COMPARISON OF FREQUENCY OF IRON DEFICIENCY ANEMIA IN INFANTS ON EXCLUSIVE BREAST FEED, FORTIFIED MILK AND COW'S MILK

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ABSTRACT

Objective: To determine the frequency of iron deficiency anemia in infants on exclusive breast feed, fortified milk and cow milk feeding regime.

Study Design: Observational cross sectional study.

Place and Duration of Study: Out Patient Department of Pak Emirates Military Hospital Rawalpindi, from Mar to Dec 2017.

Methodology: One hundred and fifty infants, fifty from each feeding regime were included in the study as per the inclusion criteria. Blood samples of infants were drawn after consent from parents for measurement of serum ferritin and blood counts.

Results: One hundred and fifty infants were included in the study with 89 male and 61 females with mean age of 7.77 months. One hundred and thirteen infants were found to anemic (75.3%) and iron deficiency was present in 6.7% of the cases. Mean Hb was 9.49 g/dl, mean MCV 66.15 fl and mean ferritin level was 25.81 ng/ml. There was a strong association between type of feeding regime and frequency of anemia among infants (p<0.001) with children consuming fortified milk having highest levels of Hb, MCV and ferritin levels, followed by mother feed and cow/buffalo milk.

Conclusion: Consumption of cow milk in infancy has detrimental effects on blood indices and serum ferritin. Breast milk is still considered the best source for nutrition however iron fortification after fourth month is recommended. Radical short and long term measures are required nationwide to overcome the menace of Iron deficiency which is still quite prevalent in our children.

Keywords: Anemia, Breastfeeding, Cow milk, Feeding practices, Iron Deficiency.

INTRODUCTION

Anemia has been a global public health concern for decades and is still the most prevalent form of micronutrient deficiency with estimated 1.6 billion people affected worldwide[1]. Children under 5 especially Infants are among the most vulnerable group with a global incidence of 40%[2] whereas in Pakistan the situation is bleaker with some studies estimating a prevalence of 40-70% in children under 5 years of age[3]. Iron deficiency is considered to have a major role in this global burden of anemia and almost half of the cases are attributed to it[3]. According to WHO 27% of preschool children suffer from anemia due to iron deficiency[4].

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Iron deficiency anemia (IDA) has been associated with severe cognitive, physical and immune impairments and is the third leading cause of disability worldwide[3]. Infants and toddlers who are not weaned at appropriate age are extremely vulnerable to iron deficiency as milk is a poor source of iron and cannot fulfill the requirements of rapidly growing body[2,3,5,6]. Initially the stored iron at birth, accumulated in the last trimester, fulfills the need but when the reserves are depleted after 4-6 months of age, dietary iron remains the only source for growth[6].

A number of studies have indicated the use of unfortified cow/buffalo milk in infancy as a risk factor for iron deficiency anemia[1,7-9]. In addition to the lower iron content and high renal solute load cow/buffalo milk has been implicated in occult intestinal blood loss and inhibition of

iron absorption[6]. Many authors have reported association between exclusive breastfeeding for 06 months or beyond and iron deficiency anemia[4,8,10-15]. A few authors however did not concur with this association[16,17].

There have been very few studies conducted in Pakistan to find association between different milk sources and incidence of anemia in children. Due to a drastic decrease in breast feeding rates and higher cost of fortified milk the practice of providing cow milk in infancy is quite common in Pakistan[18]. The effect of this practice on iron status in infancy needs to be determined so that new strategies could be introduced to curtail the incidence of Iron Deficiency in the region. Furthermore in majority of previous studies serum ferritin levels have not been accounted for in determination of iron deficiency anemia[3]. The three main sources of milk (breast milk, fortified formula milk and cow's milk) have different concentration of iron. The purpose of our study is to compare the frequency of iron deficiency anemia in late infancy and its association with the type of milk consumed.

