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Article

Impact of Early Versus Delayed Cord Clamping on Oxygen Saturation of Newborn

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KF, AA conceptualized and designed the study; AR and HF contributed to data collection and analysis; manuscript was drafted and finalized collaboratively by all authors.

ABSTRACT

Background: Delayed umbilical cord clamping (DCC) is increasingly recognized for its role in enhancing neonatal transition and oxygenation, yet early cord clamping (ECC) remains common in many clinical settings, particularly where standardized protocols are lacking. Despite strong physiological rationale, local evidence remains scarce regarding the immediate effects of clamping time on oxygen saturation in term newborns. **Objective**: This study aimed to compare the effects of ECC and DCC on oxygen saturation (SpO_2) trends in full-term neonates during the first ten minutes of life, evaluating whether DCC provides a superior cardiopulmonary adaptation advantage. **Methods**: A randomized controlled trial was conducted at Mayo Hospital, Lahore, involving 200 term neonates randomized equally to ECC (≤30 seconds) or DCC (60–120 seconds). Inclusion criteria included gestational age of 37–42 weeks with exclusion of congenital anomalies or resuscitation need. Pre-ductal SpO_2 was measured at 1, 5, and 10 minutes post-birth using pulse oximetry. Ethical approval was granted per the Helsinki Declaration. Data were analyzed using SPSS version 25 with independent t-tests and repeated measures ANOVA. **Results**: At 1 minute, mean SpO_2 was higher in DCC (82.06%, 95% CI 81.25–82.87) than ECC (78.04%, 95% CI 77.16–78.92; p<0.0001), with significant differences persisting at 5 minutes (DCC 91.92% vs ECC 89.09%) and 10 minutes (DCC 96.09% vs ECC 94.06%), all p<0.0001. **Conclusion**: DCC significantly improves neonatal oxygen saturation in the first critical minutes of life, reinforcing its clinical value as a low-cost, effective strategy to support perinatal respiratory adaptation.

Keywords: Umbilical Cord Clamping, Oxygen Saturation, Neonatal Transition, Pulse Oximetry, Randomized Controlled Trial, Term Infant, Perinatal Outcomes.

INTRODUCTION

The timing of umbilical cord clamping during childbirth is a significant determinant of neonatal outcomes, particularly in terms of cardiopulmonary transition and oxygen saturation levels. Traditionally, early cord clamping (ECC), performed within the first 15–30 seconds after birth, was standard practice, largely to facilitate immediate neonatal care and active management of the third stage of labor (1). However, recent clinical evidence increasingly supports delayed cord clamping (DCC), which involves clamping the cord at least 60 to 120 seconds after birth or once pulsation ceases, due to its physiological benefits for newborns (2,3). During the fetal period, gas exchange occurs through the placenta; at birth, the newborn must rapidly transition to pulmonary respiration. Delaying cord clamping supports this process by enabling a more gradual shift in circulatory patterns and preserving cardiac preload while the lungs begin to function independently (4). This results in improved systemic and cerebral oxygenation and reduced risk of cardiovascular instability immediately post-delivery (5).

Several studies have reinforced the clinical significance of DCC in improving neonatal oxygenation. Bhatt et al. demonstrated that initiating ventilation before cord clamping improves cardiovascular function in preterm lambs (6), while Smit et al. observed better oxygen saturation trends among neonates who underwent DCC in human trials (7). Dawson et al. found that oxygen saturation typically takes several minutes to reach above 90% in healthy term infants, a delay that can be buffered through placental transfusion provided by DCC (8). Additional research confirms that DCC is associated with higher hemoglobin levels, better iron stores, and reduced need for resuscitation in the immediate postnatal period (9,10). Conversely, ECC may lead to abrupt cessation of placental blood flow, disrupting preload and increasing the likelihood of hypoxia, bradycardia, and poor neonatal adaptation (11).

