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The Effects of Delayed Cord Clamping Within an Infant's First 12 Months of Life



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ABSTRACT

Background: Iron deficiency anemia in young and older infants remains of high prevalence, especially for those born at low birth weights, and it tends to peak around 9 to 12 months of age. **Purpose:** The purpose of this literature review was to compare the benefits of delayed cord clamping versus umbilical cord milking and early cord clamping in infants up to the 1st year of life. Delayed cord clamping is defined as clamping after 30 seconds and early cord clamping is in the first 30 seconds after birth. **Method:** The method used was analyzing research articles that were retrieved from computer databases. The patient, intervention, comparison, outcome and time (PICOT) question was: How does delayed cord clamping compare to early cord clamping and umbilical cord milking about iron stores, hemoglobin levels, and risks of such procedures within an infant's first 12 months of life? **Findings:** The results were varied among articles, mostly because the timing of delayed cord clamping varied among them. **Conclusion:** The overall conclusion was that there were significant benefits to delaying cord clamping and umbilical cord milking if possible, after birth, because the interventions increased infant's serum ferritin and hemoglobin levels within the first year of life.

1. INTRODUCTION

Delayed cord clamping and umbilical cord milking is a very simplistic and inexpensive intervention that is used in obstetrics to reduce the risk of anemia in infants. Many of the research articles found for this systematic review were studies performed in countries outside of the United States, where delayed cord clamping is an intervention commonly used. The World Health Organization (WHO), which directs public health and is responsible for encouraging health and healthy medical practices recommends that cord clamping be delayed for *1-3 minutes after birth* [1]. In comparison to delayed cord clamping, Askelof et al. [1] used the WHO's definition of early cord clamping as *clamping less than one minute after birth*. The purpose of this systematic literature review was to determine if delayed cord clamping has an impact on improving iron store levels and hemoglobin levels in infants within the first year of life. Alternate options were considered if delayed cord clamping was contraindicated at birth. The benefits of umbilical cord milking were also reviewed.

Delayed cord clamping has shown to be beneficial to infants in increasing iron store levels, and there is little risk associated with the intervention. All preterm and term infants can benefit from delayed cord clamping; however, risks outweigh the benefits of delayed cord clamping when resuscitation efforts are needed directly after birth. Before the 1950s, cord clamping was considered delayed if it was performed up to five minutes after the birth and was considered early if clamped at or before one minute after birth. Once more research had been performed on the optimal time for delayed cord clamping, it was then recommended to wait at least one minute after birth or in some cases when the cord pulsation has ceased. Many studies varied on the most beneficial time for delayed cord clamping and timing is *best made by the team caring for the mother-infant dyad* [2].

Iron deficiency anemia in young and older infants is of high prevalence, especially for those born at low birth weights, and it tends to peak around nine to 12 months of age [3]. Although there are treatments for anemia, such as blood transfusions, delayed cord clamping is an inexpensive, less invasive, and less time-consuming intervention that could be implemented as a preventative measure against developing anemia. Delayed cord clamping is a very low-risk intervention, with the highest risk to the infant being the development of jaundice. The purpose of this literature review was to determine if performing delayed cord clamping at birth prevents the incidence of anemia in infants versus early cord clamping or umbilical cord milking. How does delayed cord clamping compare to early cord clamping and umbilical

cord milking about iron stores, hemoglobin levels, and risks of such procedures within an infant's first 12 months of life?

2. METHODS

The Cumulative Index for Nursing and Allied Health Literature (CINAHL) and EBSCOhost were the two research databases that were used for this review. The keywords used to find studies were, *delayed cord clamping*, *early cord clamping*, *umbilical cord milking*, *infant benefits of delayed cord clamping*, *hemoglobin levels in delayed cord clamping*, and *iron levels in delayed cord clamping*. Using the key phrase, *delayed cord clamping*, EBSCOhost and CINAHL retrieved 231 and 317 articles, respectively. The search produced 222 articles in EBSCOhost and CINAHL when the advanced search option was utilized for articles published between 2013 and 2019, which were scholarly (peer) reviewed journals, and written in English. Only 94 articles in EBSCOhost and 94 articles in CINAHL were available online in full text.

