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Effect of Early and Late Clamping of the Umbilical Cord on the Newborns' Blood Analysis

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Abstract

Background: At the time of birth, the infant is still attached to the mother via the umbilical cord, which is a part of the placenta. The infant is usually separated from the placenta by clamping the cord. Timing of umbilical cord clamping has been and still is a highly controversial issue worldwide, the controversy about the best time to clamp the cord. The main aim of the study is to identify the effect of early and late cord clamping on newborns' blood analysis.

Hypothesis: The researcher hypothesized that the delayed cord clamping (1-3 minutes) after birth will make a difference on newborns' blood analysis.

The study design: A quasi experimental design was utilized in this study. Setting of the study: The study was conducted at the Dammam Maternity and Children Hospital, it is a Ministry of Health hospital with a higher delivery admission rate (25-3/day) according to the delivery room deputy nurse and hospital statistical records.

Study sample: The study comprised a total of selective sample of 100 women during their second stage of labor and their newborns were selected according to certain criteria.

Tools: Two tools developed and used by the researcher to collect the necessary data related to the study subjects as follows:

First tool (Maternal tool): An Interview questionnaire sheet contained the following parts: Part one, demographic data such as (age, occupational and education level.), Part two: Obstetrical history such as (gravidity, parity, last menstruation period and gestational age).

Second tool (Newborn tool): A newborn sheet contained the following parts: Part one: Early and late clamping record sheet which consists of date, time, mode of delivery and time of cord clamping (using a stopwatch). Part two: Complete new born blood count sheet to assess the level of C.B.C (Hb, RBCs, Hct and serum bilirubin and any complications or admission to the NICU) immediately and 24 hours after birth for both groups.

Methods: The necessary approvals from the ethical committee in Dammam University and General medical research committee in Saudi Arabia were obtained to collect the necessary data. Based on the present study findings, it can be illustrated that the delaying of the newborn's umbilical cord clamping at birth (1-3 minutes) have an important effect on newborns' hematologic status.

The delaying of the umbilical cord clamping 1-3 minutes after birth decreased the number of anemia cases. The study has shown that the hypothesis to be true and proved the effect of late cord clamping on the newborn's blood analysis. Significant associations were observed between the time of cord clamping and the improvement of the hematological values of the newborns' blood analysis.

Recommendations: According to the findings of the present study it is recommended to delay cord clamping and it should be the standardized practice and be supported by the Ministry of Health and hospital administration.

Keywords: Umbilical cord; Menstruation; Gestational; Hypoxic ischemic

Introduction

Labor is a normal physiological process. All mature female can give birth without external intervention [1]. At the time of birth, the infant is still attached to the mother via the umbilical cord, which is a part of the placenta. The infant is usually separated from the placenta by putting the umbilical cord between two clamps, then the cord is cut between the two clamps, this takes place during the third stage of labor [2].

Timing of umbilical cord clamping has been and still is a highly controversial issue worldwide. The controversy about the best time to clamp the cord at birth started over 2000 years ago [3]. Although, the current obstetric approach in medicine is to clamp the cord within the first 10 to 15 seconds after birth. However, there has been no sound evidence in favor of this approach in comparison to the practice of clamping the cord between 1 and 3 minutes after birth [4].

One study report that the immediate clamping of the umbilical cord can reduce the red blood cells an infant receives at birth by more than 50%, resulting in potential short-term and long-term neonatal problems such as autism, infant anemia, childhood mental disorders and hypoxic ischemic brain damage, and immediate cord clamping is not physiological [5]. In McDonald [6] study, it was observed that delayed cord clamping may help prevent iron-deficiency anemia during the first year of life [6]. On the other hand, iron deficiency anemia affect millions of children worldwide and in Saudi Arabia more than 350\100000 of infants are anemic before 6 months of age [7].

Midwives, physicians, nurses, doulas, families, and childbearing women should remember the importance of this simple act, and gently remind one another to wait before clamping the cord. This can optimize the chances for newborns to make a successful transition to extra uterine life, minimize newborn anemia, and perhaps prevent significant problems in later life [8,9].

Literature Review

Clamping and cutting of umbilical cord at birth is by far the oldest and most prevalent intervention in humans. In spite of that, the optimal timing of cord clamping has been a controversial issue for decades [10]. There are no formal practice guidelines, but most practitioners in developing countries clamp and cut the cord immediately after birth, and this takes place during the third stage of labor [11].