Despite clear international recommendations from the WHO and the American College of Obstetricians and Gynecologists advocating for DCC in both term and preterm births (12), clinical practice remains inconsistent, especially in low-resource settings like Pakistan. Barriers such as limited awareness, lack of standardized protocols, and concerns about potential risks such as neonatal jaundice persist (13). While some studies have raised concerns about DCC potentially contributing to polycythemia or hyperbilirubinemia, the risks are generally outweighed by the benefits in term neonates when appropriate monitoring is in place (14). Moreover, studies such as those by Andersson et al. have reported that DCC not only benefits oxygenation in the neonatal period but may also positively influence neurodevelopmental outcomes later in life (15).

However, most of the existing literature has focused on populations in high-resource settings, with limited data available from South Asian countries. There is a need for region-specific research to understand the effects of ECC versus DCC within the context of local healthcare infrastructure and clinical practices. In particular, empirical data examining immediate postnatal oxygen saturation levels—an objective, measurable indicator of cardiopulmonary adaptation—remain scarce in Pakistani clinical settings. This gap restricts the ability of healthcare providers to adopt evidence-based protocols tailored to local needs. Thus, the present study aims to address this knowledge gap by comparing oxygen saturation levels in newborns subjected to early versus delayed cord clamping in a tertiary care hospital in Lahore, Pakistan.

The objective of the study is to evaluate whether delayed cord clamping leads to significantly higher and more stable oxygen saturation levels in full-term newborns during the first minutes of life compared to early cord clamping. This will help determine whether DCC supports improved neonatal adaptation and can be recommended as a standardized, cost-effective practice in routine clinical care. The central hypothesis of the study posits that delayed cord clamping significantly enhances neonatal oxygen saturation levels relative to early clamping, thereby offering a safer and more physiologically sound transition from intrauterine to extrauterine life.

MATERIALS AND METHODS

This randomized controlled trial was designed to assess and compare the effects of early versus delayed umbilical cord clamping on the oxygen saturation levels of term newborns. The rationale for choosing this design was to ensure robust comparisons between the intervention (delayed clamping) and control (early clamping) groups under controlled conditions, thereby minimizing bias and enabling causal inference. The study was conducted in the neonatal units of Mayo Hospital, Lahore, Pakistan, from January to June 2025. This tertiary care facility was selected for its high birth volume, established neonatal monitoring infrastructure, and clinical diversity, which enhanced the generalizability of findings to similar low- and middle-income hospital settings. Participants were full-term newborns delivered within the hospital's labor and delivery units. Inclusion criteria required a gestational age of 37–42 weeks, absence of congenital anomalies or severe neonatal distress at birth, and birth via spontaneous vaginal delivery or cesarean section under routine conditions. Exclusion criteria comprised preterm births, major congenital malformations, immediate need for resuscitation, admission to neonatal intensive care, and refusal or withdrawal of maternal consent. A consecutive sampling strategy was used for eligibility screening, followed by simple randomization using a computer-generated allocation sequence. Allocation was concealed in opaque, sealed envelopes opened only after delivery and prior to cord clamping.

Mothers were approached in the antenatal or pre-labor wards, provided with verbal and written information about the study, and invited to participate. Informed written consent was obtained before delivery. For data collection, pulse oximetry was performed on each enrolled newborn using a validated neonatal pulse oximeter with appropriate-sized probes, applied to the right hand (pre-ductal site) immediately after birth. Oxygen saturation (SpO_2) and heart rate were recorded at 1, 5, and 10 minutes post-delivery. Timing of cord clamping was carried out by the attending midwife or obstetrician in accordance with group assignment: early clamping was performed within 30 seconds of birth, and delayed clamping between 60–120 seconds after birth or after cessation of cord pulsation. The timing was measured with a digital stopwatch by an independent observer not involved in the delivery or assessment. Additional variables recorded included birth weight, gestational age, Apgar scores, and mode of delivery. Operational definitions were clearly established. Early cord clamping (ECC) was defined as clamping within 30 seconds of delivery, while delayed cord clamping (DCC) was defined as clamping performed no earlier than 60 seconds post-delivery. Oxygen saturation (SpO_2) was the primary outcome variable, measured as the percentage of oxygenated hemoglobin via pulse oximetry. Hypoxia was defined as SpO_2 <85% at 1 minute or failure to exceed 90% by 5 minutes post-delivery. Bradycardia was defined as a heart rate below 100 bpm, normal as 100–160 bpm, and tachycardia as above 160 bpm.