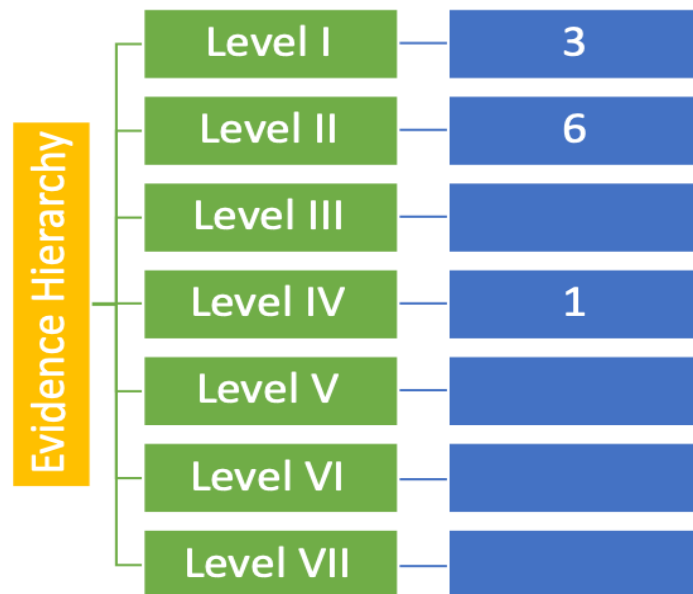


Figure No. 1: Levels of Evidence Hierarchy.

Note. Level 1 is the highest and Level 7 is the lowest.

Figure 1 displays the levels of evidence hierarchy used for this literature review. The levels of evidence hierarchy were ranked based on a predetermined scale most used for nursing

research. The scale ranks level 1 as the highest level of research to find with level four being the lowest level of research [4].

The 10 research studies chosen for this review were picked because of their relativeness to the topic of iron store levels and hemoglobin levels specifically with delayed cord clamping. The studies chosen for review eight were published within the last three years, one was published within the last five years, and one within the last six years. The two articles chosen that were published more than three years ago were picked because they answered the PICOT question and the results of the studies are currently being used as evidence-based practice guidelines in obstetrics. All articles chosen for review are within the top four tiers of evidence hierarchy listed in Figure 1. In this review, it was analyzed whether iron store levels increased if umbilical cord clamping was delayed rather than implemented immediately after birth. This review was conducted to also determine if any major risks were accompanying delayed cord clamping and whether the risks outweigh the benefits of the intervention.