Third stage of labor management

Third stage of labor is the period extend from the complete expulsion of the fetus to complete separation and expulsion of the placenta. There are two contrasting approaches to managing the third stage of labor either expectant management or active management. Active management of the third stage has undoubtedly helped to reduce hemorrhagic morbidity for mothers worldwide. In spite of this, it has been accepted into clinical practice without much consideration or evaluation of the potential harm to the baby [12].

Feto placental circulation transfusion

1n 1773 discussions started in the complex changes from fetal to adult circulation that takes place at birth. The physiological transformation from placenta to pulmonary respiration takes place over several minutes after birth [11,13]. The total feto placental blood volume is about 120 ml/kg of fetal weight. At birth, the distribution of blood between fetus and placenta is roughly in a ratio of 2:1 and this distribution remains unchanged if the cord is clamped immediately after birth [12,14]. Earlier physiological study has shown that the total blood volume in the combined fetal-placental circulation at full gestation, approximately 25% to 60% is found in the placental circulation and that as many as 60% of the fetal red blood cells are found in the placenta and this blood is also known to be rich in hematopoietic stem cells [15].

Advantages and disadvantages of early cord clamping

There are many studies where findings showed different points of view regarding the time of cord clamp world wild, the most important points of differences are related to maternal and infant safety. Many health care workers worldwide tend to clamp the cord and pass the baby off as quickly as possible [16].

Early clamping of the cord (within the first 5 to 15 seconds of birth) compared with late clamping of the cord (1-3 minutes after birth) leads to a decrease in the neonate of 20 ml to 40 ml of blood per kilogram of body weight [17]. It has been argued that early cord clamping puts the newborn at increased risk of hypovolemic damage and iron loss, as well as of several blood disorders such as type 2 diabetes, as a consequence of loss of hematopoietic stem cells [18]. Early cord clamping has been postulated as a major cause of anemia in infancy, and this has led some investigators to recommend late clamping as a low-cost intervention to reduce anemia during the first 6 months of life [19].

Benefits of late cord clamping

Ononeze [20] defined delayed clamping as a delay of 30 second or more after birth, or waiting for 3 minutes before clamping the cord in full term infants, unless the state of the infants required earlier interventions. Delayed cord clamping was defined as waiting until the umbilical cord had stopped pulsing [21]. Recently several theories about the potential benefits of late clamping of umbilical cord have been postulated and studied. The benefits of late cord clamping, specifically increased hemoglobin (Hb) and (Hct) levels for the neonate with a subsequent reduction in rates of anemia especially iron deficiency that may extend into the infant period [22].

Newborn Life Support; London Resuscitation Council (UK) [23] stated that the baby which breathes within 2 minutes of birth usually survives. If the process is interrupted by cord clamping which obstructs the placental circulation, survival can be compromised (**Figure 1**).

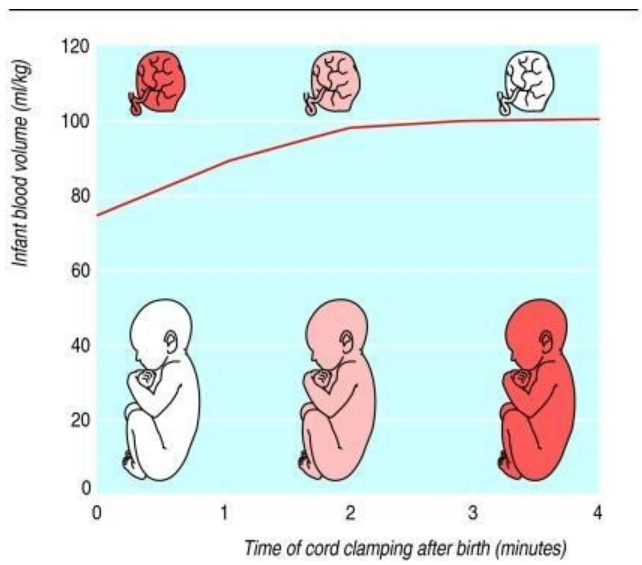

Figure 1 Strauss RG stressed that delaying clamping of the umbilical cord.

