### **Original Research Article**

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# Risk of infant anemia in 3-6 months old babies and its association with maternal anemia

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#### **ABSTRACT**

**Background:** Anemia is a significant health problem in developing countries. Maternal anemia reduces fetal iron stores prior to birth and hence babies born to anemic mothers tend to develop iron deficiency anemia before 6 months which has adverse psychomotor consequences. Objective of this study was to estimate the prevalence of anemia and weight gain pattern in 3 - 6 months old term exclusively breast-fed infants and its association with maternal anemia.

**Methods:** This is a cross - sectional analytical study including 120 babies who are born as term appropriate for gestational age. Preterm and babies with history of bleed or jaundice were excluded from the study. The haemoglobin estimation and weights of these babies was measured after informed consent from parents. Maternal haemoglobin concentration during last trimester was obtained from the maternal records.

**Results:** Seventy-nine (65.8%) out of 120 babies had haemoglobin concentration <11 gm/dl, which was significantly associated with maternal anemia (p <0.004, OR 5.9). Thirty-seven (30.8%) babies had low weight for age and were born to anemic mothers and 28% of this variation in weight was contributed by maternal anemia (p =0.001).

**Conclusions:** Low haemoglobin and poor weight gain in term 3-6 months old babies are significantly associated with maternal anemia in last trimester.

Keywords: Anemia, Breast fed, Infants, Maternal anemia, Term

#### **INTRODUCTION**

Nutrition is the key factor in child's growth and development especially during the first two years of life. Iron deficiency anemia is the most common nutritional disorder in the world especially in developing countries. Iron plays an important role in many metabolic processes, including oxygen transport, oxidative metabolism, and cellular growth. During infancy, inadequate supply of iron resulting in iron-deficiency anemia is associated with more risk of infectious diseases, impaired growth, and poor psychomotor development which is often irreversible even after the correction of anemia. Increased incidence of breath holding spells and febrile

seizures have also been reported with iron deficiency anemia.<sup>3</sup> During pregnancy, maternal serum ferritin usually falls markedly between 12 - 25 weeks of gestation probably due to rapid utilization of iron for the expansion of maternal red blood cell mass. Most iron transfer from mother to the fetus occurs after 30 weeks of gestation.<sup>4</sup> This transfer of iron from the mother to the fetus is supported by a substantial increase in maternal iron absorption and is regulated by the placenta when the receptors for iron located on the apical surface of placental syncytiotrophoblast gradually increases near term. The capacity of this system may be inadequate to maintain iron transfer to the fetus when the mother is iron deficient. Maternal iron deficiency during pregnancy may

hamper the development of fetal iron stores prior to birth, and perhaps well into the first year of life also and therefore increasing the risk of anemia during infancy. This has adverse consequences on the neurological development of these infants. Iron deficiency anemia in pregnancy leads to decreased placental weight and significantly reduced number of placental cotyledons and thus is a risk factor for preterm delivery, intra uterine growth retardation and low birth weight and neonatal mortality. However mounting evidences suggest that even though infants of anemic mothers are born with adequate birth weight, they have low iron stores and are more likely to develop anemia.<sup>5-11</sup> In fact, the infants risk of having low hemoglobin when their birth weight was normal (>2500g) but mother was anemic (<11gm/dl) was greater than the infants who had a low birth weight (<2500g) and were born to non-anemic mother(>11g/dl). Hence this study is being done to estimate the prevalence of anemia in term exclusively breast fed 3-6 months old infants and its association with maternal hemoglobin status in the last trimester.

#### **METHODS**

This cross sectional analytical study was done in the Department of Pediatrics, Government Chengalpattu Medical College between January 2017 to July 2017. Ethical committee approval was obtained. 120 babies (3-6 months of age) were included in this study. All the babies were born as term appropriate for gestational age, with birth weight of >2500g in the hospital. Babies who were exclusively breast fed, without any previous history of hospitalization and also whose mothers had uneventful antenatal period were included in this study. Preterm babies, NICU graduates and neonates with history of significant jaundice and bleed were excluded from the study. These babies were weighed in the digital weighing scale and their weight was plotted in WHO growth chart. Maternal hemoglobin concentration in the last trimester was obtained from the maternal records. Under medical supervision, 0.5ml of venous blood sample was drawn from these babies by a qualified personnel after obtaining informed consent from their parents. 12-14 Blood collected in sterile vacuum tubes with EDTA was analyzed for hemoglobin concentration using autoanalyzer.