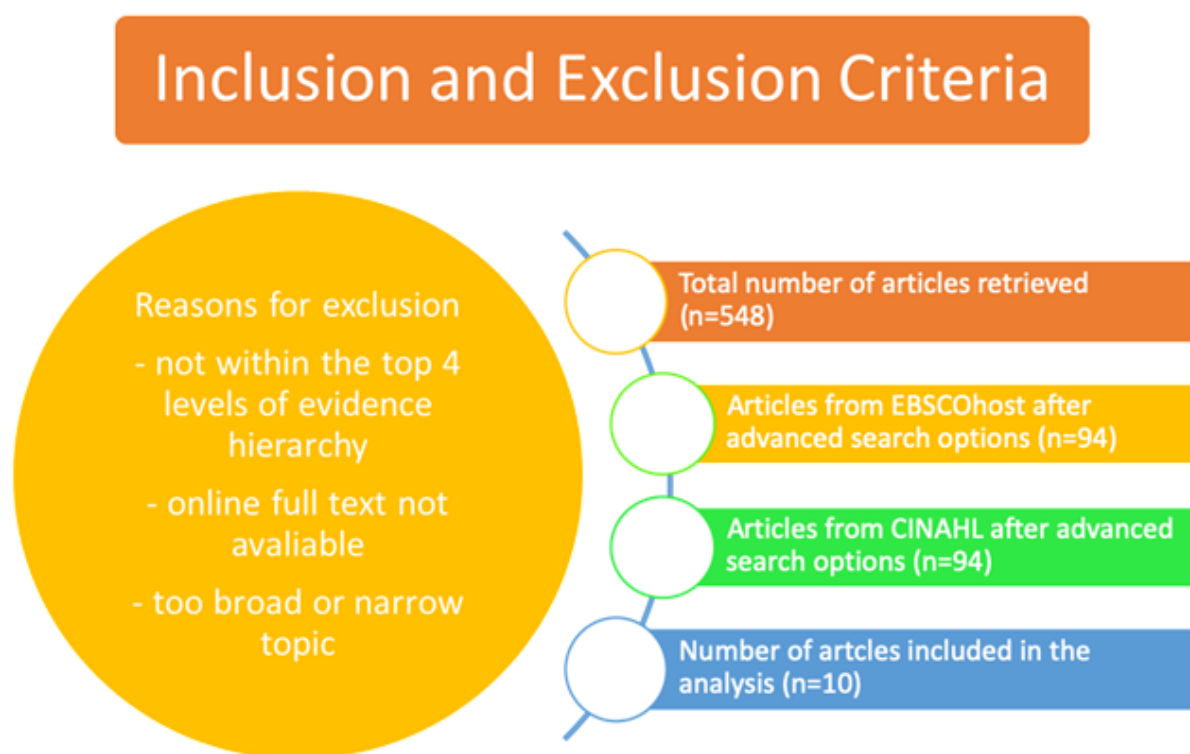


Figure No. 2: Research Article Inclusion and Exclusion Chart

Figure 2 displays the reasons for article exclusion and inclusion during study analysis. The total number of articles retrieved, the articles obtained from CINAHL and EBSCOhost, and articles included in the analysis are displayed on the right.

3. FINDINGS

The purpose of this literature review was to determine if delayed cord clamping and umbilical cord milking increased iron store levels within the first year of a child's life versus early cord clamping. Ten studies relating to the effects of delayed cord clamping and umbilical cord milking and its associated risks in increased iron store and hemoglobin levels were analyzed for this review. Emerging themes included (1) delayed cord clamping increases serum ferritin levels within the first 12 months of life, (2) delayed cord clamping is associated with higher hemoglobin levels within the first 12 months of life, (3) the benefits of delayed cord clamping outweigh the risks associated with the intervention within the first 12 months of life, (4) and delayed cord clamping compared to umbilical cord milking resulted in no significant difference in iron stores and hemoglobin levels within the first 12 months of life. Figure 3 represents the themes that emerged in this systematic review of the literature. Delayed cord clamping is centered to represent the topic of the review with the outside circles representing the themes found throughout the research.