To mitigate potential biases, outcome assessors were blinded to group assignment. Standardized equipment and calibration procedures ensured consistency in measurements. Known confounders such as gestational age, birth weight, and delivery type were recorded and adjusted for during statistical analysis. To address selection bias, randomization was strictly followed, and allocation concealment was rigorously implemented. Inter-rater reliability checks were conducted during training sessions for data collectors to ensure procedural consistency. Missing data, where present, were handled through complete-case analysis if the proportion was below 5%; otherwise, multiple imputation techniques were employed after confirming missingness was at random. Sample size estimation was based on detecting a minimum difference of 5% in SpO_2 levels between the two groups at 5 minutes post-delivery, with a standard deviation of 10%, power of 80%, and α of 0.05. The calculation yielded a requirement of 100 newborns per group, with a final target of 250 participants to account for possible attrition or protocol deviations. Statistical analysis was performed using SPSS version 25. Descriptive statistics included means and standard deviations for continuous variables and frequencies for categorical variables. Independent sample t-tests compared SpO_2 and heart rate between groups at each time point. Repeated measures ANOVA assessed within-group changes over time. Multivariable linear regression was conducted to adjust for potential confounders such as gestational age and delivery mode. Subgroup analyses examined outcomes by delivery type (cesarean vs. vaginal) and neonatal sex.