Maternal hemoglobin in the last trimester <11g/dl was considered as maternal anemia as per WHO guidelines.<sup>15</sup> There is no established cut off available for hemoglobin concentration to diagnose anemia in infants < 6 months.<sup>16</sup> Hence the WHO definition of anemia for infants above 6 months as hemoglobin concentration <11g/dl was applied as cut off for babies between 3-6 months of age in this study.<sup>15</sup>

The prevalence of low hemoglobin (<11g/dl) in the study population was estimated. Univariate analysis was done to assess the correlation between the maternal anemia in the last trimester (<11g/dl) and low hemoglobin

concentration in these terms exclusively breast fed 3-6 month old infants (11 g/dl).

Linear correlation analysis was done between maternal hemoglobin concentration recorded in their last trimester and infant weight using SPSS 16 software and the values and equation were obtained to determine the influence of maternal anemia on weight gain pattern of these term exclusively breast fed 3-6 months old infants.

#### **Definitions**

Maternal anemia was considered if their hemoglobin concentration in the last trimester fell below <11g/dl as per WHO criteria and for 3 - 6 months infants <11g/dl was taken as low hemoglobin. Weight for age <-2 SD was considered low weight for age when plotted on WHO growth chart.

#### **RESULTS**

Among 120 mothers included in our study, 96 (81%) had last trimester hemoglobin concentration <11g/dl. Forty seven (39.1%) had hemoglobin concentration between 9 - 10.9 g/dl, 40 (33.3%) mothers had hemoglobin concentration between 7-9g/dl, 9 (7.5%) of them had hemoglobin concentration between 4-7g/dl and none of the mothers had very severe anemia (<4g/dl). Seventynine (65.8%) babies (3-6 months) out of 120 babies born as term appropriate for gestational age and exclusively breast fed had hemoglobin concentration <11g/dl (Figure 1).

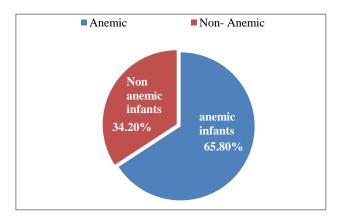


Figure 1: Prevalence of Anemia In 3-6 Months old infants.

Among these babies who had hemoglobin concentration less than 11g/dl, 1 baby (0.8%) had hemoglobin concentration of less than 7g/dl, 67 babies (55.80%) had hemoglobin concentration between 7-9g/dl and 11 babies (9.1%) had hemoglobin concentration between 9-10.9 g/dl (Figure 2). The mean hemoglobin concentration in the study group was 9.9g/dl. Out of 79 babies who had low hemoglobin concentration (<11g/dl), 71 (59.16%) were born to anemic mothers (<11 g/dl) and 8 (6.6%)

babies were born to non-anemic mothers (>11g/dl) (Figure 3).

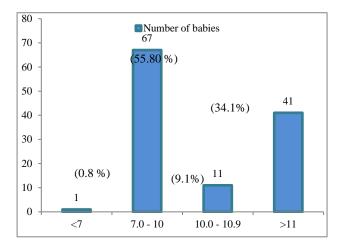


Figure 2: Proportion of babies in various hemoglobin ranges.

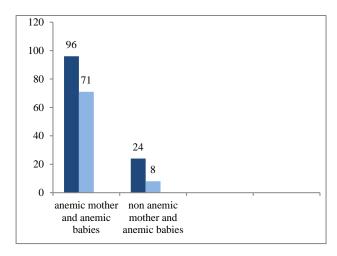


Figure 3: Prevalence of anemia in infants born to anemic and non-anemic mothers.

Twenty-five (21.6%) babies who were born to anemic mothers had hemoglobin concentration >11g/dl. On univariate analysis to find the association between maternal hemoglobin and infant hemoglobin, it was observed that maternal hemoglobin concentration had significant association with the infant hemoglobin concentration with an odds ratio of 5.980 (95% confidence interval 2.168-14.884 and p value 0.004) (Table 1).