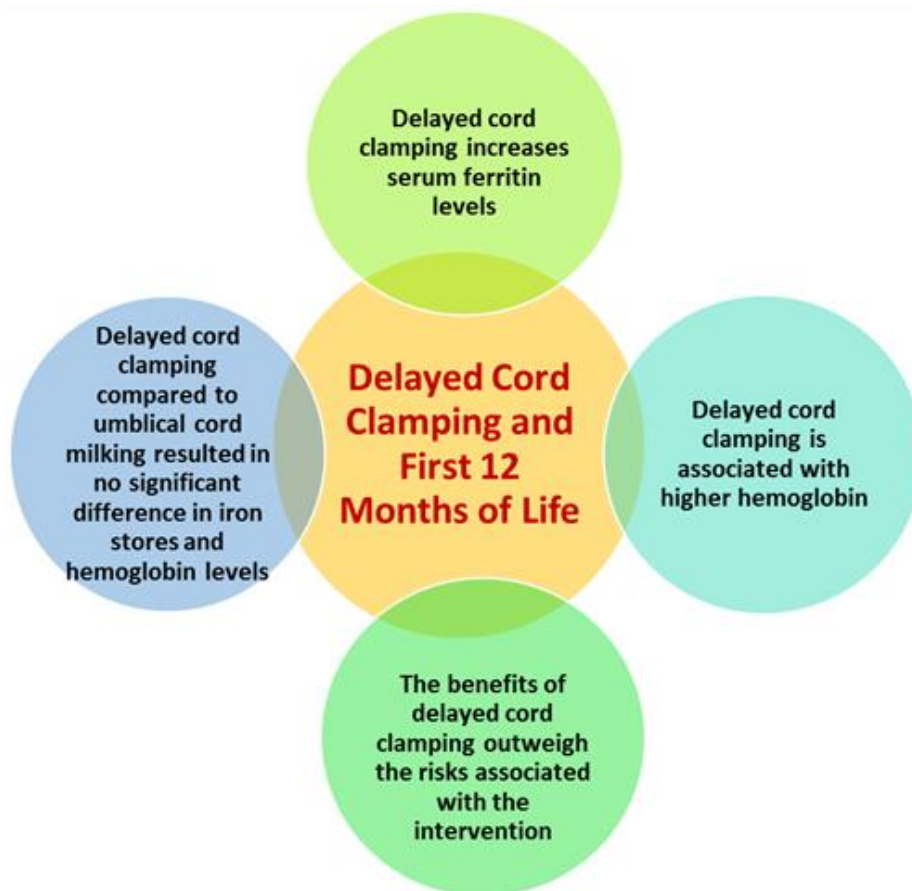


Figure No. 3: Emerging Themes of Delayed Cord Clamping

3.1 Increased Serum Ferritin Levels

During the review of the studies, it was a common theme that their results showed delayed cord clamping increased serum ferritin levels within the first year of life. Each of the studies reviewed different stages of an infant's life and different cord clamping times but found very similar results. A Swedish study [1] measured ferritin levels on both pre-term and term infants. Delayed cord clamping was considered cutting the umbilical cord 60 and 180 seconds after birth. Results indicated that *the 60-second group had significantly higher ferritin concentrations compared with 10 seconds* [1].

In another study, Qian et al. [5] found that delayed cord clamping improved iron storage levels in infants whose cord clamping was delayed by at least 180 seconds. Another study [2] concluded that delayed cord clamping in preterm infants was shown to have significant benefits on iron store levels that *improved transitional circulation, better establishment of red blood cell volume, decreased need for blood transfusion, and lower incidence of necrotizing enterocolitis and intraventricular hemorrhage* [2].

Bloui et al. [6] examined delayed cord clamping benefits on infants born to mothers who were anemic. In this study, although infants born to anemic mothers had greater serum ferritin benefits, delayed cord clamping benefited both groups. The results at eight months of age showed a greater benefit to the infants than at four months of age, signifying that delayed cord clamping has long term benefits on iron store levels [6].

Berchard's study [7] identified the benefits of delayed cord clamping as increasing iron store levels and decreasing anemia in infants. Chopra et al. [3] also established that serum ferritin levels were increased in the delayed cord clamping group. Iron deficiency at three months of age was *defined as serum ferritin <50ng/ml* [3]. Another study [8] concluded that delayed cord clamping increased serum ferritin levels and decreased the prevalence of anemia related to the increased iron.

3.2 Higher Hemoglobin Levels

Another theme found throughout the review correlated delayed cord clamping with increased hemoglobin levels in infants within the first year of life. These studies supported delayed cord clamping by 30 seconds after birth and compared the hemoglobin levels to that of early

cord clamping, 10-15 seconds after birth. Findings indicated, delayed cord clamping improved iron storage levels as well as hemoglobin levels in infants [5].

Berchard's [7] study identified the benefits of delayed cord clamping as increasing hemoglobin and hematocrit levels in infants. This was a meta-analysis and although there was no specific age given it concluded that delaying cord clamping by three minutes or when the cord pulsation has ceased, correlates to the greatest benefit for infants [7]. Alzaree et al. [9] also concluded that hemoglobin levels were increased in infants who had delayed cord clamping at birth. The study tested hemoglobin levels at 6 weeks of age and determined delayed cord clamping was beneficial in increasing hemoglobin levels to decrease the risk of infants needing blood transfusions [9].