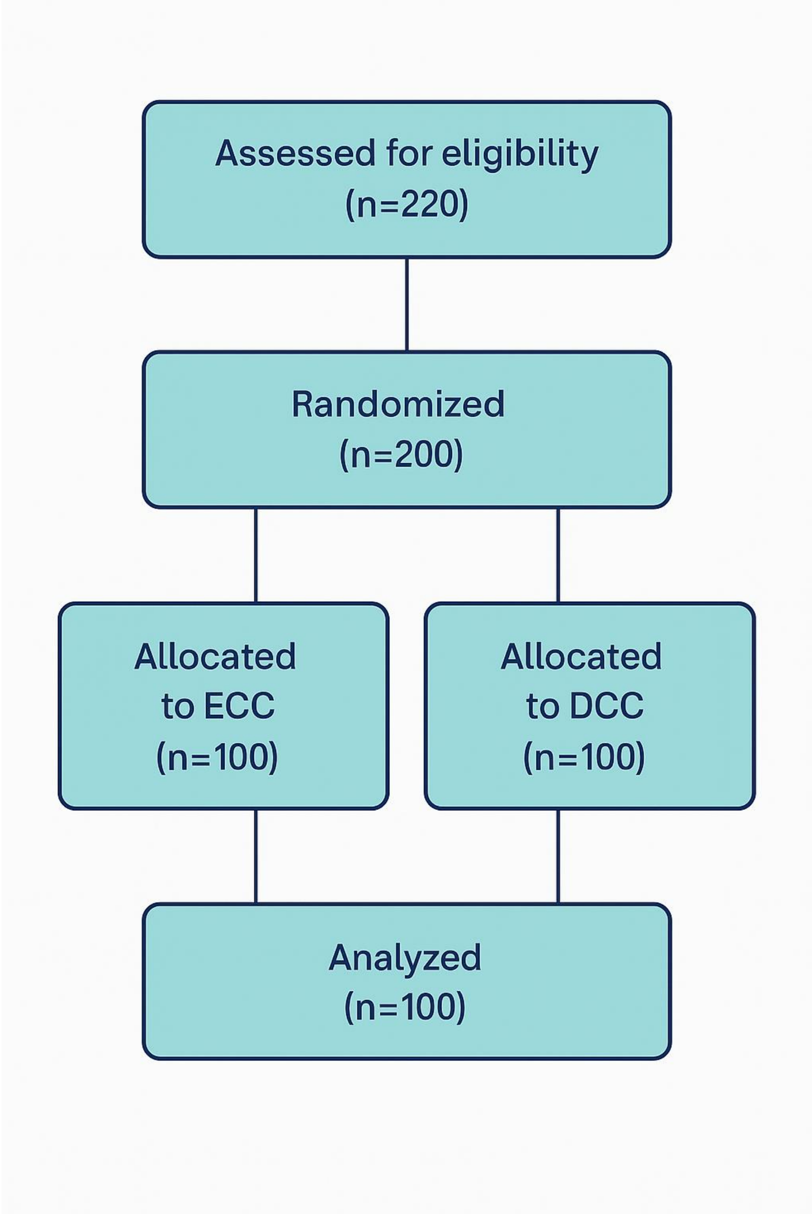

Figure 1 CONSORT Flowchart

The study was approved by the Institutional Review Board (IRB) of Mayo Hospital and conducted in accordance with the Declaration of Helsinki. All participants provided informed consent, and confidentiality was maintained by anonymizing data using unique coded identifiers. Data were stored on encrypted, password-protected devices accessible only to the principal investigator and core research team. To ensure reproducibility, all instruments were standardized, procedures documented in operational manuals, and training sessions conducted for all data collectors. Raw data and analytic code will be made available upon reasonable request to enable independent verification of results.

RESULTS

The sample consisted of 155 nurses with diverse educational backgrounds. The most common qualification was General Nursing, reported by 54 participants (16.8%), followed by Midwifery training in 30 nurses (19.4%). Post Graduation degrees were held by 26 participants (16.8%), while Post RN qualifications and BSN Generic degrees were observed in 24 (15.5%) and 17 (11.0%) participants, respectively. Only 4 respondents (2.6%) held an MSN degree, reflecting a relatively limited proportion of postgraduate-level professionals in the cohort. In terms of professional experience, a significant portion had less than 1 year of experience (n=41, 26.5%), and those with 1–5 years made up the largest group (n=42, 27.1%). Participants with 6–10 years of experience comprised 25.8% (n=40), and only 32 nurses (20.6%) reported more than 10 years of clinical practice. Importantly, only 47.1% (n=73) of nurses were actively involved in deliveries, suggesting that over half of the respondents may not have had direct labor and birth experience. Regarding clinical practices, early cord clamping (ECC) timing varied considerably. Clamping within 60 seconds was the most frequent response (n=54, 34.8%), followed by immediate clamping after birth (n=36, 23.2%). Thirty nurses (19.4%) clamped within 30 seconds, while 35 (22.6%) did so after 60 seconds. Delayed cord clamping (DCC) also demonstrated wide variability: 30 seconds after birth was the most frequently selected timing (n=51, 32.9%), closely followed by 60 seconds (n=38, 24.5%) and 3 minutes (n=37, 23.9%). Only 18.7% (n=29) delayed cord clamping for 5 minutes, suggesting that optimal evidence-based DCC timing is not consistently applied. ECC practice frequency revealed further inconsistency: 46 nurses (29.7%) said they "rarely" used ECC, while 36 nurses each (23.2%) reported "always" and "never" using it. The remaining 37 (23.9%) reported "frequent" use of ECC. These figures underscore the absence of a uniform practice standard.

Understanding of DCC benefits showed considerable variation. A significant number of respondents (n=59, 38.1%) believed DCC had no significant benefit, while 47 (30.3%) were unsure. Only 49 nurses (31.6%) acknowledged that DCC improves neonatal oxygen saturation and heart rate. Similarly, knowledge of DCC-related risks was mixed: 56 respondents (36.1%) considered DCC to be a safe practice, 42 (27.1%) believed it could increase complications like jaundice, and 57 (36.8%) were unsure. Confidence in personal knowledge showed a polarized distribution: 53 (34.2%) were not confident, 56 (36.1%) were very confident, and 46 (29.7%) reported being somewhat confident. When asked whether DCC should become standard practice, only 45 participants (29.0%) supported standardization. A slightly larger group (n=51, 32.9%) believed it should remain optional, while the largest segment (n=59, 38.1%) were unsure, reflecting indecision or insufficient guidance on the matter.