Table 1: Univariate analysis between maternal Hb and baby Hb.

	Maternal Hb <11g/dl	Maternal Hb >11g/dl
Baby Hb <11.0g/dl	71	8
>11.0g/dl	25	16

P value - 0.004, Odds ratio- 5.980, Confident interval 2.168-14.884, Chi - square - 14.008

Maternal anemia had significant (p value 0.0004) influence on the hemoglobin status of these infants. The risk of infant anemia is 5.9 times higher in babies born to anemic mothers. The weight of these babies (3 - 6 months of age) who were born at term with adequate birth weight was measured and recorded. These measurements when plotted on WHO growth charts revealed that 37 (30.8%) of these babies had low weight for age (-2SD) as per WHO growth chart. All these 37 babies (30.8%) were born to anemic mothers whose hemoglobin concentration in last trimester was <11g/dl and none of the babies were born to mothers with hemoglobin concentration more than 11gm/dl (Figure 4).

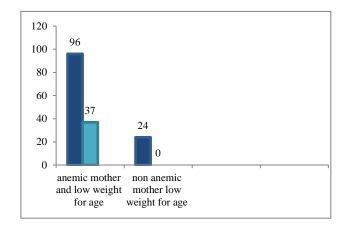
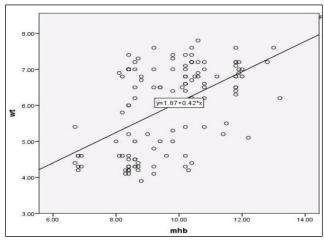


Figure 4: Prevalence of low weight for age of the babies among anemic and non-anemic mothers.

Linear regression analysis to assess the correlation between maternal hemoglobin and infant weight gain pattern was done and found that 28% variation in weights of these 3-6 months old term exclusively breast-fed infants was influenced by maternal hemoglobin concentration during their last trimester (Figure 5).



 $r=0.529~p{<}0.001$  significant. Positive correlation is present,  $R^2{=}0.28,$  meaning 28% of variation in present weight of child is contributed by maternal anemia

Figure 5: Relation between maternal Hb and present weight.