Infants undergoing delayed clamping had *higher levels of hemoglobin and decreased prevalence of anemia* [8]. At both age marks tested in this trial, the results included an increase in hemoglobin for those in the delayed cord clamping group compared to the early cord clamping group [8]. At the 12 months of age follow-up, it was noted that there was still increased hemoglobin in the infants of the DCC group and that the risk for anemia at this point was only relative. In another study, *approximately 80ml of blood (is transferred) within 1 minute after birth, reaching approximately 100ml at 3 minutes after birth* [2]. In a 12-month follow-up, they noted that there was still increased hemoglobin in the infants of the delayed cord clamping which directly relates to an increased blood volume [2].

3.3 The Benefits Outweigh the Risks

Many of the studies focused on the associated risks with delayed cord clamping; however, they reiterate that the risks do not outweigh the benefits of increasing ferritin and hemoglobin levels or the benefit of decreasing infancy anemia within the first year of life. The risks mentioned within the studies were either easily corrected or they were not directly associated with delaying the cord clamping. The studies that referred to the risks associated with delayed cord clamping agreed that if a physician finds any possibility of the infant or mother is in immediate danger from birthing complications, that delayed cord clamping should not be done and resuscitation efforts should take priority.

Qian et al. [5] found that although there are risks associated with delayed cord clamping which can include jaundice, low Apgar scores, neonatal hypothermia, and respiratory distress, these risks were very low and do not outweigh the benefits of increasing iron stores

and hemoglobin levels. The main risk associated with delayed cord clamping was jaundice in infants who were carried to term; however, it was corrected with light phototherapy and had no lasting effects on the infant [2]. Since jaundice is easily corrected with non-invasive interventions, delayed cord clamping should be performed because of its ability for *improved transitional circulation, better establishment of red blood cell volume, decreased need for blood transfusion, and lower incidence of necrotizing enterocolitis and intraventricular hemorrhage* [2].

3.4 Delayed Cord Clamping Compared to Umbilical Cord Milking

Umbilical cord milking is often used when delayed cord clamping cannot be used at birth due to any complication in which the infant's cord needs to be cut immediately. Umbilical cord milking involves squeezing the blood in the umbilical cord down towards the infant multiple times to force the excess blood to the infant. The theme found throughout the research review is that umbilical cord milking shows the same benefits as delayed cord clamping when delayed cord clamping is contraindicated.

Another study [10] indicated the mean hemoglobin that was found with the infants who had delayed cord clamping was 17.2 g/L and serum ferritin average was 2.77 ug/L. These labs were also done with infants who were in the umbilical cord milking group. The mean hemoglobin that was found with the infants who had umbilical cord milking was 17.1 g/L and the mean serum ferritin was 2.8 ug/L.

Differences in the average hemoglobin and serum ferritin levels between the umbilical cord milking group and the delayed cord clamping group revealed minimal evidence that one may be better than the other. The randomized control trial showed *that term-born Indian infants who had delayed cord clamping at 60-90 seconds or umbilical cord milking showed no significant differences in ferritin and hemoglobin levels and growth parameters at 12 months of age* [10]. There was no significant difference in the outcomes that this trial was focusing on that would suggest using either delayed cord clamping or umbilical cord milking over one another.

Alzaree et al. [9] found the hemoglobin and hematocrit levels also showed no significant difference between the two groups, delayed cord clamping, and umbilical cord clamping, but did show a positive correlation between the two groups. Both the delayed cord clamping and the umbilical cord milking increased the infant's hemoglobin levels at 6 weeks of age [9].

With these positive correlations between delayed cord clamping and umbilical cord milking and increased hemoglobin levels at six weeks of age, the conclusion of the trial was reached. The conclusion was that delayed cord clamping and umbilical cord milking improved the important hematological factor of hemoglobin levels. These increased factors that are seen with delayed cord clamping and umbilical cord milking are important in decreasing the prevalence of infant anemia. *The use of umbilical cord milking in term babies when delayed cord clamping is unavailable* may be used to benefit the infant's outcome especially when it relates to hemoglobin levels [9].

4. DISCUSSION

Most of the articles uncovered that cord clamping was considered delayed if it was at least 30 seconds after birth. Delayed cord clamping may benefit preterm infants more than it may benefits infants born at term, 35 weeks' gestation or more. The benefits of delayed cord clamping outweigh the associated minor risks. Although many studies listed certain risks, the risk of jaundice was listed in more than one study. This was considered minor because jaundice is easily corrected with phototherapy and has no long-term side effects on the development of the child.