Based on the above Figure Strauss [24] stressed that delaying clamping of the umbilical cord for at least 2 minutes after birth consistently improved feto placental circulation and both the short- and long-term hematologic and iron status of full term infants.

According to another study done in this context, it was mentioned that the presence of polycythemia in both the late and the early clamping groups can occur in some normal healthy neonates, regardless of the time at which the cord is clamped. Regarding the consequence of a rapid change in the hematocrit level that normally occurs during the first 24 hours of life, comparing late with early cord clamping, the risk of anemia was decreased with late cord clamping at 24 to 48 hours after birth [24,25]. Van Rheenen [23,26] showed that the most important finding was that the beneficial effects of late cord clamping appear to extend beyond the early neonatal period and it is a physiological and inexpensive means of enhancing hematologic status, preventing anemia over the first 3 months of life and enriching iron stores and ferritin levels for as long as 6 months.

Maternal outcomes

Studies reported on maternal outcomes including early postpartum blood loss are particularly significant because active management of the third stage of labor includes administration of a uterotonic agent before delivery of the placenta, early cord clamping and cutting are recognized as a mean of minimizing blood loss for women in the early postpartum period [27,28]. Delayed clamping is compatible with active management of the third stage of labor and have been shown to increase the rate of placental transfusion and are thus likely to enhance the effect of delayed clamping [29,30].

Recently, World Health Organization (WHO) and international confederation of midwives (ICM) and International Federation of Gynecology and Obstetrics have updated their guidelines on preventing postpartum hemorrhage. They refer to the benefits of delaying cord clamping. Therefore, the amount of time between birth and cord clamping is a decision made by the individual health care provider based largely on personal preference. It is fundamental for midwives and other health care providers to establish a clear definition of delayed cord clamping, along with a set of clinical guidelines on evidence based practices [9,29,31,32].

Hypothesis

The researcher hypothesized that the delayed cord clamping (1-3 minutes) after birth will make a difference on newborns' blood analysis.

Research Aim

The main aim of the study is to identify the effect of early and late cord clamping on newborns' blood analysis.

Material and Methods

Study design

A quasi experimental design was utilized in this study.

Setting

The study was conducted at the Dammam Maternity and Children Hospital, it is a Ministry of Health hospital with a higher delivery admission rate (25-3/day) according to the delivery room deputy nurse and hospital statistical record.

Study sample

The study comprised a total of selective sample of 100 women during their second stage of labor and their newborns were selected according to the following:

Inclusion criteria: All subjects met the following selection criteria are included in this study: birth weight >2000 g, gestational age ≥ 37 week, singleton birth, vaginal delivery, no maternal gestational diabetes, no serious hemorrhage during pregnancy, no previous cesarean delivery, no cefalo-pelvic disproportion, preeclampsia, multiple delivery, and diabetes mellitus.

Exclusion criteria: All subjects with the following criteria: premature delivery, preterm infants low-birth-weight infants, co-existing congenital anomalies and with major congenital anomalies as neural tube defects, hyaline membrane and respiratory distress syndrome and fetal-maternal distress were excluded from the study.

Tools

Two tools were developed and used by the researcher to collect the necessary data related to the study subjects as follows:

First tool (Maternal tool): An Interview questionnaire sheet contained the following parts:

Part one: Demographic data such as (age, occupational and education level).

Part two: Obstetrical history such as (gravidity, parity, last menstruation period and gestational age).

Second tool (Newborn tool): A newborn sheet contained the following parts:

Part one: Early and late clamping record sheet which consists of date, time, mode of delivery and time of cord clamping (using a stopwatch).

Part two: Complete new born blood count sheet to assess the level of C.B.C (Hb, RBCs, HCT and serum bilirubin and any complications or admission to the NICU) immediately and 24 hours after birth for both groups.

Methods

The necessary approvals from the ethical committee in the University of Dammam and General medical research committee in Saudi Arabia was obtained to collect the necessary data. Collection of data covered a period of 8 weeks from September 11, 2011 to December 12, 2011. The setting was visited 5 times a week from Saturday to Wednesday in the morning duty hours, during these periods women were selected randomly the first woman to be as an early cord clamping sample while the second woman to be as late cord clamping sample. The time taken to complete the interview questionnaire ranged between 10-20 minutes, depending upon the degree of understanding and response of each interviewee.

