results advocate for the continued promotion of DCC as a standard practice in delivery settings to improve newborn haemoglobin indices

Recommendations

We recommend the institutionalization of DCC into national obstetric and neonatal care protocols. The Ministry of Health should develop and enforce standardized clinical guidelines mandating DCC for all uncomplicated vaginal births, unless medically contraindicated. Moreover, DCC should be included as a key indicator in routine maternal and neonatal quality assurance audits.

To support widespread adoption, structured in-service training and continuous professional development programs should be implemented to reinforce DCC practices among birth attendants. Integration of DCC education into midwifery and obstetric curricula is also essential to ensure early professional alignment with evidence-based practice.

Furthermore, policy frameworks should encourage monitoring and evaluation systems that track DCC compliance, supported by health information systems that document cord clamping time as a standard perinatal indicator.

Study Strengths and Limitations

This study had several limitations that need to be acknowledged. The results can only be generalized to term singleton pregnancies, low-risk babies, low-risk pregnancies, and low-risk births. The current study enlisted the cooperation of staff to recruit and obtain consent from women and conduct the cord clamping. It could be that staff interested in research and delayed cord clamping volunteered for participation and this approach may have affected recruitment and results. However, this effect is likely to be small, given that the sample was representative of the birthing population in the participating sites and results were like those of previous studies. Another, limitation to this study was the relatively small number of infants in the group with a cord clamping time of less than one minute, this could have caused a risk of selection bias. However, the representative sample size may positively affect generalizability to other similar settings.

Dissemination of Results

The results of this study will be presented to the department of obstetrics and Gynaecology at WNH and will also be shared with the District Health Office. As well as the management staff at the study facilities and the results will be made freely available to the study anyone, upon request, if they wish to know the outcome of the study. The results will be published through a reputable medical journal and shared with relevant stakeholders.

It is hoped that the results of the study will help to generate information relevant to improve the management of obstetric patients to help reduce the neonatal mortality rate both at the institutional and country level as well as the region and globally. The results may guide on how to allocate resources and management of limited resources.

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