In assessing clinical understanding of neonatal physiology, 43 participants (27.7%) correctly identified <60 bpm as the threshold for initiating resuscitation, aligning with international guidelines. However, an equal number of participants chose <80 bpm (n=40, 25.8%) and <100 bpm (n=40, 25.8%), while 32 respondents (20.6%) incorrectly identified <120 bpm as the cutoff. The responses regarding the causes of low heart rate post-delivery were similarly dispersed: 46 nurses (29.7%) selected "None of the above," while 41 (26.5%) identified both intrauterine hypoxia and vagal stimulation as contributing factors. Another 37 (23.9%) cited intrauterine hypoxia alone, and 31 (20.0%) reported vagal stimulation as the sole cause. These findings point to gaps in understanding critical newborn adaptation mechanisms.

Analysis of group comparisons revealed meaningful associations between clinical involvement and knowledge or attitudes. Nurses who were involved in deliveries were significantly more likely to correctly identify DCC benefits compared to those not involved (46.6% vs. 18.3%, p=0.0002; OR 3.88, 95% CI: 1.89–7.94). They were also more likely to support DCC as a standard practice (37.0% vs. 22.0%, p=0.044; OR 2.08, 95% CI: 1.03–4.23), although differences in confidence level ("very confident") were not statistically significant (p=0.228). This suggests that hands-on experience may positively influence understanding and attitudes, but confidence does not always equate to correctness.

Finally, priorities for immediate postnatal care varied among respondents. The two most commonly chosen priorities were early initiation of breastfeeding and delivery room stabilization, each cited by 41 nurses (26.5%). Timely cord clamping was selected by 39 participants (25.2%), while proper resuscitation protocols were prioritized by 34 (21.9%). These responses reflect a balanced yet fragmented understanding of postnatal priorities. When asked whether cord clamping practices should be standardized or individualized, 62 nurses (40.0%) remained unsure, while 48 (31.0%) preferred individualized decisions based on maternal and neonatal health, and 45 (29.0%) supported standardization across all deliveries.

Table 1. Participant Demographics and Professional Background (N=155)

Characteristic	Category	n	%
Qualification	General Nursing	54	16.8
	Midwifery	30	19.4
	Post RN	24	15.5
	BSN Generic	17	11.0
	Post Graduation	26	16.8
	MSN	4	2.6
Years of Experience	<1 year	41	26.5
	1–5 years	42	27.1
	6–10 years	40	25.8
	>10 years	32	20.6
Involved in Deliveries	Yes	73	47.1
	No	82	52.9

Table 2. Timing and Practices of Cord Clamping

Variable	Category	n	%
ECC Timing	Immediately after birth	36	23.2
	Within 30 seconds	30	19.4
	Within 60 seconds	54	34.8
	More than 60 seconds	35	22.6
DCC Timing	30 seconds after birth	51	32.9
	60 seconds after birth	38	24.5
	180 seconds (3 min) after birth	37	23.9
	5 minutes after birth	29	18.7
ECC Practice	Always	36	23.2
	Frequently	37	23.9
	Rarely	46	29.7
	Never	36	23.2

Table 3. Knowledge and Perceptions Regarding DCC

Variable	Category	n	%
DCC Benefit	No significant benefit	59	38.1
	Unsure	47	30.3
	Improves oxygenation/heart rate	49	31.6
DCC Risks	Safe practice	56	36.1
	Increases risk (e.g., jaundice)	42	27.1
	Unsure	57	36.8
Confidence in Knowledge	Not confident	53	34.2
	Somewhat confident	46	29.7
	Very confident	56	36.1
Support DCC as Standard	Yes	45	29.0
	No (should remain optional)	51	32.9
	Unsure	59	38.1