A sample of 100 women during their second stage of labor were randomly selected according to the previously mentioned inclusion criteria and divided into two groups: first group (n=50): early cord clamping (within the first minute) after birth; second group (n=50): late cord clamping (1-3 minutes) after birth, the infant placed on the mother's abdomen. An informed consent was secured from women and confidentiality was maintained. The researcher used the first tool, part one to collect the following information from the women during second stage of labor, socioeconomic and demographic characteristics such as (age, occupational and education level), part two used to collect the following information related to obstetrical history such as (number of pregnancies and number of deliveries, LMP, EDD and gestational age).

The researcher used the second tool, part one (stop watch) to record the time of cord clamping for both groups upon the delivery of the fetus. Second tool, part two used by the researcher to record the results of the newborns blood analysis for early and late groups immediately and 24 hours after birth. Newborns blood samples were collected by the researcher (venipuncture) after expulsion of the fetus and 24 hours after birth in both groups (early and late) and sent to the laboratory for analysis.

The researcher received and recorded the results in the second tool, part two and compared them with the normal values.

Statistical analysis was carried out by using the computer package of SPSS version11.

A comparison between both groups' lab findings was done to identify the difference between early and late cord clamping blood analysis.

Results

Table 1 illustrated that newborn's means of hemoglobin concentration were higher (17.4 g/dl ± 2.1 and 17.0 g/dl ± 2.7) in early cord clamping group at birth and 24 hrs. after birth respectively, compared with (17.8 g/dl ± 1.6 and 17.9 g/dl ± 1.7) in late cord clamping groups at birth and 24 hrs. after birth respectively. Statistical analysis among groups revealed no significant differences were observed (t=0.3:95% CI at birth and t=0.06:95% CI after 24 hrs. after birth).

Table 1 Distribution of the newborns in both groups according to the hematologic results at birth and after 24 hours.

	Group1: Early clamping (30-60second) N=50			Group 2: Late clamping (1-3minutes) No=50		
	At birth	24 hrs	Sig t=value	At birth	24 hrs	Sig t=value
Hemoglobin g/l						
Ẍ	71.4	17	0.37	17.8	17.9	0.06
SD ±	2.1	2.7		1.6	1.7	
Hematocrit %						
Ẍ	53.5	53		55.6	55.4	0.02
SD ±	5.7	5.7	0.05	5	4.7	

RBCs counts						
Ẍ	5.2	6.1	0.05	5.4	5.5	0.49
SD ±	0.5	6.1		0.5	0.5	
Serum bilirubin						
Total						
Ẍ	2.4	3.8	0.07	3.1	4.4	0.17
SD ±	1.3	2.3		2.3	2.4	

Newborn's means of hematocrit levels increased in newborns assigned to late cord clamping group compared with the early cord clamping group (53.5% ± 5.7 and 53.0% ± 5.7) in early cord clamping at birth and 24 hrs after birth respectively compared with (55. 6% ± 5.0 and 55.4% ± 4.7) in late cord clamping at birth and 24 hrs. after birth respectively. Statistical analysis among groups showed significant differences (t=0.05: 95% CI at birth and t=0.02:95% CI at 24 hrs after birth).

Newborns' means of RBCs counts were higher (5.2 ± 0.5 and 6.1 ± 0.6) in early cord clamping at birth and 24 hrs. respectively compared with (5.4% ± 5.4 and 5.5 ± 0.5) in late cord clamping groups at birth and 24 hrs. after birth respectively. The observed differences were not significant (t=0.05: 95% CI at birth and t=0.49:95% CI after 24 hrs.

Total Serum bilirubin values at birth were similar between groups, the total means of bilirubin were (2.4 ± 1.3 and 3.8 ± 2.3) in early cord clamping group at birth and 24 hrs. respectively compared with (3.1 mg/dl ± 2.3 and 3.1 mg/dl ± 2.3) in late cord clamping group at birth and 24 hrs. respectively, with no observed significant differences (t=0.07: 95% CI at birth, t=0.17: 95% CI at 24 hrs. after birth).

Table 2 showed that the hematocrit values (>65%) were more likely to occur in the group with early cord clamping (2/50), compared with (1/50) in late cord clamping at birth and (2/50) in early cord clamping group, compared with (1/50) in late cord clamping group at 24 hours after birth.

Table 2 Distribution of the newborns in both groups according to the number of cases of Polycythemia and anemia at birth and after 24 hours.