#### **DISCUSSION**

Anemia is a public health problem with most common cause being iron deficiency anemia in developing countries, more predominantly in women children. 17,18 The prevalence of iron deficiency anemia in rural India among pregnant women is 65-75% and among children aged 6-59 months is 70%. 19,20 Present study shows increased prevalence of maternal anemia (81%) in our part of state. There is less data available on the prevalence of anemia in less than 6 months infants as it is generally assumed that these infants born as term with an appropriate weight for gestational age have adequate stores of iron, but several evidences suggest that though born as term with adequate birth weight, when born to anemic mothers these infants have low stores of iron. Among 120 babies born as term with adequate birth weight in our study, 79 babies (65.8%) had hemoglobin concentration <11g/dl. A post-natal fall in hemoglobin is physiologically expected in infants due to suppression of erythropoietin production in the relatively hypertoxic extrauterine environment reaching nadir between 6 and 12 weeks of age.<sup>21</sup> In general, though term neonates have a drop in hemoglobin up to 6 - 12 weeks due to physiological anemia of infancy, they have sufficient iron stores for first 6 months of life. However, mild maternal iron deficiency anemia has few significant repercussions on the iron status of the new born but severe anemia does have a strong influence. The fetus of iron deficient mothers accumulates less iron reserves and has smaller hemoglobin mass than their normal counterparts. After about 4 months of age a gradual shift occurs from an abundance of iron to the marginal iron reserves that caters a period of continued rapid growth. According to existing evidences low hemoglobin levels during pregnancy lead to reduced iron stores, causing infantile anemia even before the age of 6 months. In present study it was observed that the risk of anemia in 3-6 months old infants when to born to anemic mothers is 5.9 times greater than those born to non-anemic mothers. Similarly Zhang Y and Jin L et al in their study on maternal hemoglobin concentration during gestation and risk of anemia in infancy have shown that maternal hemoglobin concentrations measured during 24-28 weeks of gestation, but not in first trimester were correlated with infant hemoglobin concentration and the risk of infant having low hemoglobin at 5-7 months of age (AOR: 1.95, 95% CI: 1.59 - 2.40) and 11 - 13 months is increased (AOR: 1.72, 95% CI: 1.36 - 2.18) when the maternal hemoglobin concentration was ≤10.9g/dl during 24-28 weeks of gestation.<sup>22</sup> Similarly Maria de lourds et al in their study on the influence of breast feeding type and of maternal anemia on hemoglobin concentration in 6 months old infants has concluded that maternal anemia did have an influence on the hemoglobin level of 6 months old infants even when only children on exclusive and predominant breast feeding were analyzed and there is an urgent need to prevent maternal anemia before conception, during pregnancy and throughout lactation.<sup>23</sup> Also, Jareen K et al in a study on infant anemia and its association with maternal anemia had stated that maternal anemia was independently associated with a threefold increased risk of infant anemia (p value 0.03) and those associations were not explained by confounding with other maternal or infant factors.<sup>24</sup> Colomer et al in a prospective cohort study tested 156 neonates and analyzed the relation between hemoglobin concentration of pregnant women and the risk of anemia in their infants at twelve months of age.<sup>25</sup> The study concluded that infants born to anemic mothers were more likely to become anemic themselves (odds ratio 6. 57) when stratified analysis was performed to control the potential effects of confounding factors like feeding practices, morbidity and socioeconomic status. Teltar B et al in their study on the effect of maternal anemia on anthropometric measurements of newborns included 3688 mothers among which 1588 (43%) were found to be anemic and had stated that there was a statistically significant difference in height, weight and chest circumference of newborns of severe and mild anemic mothers (p 0.017, 0.008 and 0.02 respectively).<sup>26</sup> It was reported in their study that severe anemia had significant effect on neonatal anthropometric measurements. In this study, it was observed that there is a linear correlation between maternal hemoglobin and weight of these exclusively breast-fed babies. All the babies with weight <-2SD were born to anemic mothers. In a similar study, Alok Bhargava et al included 100 infants of age less than 6 months in kenya and determined the association of maternal anemia and the weight gain pattern of these infants.<sup>27</sup> The study finally stated that maternal hemoglobin concentration and weight of these less than 6 months old infants was positively correlated with a p value <0.05. Saskia de Pee, Martin W. Bloem, Mayang Sari et al in their study that included 990 babies of age 3 - 5 months old hypothesize that the hemoglobin concentration of many infants is too low below the age of 6 months due to iron deficiency anemia, particularly by increased risk of low hemoglobin concentration among infants of anemic mothers.16 Univariate analysis revealed among several factors influencing prevalence of low hemoglobin in infants less than 6 months, four of the factors were highly correlated, maternal hemoglobin concentration, birth weight, child age and breast feeding status. However, in this study, the study population was made homogenous by including term babies with birth weight (>2500g) on exclusive breast feeding. In line with our study there are yet studies stating that there is direct relationship between maternal anemia and fetal hemoglobin, suggesting that placental iron transport mechanisms may not work at higher degrees of maternal anemia thus leading to fall in hemoglobin of these infants. 28,29

Limitation of the study is that the estimation of weight and hemoglobin concentration of these term exclusively breast 3 - 6 months old babies was done only once. Further prospective studies with larger sample size may be more appropriate to assess the significance of this association between maternal anemia with infant hemoglobin status and their weight gain pattern. Moreover, iron status of mother during pregnancy and the iron status of infants postpartum too deserves exploration.

#### What is already known?

Maternal anemia has a significant impact on the perinatal outcome of neonates such as low birth weight, intra uterine growth retardation, prematurity, stillbirth and increased neonatal mortality.<sup>30</sup>

#### What this study adds?

Maternal anemia has significant influence on the hemoglobin status and weight gain pattern even beyond the neonatal period in term babies even though they are born with adequate birth weight.

#### **CONCLUSION**

The prevalence of low haemoglobin concentration (<11g/dl) in 3-6 months old term exclusively breast-fed infants was 65.8%. The greater proportion of these anaemic babies were born to anaemic mothers when compared to those born to non-anaemic mothers and there is significant association between maternal anemia and low haemoglobin concentration in these term infants on exclusive breast feeds. Maternal anemia during last trimester also has significant impact on weight gain pattern of these infants.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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