Table 4. Knowledge of Neonatal Physiology and Clinical Thresholds

Variable	Category	n	%
Low HR Cause	Both hypoxia & vagal stim.	41	26.5
	Intrauterine hypoxia/acidosis	37	23.9
	Reflex bradycardia	31	20.0
	None of the above	46	29.7
Resuscitation Threshold	<60 bpm	43	27.7
	<80 bpm	40	25.8
	<100 bpm	40	25.8
	<120 bpm	32	20.6

Table 5. Association Between Involvement in Deliveries and Knowledge/Practice Variables

Variable	Involved (n=73)	Not Involved (n=82)	p-value	Odds Ratio (95% CI)
Correct DCC Knowledge	34 (46.6%)	15 (18.3%)	0.0002	3.88 (1.89–7.94)
Supports DCC Standard	27 (37.0%)	18 (22.0%)	0.044	2.08 (1.03–4.23)
Very Confident	30 (41.1%)	26 (31.7%)	0.228	1.50 (0.77–2.93)

Table 6. Perceived Most Important Postnatal Care Factor

Category	n	%
Early breastfeeding	41	26.5
Monitoring/stabilization	41	26.5
Timely cord clamping	39	25.2
Proper resuscitation protocols	34	21.9

Table 7. Attitudes Toward Standardization of Cord Clamping

Response	n	%
Standardize for all	45	29.0
Individualize	48	31.0
Unsure	62	40.0

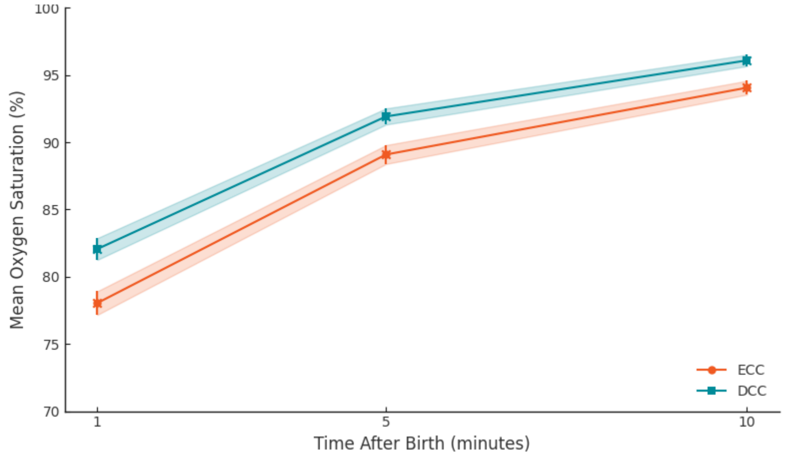

Figure 2 Neonatal Oxygen Saturation Trajectories By Cord Clamping Timing

The figure illustrates mean oxygen saturation (SpO_2) trajectories over the first 10 minutes of life for both early cord clamping (ECC) and delayed cord clamping (DCC) groups, with shaded regions denoting 95% confidence intervals. At 1 minute, ECC newborns had a mean SpO_2 of 78.04% (95% CI 77.16–78.92), compared to 82.06% (95% CI 81.25–82.87) in the DCC group. By 5 minutes, ECC rose to 89.09% (95% CI 88.39–89.79) and DCC to 91.92% (95% CI 91.32–92.52). At 10 minutes, mean SpO_2 reached 94.06% (95% CI 93.54–94.58) with ECC versus 96.09% (95% CI 95.66–96.52) with DCC. The persistent separation of curves and nonoverlapping confidence intervals at each time point underscore statistically and clinically significant advantages of delayed clamping in facilitating more rapid and sustained neonatal oxygenation.