	Early cord clamping N=50		**late cord clamping N=50**	
	At birth	**After 24 hours**	**At birth**	**After 24 hours**
Polycythemia (HCT>65%, n %)	2	2	1	1
Anaemia (HCT<45%, n%)	3	3	1	0

The hematocrit values (<45%, anemia) were more likely to occur in early cord Clamping group (3/50) compared with (1/50) in late cord clamping group at birth and (3/50) compared with (0/50) in late cord clamping group at 24 hours after birth.

Table 3 revealed the cut off point for normality in relation to the hematocrit percentage as mentioned by Tietz [33].

Table 3 Distribution of the experimental and control groups according to the hematocrit percentage (risk measurements) at birth and 24 hours after.

Group	**Hematocrit percentage (%)**			
	At birth **Normal N %** **(45-75 %)** **Low N (%) <45%** **High N %) >65%**	**Test**	**After 24 hours** **Normal N %** **(45-75 %)** **Low N (%) <45%** **High N %) >65%**	**Test**
Experimental (Late cord clamping N=50	49 (98.0) 1 (2.0) 0 (0.0)	FET P= 0.6 RR=0.33	50 (100.0) 0 (0.00) 0 (0.0)	FET P = 0.1 AR=8 %

Control (Early cord clamping N=50	47 (94.0) 3(6.0) 0 (0.0)	AR= 4% NNT= 25	46 (92.0) 4 (8.0) 0(0.0)	NNT=12.5 ≅ 13
FET= Fisher's Exact Test RR= Relative Risk AR= Attributed risk				

The present finding about Hct at birth showed that 6% (3/50) of newborns belonged to the control group had abnormal range of hematocrit (<45%) compared with the experimental group 2% (1/50), this difference is not statistically significant as, p=0.6, while after 24 hours the Hct showed that 8% (4/50) of newborn belonged to early Cord Clamping had abnormal range of hematocrit (<45%) compared to none (0/50) of the late Cord Clamping group, this difference is not statistically significant as p=0.1. The incidence of anemia (Hct<45%) among the control group was 6% and 8% respectively compared with (2% and 0%) respectively among the experimental group. This difference is statistically insignificant as FET p=0.6.

Accordingly, in the present study 6% to 8% of anemia could be attributed to early cord clamping as AR=4. Hence, it was concluded that 25 delivered women required to apply late cord clamping in order to avoid one newborn with anemia as NNT was about 25.

Discussion

The results of the present study indicated that delaying the clamping of the umbilical cord (1-3) minutes after birth improved the hematologic status of the studied newborns. The randomized nature of this study and the equivalence of the groups at baseline support the conclusion that this effect was causal.

Although, an improvement in the newborns' hematologic status is more likely to explain the present study findings, but the values still within the normal physiologic ranges, and without harmful effects if it is compared to early cord clamping group. The new born blood hematologic values revealed that the mean venous hematocrit of the newborns at birth and after 24 hours remained within the physiologic ranges with a significant difference between both groups (early and late), where means equal (53.5% and 53.0%) in early cord clamping at birth and 24 hrs. respectively compared with (55.6% and 55.4%) in late cord clamping at birth and 24 hrs respectively, which is confirming the study hypothesis.

There is a correlation between cord clamping time and the observed slight increase in the hematocrit values. Grajeda study findings revealed that the means of his study were (51.1%) and (56.4%) with a slight increase of hematocrit values. In the present study, hemoglobin means were higher in the late cord clamping group (17.4 and 17.0 g/dl at birth and 24 hrs. after respectively) in early cord clamping compared with 17.8 g/dl and17.9 g/dl (at birth and 24 hrs. after respectively) in late cord clamping. The observed differences between both groups were statistically not significant, where t=0.37 at birth and t=0.65 after 24 hours. These results agreed with Runin [31] who mentioned that the hemoglobin concentrations were higher in the newborns who had late cord clamping with (means=16.1 and 18.6 g/dl respectively).

In the current study, RBCs means were also higher in both groups (early and late), the observed differences between both groups were not statistically significant (5.2, and 6.1 million/ml) in early cord clamping and (5.4 and 5.5 million/ml) in late cord lamping at birth and at 24 hours after birth, these findings agreed with Blackburn [32] who found that circulating RBC increased after delayed cord clamping (7.4 million/ml) compared with immediate cord clamping (7.2 million/ml) in term infants.