More research is needed to determine the optimal time for delayed cord clamping, but from the analysis, it is suggested that cord clamping should be delayed by at least 30 seconds. This timeframe was concluded because delayed cord clamping at 30 seconds, in the studies who used this timeframe, showed increased iron storage and hemoglobin levels in infants. Iron deficiency anemia can cause long term cognitive and behavioral side effects; therefore, delayed cord clamping should be implemented when resuscitation efforts are not necessary immediately after birth.

There were several limitations to each study that were found throughout the literature review. A few limitations could be noted in multiple studies. The limitation found in Askelof's et al. [1] study was that there was no comparison in the different socioeconomic or ethnic backgrounds of the infants tested. This could alter results because the infant's food sources and genetics alone could have effects on iron levels. Only two of the 10 studies took into consideration whether the infant was born to a mother who was anemic, which could have impacted their iron levels as well. None of the reviewed studies discussed different food

options for infants during the first year of life, such as exclusively breastfed or bottle-fed infants, or at what age different food groups were introduced.

Another limitation was that the number of participants who experienced adverse effects of delayed cord clamping, such as jaundice, was never mentioned in the discussions. The adverse effect itself was mentioned, but not how often it occurred. Other complications were mentioned such as possible respiratory distress on the infant, but again it was not concluded how many infants experienced this reaction and if the reaction was exclusively from the timing of umbilical cord clamping.

Each study concluded that delayed cord clamping or umbilical cord milking improved iron and hemoglobin levels; however, the timing of such interventions was different for multiple studies. In Blouin et al. [6] study, they concluded that delayed cord clamping improved iron store and hemoglobin levels, but the timing of umbilical cord clamping ranged from 8.9 seconds to 397.3 seconds [6]. This was also the problem with Bechard's [7] study in that there was an inconsistency in the timing of delayed cord clamping. Although each article shows that there are significant benefits to delaying cord clamping, they do not delay the cord clamping in the same time frame [7].

Lastly, many of the reviewed studies did not mention the specific iron levels they were basing their claims on; however, two of them did. Each of the studies that did mention at what level they defined iron-deficiency both used different levels. One study mentioned that infants whose serum ferritin levels were >20 ng/ml were considered anemic while another study concluded anemia was having serum ferritin levels >50 ng/ml.

It can be concluded that delayed cord clamping is beneficial to infants in increasing serum ferritin and hemoglobin levels. Delayed cord clamping should be used for all preterm and term infants unless contraindications, such as resuscitation efforts needed or hemorrhaging after birth occurs. If delayed cord clamping is contraindicated, then umbilical cord milking should be performed for the infant to receive the same benefits. Preterm infants and infants born to mothers who were anemic show more significant benefits to delaying cord clamping by at least 30 seconds or until pulsation of the cord has ceased. Overall, delayed cord clamping is a *simple, safe, and effective delivery procedure, which should be recommended, but the optimal cord clamping time remained controversial* [5]. *With a high global*

prevalence of infant anemia, delayed cord clamping has the potential to reduce infant anemia and thereby improve infants' and children's health and development [11].




5. CONCLUSION

To conclude this systematic review, it can be noted that the benefits of delayed cord clamping outweigh the risk associated with this intervention. The optimal time for cord clamping was not established; however, delaying the cord clamping by at least 30 seconds increased iron stores and hemoglobin levels in infants, in turn reducing the risk of iron deficiency anemia. Delayed cord clamping is a cost-effective, simple, low resource intervention that only requires a minimal amount of time to be implemented into practice. The benefits of delayed cord clamping are shown in different stages of the infants in the first year of life. Therefore, the PICOT question of “How does delayed cord clamping compare to early cord clamping and umbilical cord milking about iron stores, hemoglobin levels, and risks of such procedures within an infant's first 12 months of life?” is answered from the review of the above-mentioned studies. The iron levels and hemoglobin levels are increased within the first 12 months of life, decreasing the risk of developing iron-deficiency anemia.

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