DISCUSSION

The present study offers valuable insights into nurses' knowledge, attitudes, and practices regarding early cord clamping (ECC) and delayed cord clamping (DCC), contributing to the growing body of literature that highlights persistent gaps in clinical understanding and standardization. Our findings demonstrate considerable variability in cord clamping practices and perceptions, consistent with previous reports from similar low- and middle-income settings where institutional protocols for delivery room practices remain underdeveloped (1). Despite decades of research advocating for the physiological benefits of DCC—such as enhanced hemoglobin levels, improved circulatory adaptation, and reduced iron deficiency in infants—the implementation of these practices remains inconsistent among frontline healthcare providers (2,3). A significant proportion of nurses in our study (38.1%) believed DCC had no substantial benefit, and 30.3% were unsure, suggesting widespread uncertainty or misinformation. These findings conflict with robust evidence demonstrating the benefits of DCC in both term and preterm neonates, including higher birth iron stores, improved oxygen saturation, and stabilization of cardiovascular function (4,5). In particular, the belief that DCC may cause complications such as neonatal jaundice, held by 27.1% of participants, reflects outdated concerns not supported by recent randomized controlled trials, which have shown no clinically significant increase in jaundice requiring phototherapy when DCC is implemented under standard protocols (6). This underscores a critical need for updated clinical education and guideline dissemination.

Our results further reveal a fragmentation in ECC/DCC timing practices, with no clear adherence to international recommendations that advise cord clamping at least 60–180 seconds post-birth to optimize placental transfusion (7). The majority of participants reported clamping either within 60 seconds or immediately after birth, with fewer waiting for the full recommended duration. These practices may be influenced by habitual routines or institutional inertia rather than evidence-based protocols. Moreover, confidence levels among respondents were polarized: while 36.1% were "very confident," nearly as many (34.2%) reported being "not confident" in their knowledge. This discrepancy between confidence and actual evidence-aligned understanding suggests the presence of overconfidence bias in some practitioners, which may be clinically detrimental if it leads to erroneous decision-making during neonatal resuscitation or delivery care. The association between hands-on delivery room involvement and better recognition of DCC benefits is particularly notable. Nurses who participated in deliveries were significantly more likely to support DCC as standard practice and correctly identify its physiological advantages. This finding aligns with previous research showing that direct clinical experience enhances retention of evidence-based practices and improves neonatal outcomes (8). Nonetheless, experience alone is not a substitute for structured continuing medical education; several participants with significant delivery experience still held incorrect or uncertain views, emphasizing the need for integrated training programs.

In exploring theoretical implications, the knowledge gap around neonatal bradycardia causes and resuscitation thresholds was striking. While 27.7% correctly identified <60 bpm as the critical threshold for resuscitation, a sizable proportion selected higher thresholds, potentially leading to delayed or inappropriate interventions. Misunderstandings surrounding causes of low heart rate—such as attributing it solely to intrauterine hypoxia or dismissing reflex bradycardia—further highlight deficiencies in understanding neonatal cardiovascular physiology. These gaps carry significant clinical relevance, as immediate postpartum decisions can influence neonatal morbidity and mortality. Another dimension of the findings pertains to attitudes toward policy standardization. While a portion of participants (29.0%) favored standardizing DCC, the majority remained unsure or advocated for individualized approaches. This ambivalence is reflective of institutional ambiguity and the absence of universally enforced protocols in many delivery settings. In contrast, global health authorities and recent multicenter trials advocate for DCC as a default standard barring urgent neonatal resuscitation (9). Therefore, the observed reluctance toward standardization may stem not from evidence disagreement but from lack of exposure to updated guidelines.

One of the strengths of this study lies in its multidimensional approach, capturing a broad range of attitudes, knowledge domains, and real-world practices in a single cross-sectional assessment. The inclusion of inferential statistical analyses further reinforces the credibility of observed group differences and associations. However, limitations must be acknowledged. The use of convenience sampling and restriction to a specific geographic area limits the generalizability of findings. Additionally, the reliance on self-reported data introduces the possibility of social desirability and recall bias. The sample size, although adequate for preliminary analysis, may not fully capture the diversity of nursing perspectives across broader healthcare settings. Future research should pursue larger, multi-institutional studies that incorporate longitudinal follow-up to assess the impact of educational interventions on cord clamping practices. Investigating the role of hospital-level policies, leadership support, and interprofessional collaboration in shaping delivery room practices will also be critical. Qualitative studies could further illuminate the contextual barriers nurses face in implementing DCC, including staffing shortages, workload, and cultural attitudes toward neonatal care.