Regarding the hematocrit values (Hct >65%) the findings of the present study illustrated that Polycythemia (Hct >65%) were more likely to occur in the newborns of early cord clamping group (2/50) compared with 1/50 in late cord clamping at birth, the hematocrit values (Hct <45%, anemia) were more likely to occur in the newborns of early cord clamping group (3/50) compared with (1/50) in late cord clamping at birth, these results are supported by Nelson [34] who reported that there were no Polycythemia related harmful effects and all Polycythemia newborns were symptomless. Furthermore, it was observed that there was an increase of number of anemia in the group with early cord clamping, both at birth and 24 hours after birth (**Tables 2 and 3)**.

As shown in **Table 2** there were no significant differences in the means of serum bilirubin levels within the first 24 hours of life (3.8 mg/dl) in early cord clamping compared with (4.4 mg/dl) in late cord clamping, all go with the normal biochemical values. These results go along with Brabin [35], where means=7.3 mg/dl in early and 7.2 mg/dl in late group. None of the study sample in early and late was admitted in NICU.

Conclusion

Based on the present study findings, it can be concluded that most of the study sample were young women with age of 20-35 years old, educated and housewives. It can also be concluded that the majority of the sample were multi para with gestational age between 38-40 weeks. The study illustrated that the delaying of the newborn's umbilical cord clamping at birth (1-3 minutes) have an important effect on newborns' hematologic status. The delaying of the umbilical cord clamping at least 1-3 minutes after birth decreased the number of anemia cases.

The study has shown that the hypothesis to be true and proved the effect of late cord clamping on the newborn's blood analysis.

Recommendations

According to the findings of the present study the following recommendations can be suggested:

- Delayed cord clamping should be the standardized practice and supported by the Ministry of Health and hospital administration. Awareness of all health care providers regarding the benefits of delayed cord clamping is highly recommended. Delayed cord clamping should be considered as one of the total quality standards to achieve the mothers' and babies' benefits.
- Finally, further studies in this context should be done such as: "Effect of new born's late cord clamping on the presence of iron deficiency anaemia during the first year of life", and "Effect of delayed new born's cord clamping on the incidence of maternal postpartum hemorrhage and duration of placental separation".

Summary

The present study was conducted to identify the effect of early and late cord clamping on the newborns' blood analysis, so a random sample of 100 women with their newborns were selected from the Dammam Maternity and Children Hospital. All women were interviewed according to a specially designed interview questionnaire to achieve the aim of the study and collect the necessary data about the study subjects. The Interview questionnaire sheet consisted of four parts.

The first Part included data related to the Demographic data (age, occupational, and education level). Second Part included data related to obstetrical history (gravity, parity, last menstruation period and gestational age). Third Part included data related to the Early and late clamping record sheet which consists of date, time, and mode of delivery and time of cord clamping (using a stopwatch). Fourth part included data related to the complete new born blood count sheet to assess the level of C.B.C (Hb, RBCs, Hct and serum bilirubin and any complications or admission to the NICU) immediately and 24 hours after birth for both groups.

The Main Findings of this Study are

General characteristics: It was noticed that most of the study sample were young women with age of 20-35 years old, educated and housewives and the majority of the sample were multi parous women with gestational age between 38-40 weeks with no significant effects on the hematologic status of the newborns' blood analysis.

Parameters Related the Newborns' Blood Analysis

1. The study illustrated that the delaying of the newborn's umbilical cord clamping at birth (1-3 minutes) improved the hematologic status.
2. The delaying of the umbilical cord clamping 1-3 minutes after birth decreased the number of anemia cases.
3. The study has shown that the hypothesis to be true and proved the effect of late cord clamping on the newborn's blood analysis.
4. Significant associations were observed between the time of cord clamping and the improvement of the hematological values of the newborns' blood analysis.
5. So, it is highly recommended that: late cord clamping as an evidence based practice should be applied by the midwives and obstetricians in their practices.
6. This can play a crucial role in decreasing the incidence of infancy anemia in Saudi Arabia, particularly in Eastern Province, which anemia during infancy and childhood is highly prevalent (350/100000 WHO ,2005).
7. This intervention seems to be safe, effective and could be implemented easily.

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