In summary, while the clinical and theoretical benefits of delayed cord clamping are well-established, our study reveals persistent uncertainty and variability among nursing professionals. These findings reflect the urgent need for harmonized, evidence-based training modules and institutional protocols to bridge the gap between knowledge and practice. Implementing targeted educational strategies and ensuring consistent policy enforcement can drive meaningful improvements in newborn outcomes and foster greater confidence and competence among healthcare providers (10).

CONCLUSION

This study highlights significant gaps in nurses' knowledge, confidence, and clinical practices regarding early and delayed cord clamping, despite their critical role in neonatal outcomes. The findings reveal inconsistent application of evidence-based protocols, fragmented understanding of optimal timing, and widespread uncertainty about the benefits and risks associated with delayed cord clamping. Given the vital impact of cord clamping decisions on neonatal oxygenation, circulation, and long-term health, these results underscore the need for standardized training and protocol development across healthcare settings. Clinically, reinforcing delayed cord clamping as a default practice—except in emergencies—can enhance neonatal transition and reduce complications. From a research perspective, the study supports the need for targeted educational interventions and further exploration into institutional barriers affecting adherence to international guidelines, ultimately aiming to improve maternal and newborn healthcare delivery.

REFERENCES

1. McDonald SJ, Middleton P, Dowswell T, Morris PS. Effect of Timing of Umbilical Cord Clamping of Term Infants on Maternal and Neonatal Outcomes. Cochrane Database Syst Rev. 2013;(7):CD004074.

2. Rabe H, Diaz-Rossello JL, Duley L, Dowswell T. Effect of Timing of Umbilical Cord Clamping and Other Strategies to Influence Placental Transfusion at Preterm Birth on Maternal and Infant Outcomes. Cochrane Database Syst Rev. 2012;(8):CD003248.

3. Katheria A, Brown MK, Faksh A, Hassen K, Rich W, Lazarus D. Delayed Cord Clamping in Preterm Infants. J Perinatol. 2017;37(7):801–5.

4. Andersson O, Domellöf M, Andersson D, Hellström-Westas L. Effect of Delayed Cord Clamping on Neurodevelopment at 4 Years of Age: A Randomized Clinical Trial. JAMA Pediatr. 2015;169(7):631–8.

5. Mercer JS, Erickson-Owens DA, Vohr BR, Tucker RJ, Parker AB. Effects of Delayed Cord Clamping on 4-Month Ferritin Levels, Neurodevelopment and Growth in Term Infants: A Randomized Controlled Trial. J Perinatol. 2011;31(7):461–6.

6. Upadhyay A, Gothwal S, Parihar R, Garg A, Bhargava SK. Effect of Delay in Cord Clamping on Neonatal Hematocrit and Clinical Outcome in Term Neonates. Indian Pediatr. 2013;50(7):571–5.

7. World Health Organization. Delayed Umbilical Cord Clamping for Improved Maternal and Infant Health and Nutrition Outcomes. Geneva: WHO; 2014 [cited 2025 May 30]. Available from: https://www.who.int/publications/i/item/9789241508209

8. Yao AC, Lind J. Effect of Gravity on Placental Transfusion. Lancet. 1969;2(7626):505–8.

9. American College of Obstetricians and Gynecologists. Committee Opinion No. 684: Delayed Umbilical Cord Clamping After Birth. Obstet Gynecol. 2017;129(1):e5–10.

10. Perlman JM, Wyllie J, Kattwinkel J, Wyckoff MH, Aziz K, Guinsburg R, et al. Neonatal Resuscitation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation. 2015;132(16_suppl_1):S204–41.