METHODOLOGY

The study was cross sectional and conducted in Out Patient Department, Pak Emirates Military Hospital Rawalpindi, from March to December 2017. The majority of infants enrolled came for vaccination or were siblings of children attending Pediatric clinic. Study was approved by ethics review committee of the hospital. Written informed consent was taken from parents/guardians of all infants involved in the survey. A total of 150 infants were enrolled from 3 different categories; exclusively breast fed for 6 months (n=50), fortified milk fed (n=50) and cow's milk fed (n= 50) by stratified sampling. Exclusive breast fed infants included only those who had not been given any other source of nutrition except breast milk from birth till 06 months of age. All healthy afebrile Infants 6 to 9 months of age, born at term, with birth weight of at least 2500 grams were included. The exclusion criteria were: prematurity, low birth weight, twin pregnancy, history of IUGR, any chronic illness or acute infection in last 2 weeks, history of blood transfusion, hemolytic or coagulation disorder and intake of iron supplements. Demographic data included age, gender, along with biochemical measurements of hemoglobin level; serum ferritin and mean crepuscular volume were recorded.

Approximately 2 ml of venous blood samples were collected for serum ferritin and blood counts. Tests were performed within 5 days of blood collection. After obtaining complete blood count via automated blood cell coulter remaining sample was centrifuged, serum separated and stored at -20°C. Serum ferritin was determined using enzyme immunoassay kit (Diametra, Italy).

Anemia was defined as adjusted Hb <11 g/dL, as per WHO guidelines. Iron Deficiency was defined as ferritin <12 µg/L and Iron Deficiency Anemia was the presence of anemia plus iron deficiency[19].

All data were analyzed using SPSS ver 16.0. Quantitative variables were presented as mean (SD) and categorical as frequencies (%). One-Way Analysis of Variance (ANOVA) was run to analyze differences in mean Hb, ferritin and MCV levels among the feeding groups. Furthermore, means plot were visualized to assess differences among subgroups of children with different feeding regimes. Chi-square analyses were run to explore associations between diagnosis of anemia among children and their feeding regimes. Point-biserial correlation was run to analyze association of gender of children with Hb, ferritin and MCV values. *p*-value ≤0.05 was considered significant.

RESULTS

A total of 150 children aged between 6-9 months were included in the study, among which 75.3% were found to have anemia and IDA was present in 6.7% of cases based on the levels of hemoglobin and serum ferritin. Eighty-nine infants were male (59%) and 61 females (41%) with a male to female ratio of 1.46:1. Mean age was 7.77 months (1.29). The mean patients hemoglobin was 9.49 (1.83) g/dl (range: 5.5-13.6), mean MCV 66.15 (8.4) fl (range: 48-90) and mean ferritin 25.81

(9.2)ng/ml (range: 6-46) in all feeding regimes based on descriptive analysis (table-I).

One Way ANOVA revealed significant differences in levels of Hb (F=190.66, p<0.001), MCV (F=62.91, p<0.001) and ferritin levels (226.64, p<0.001) among children consuming different feeding regimens. Children consuming fortified milk had highest mean values of Hb, MCV and ferritin levels, followed by mother feed and cow/buffalo milk (table-I).

Table-I: Iron status indices of cases grouped according to feeding regime.

	All	Cow / Buffalo Milk	Breast Milk	Fortified Milk
Number	150	50	50	50
Anemia, n (%)	113 (75.3)	50 (100)	45 (90)	18 (36)
IDA, n (%)	10 (6.7)	9 (18)	1 (2)	0 (0)
Hb (g/dl)	9.49 (1.83)	7.59 (0.91)	9.48 (0.96)*	11.39 (1.04)*,**
MCV (fl)	66.15 (8.42)	59.45 (6.65)	65.61 (6.6)*	73.39 (5.3)*,**
Ferritin (ng/ml)	25.81 (9.2)	16.2 (3.9)	25.62 (5.0)*	35.66 (4.6)*,**

*Data are presented as Mean (SD). *Significant difference from Cow / Buffalo Milk p<0.005. **Significant difference from Breast Milk p<0.005.*

Table-II: Mean values based on gender.

		Male (n=89)	Female (n=61)	Total (n=150)
Hb (g/dl)	Mean	9.1	10.0	9.49
	SD	1.66	1.94	1.83
MCV (fl)	Mean	64.32	68.82	66.15
	SD	8.60	7.45	8.42
Serum Ferritin (ng/ml)	Mean	23.81	28.74	25.81
	SD	8.62	9.3	9.2

Chi-square analyze showed significant association between feeding regimens and presence of anemia among children (Chi square=63.79, p<0.001). According to it, children consuming cow/buffalo milk had the highest proportion of anemia, followed by those on mother feed and fortified milk. Among genders, males had a mean Hb of 9.1 (1.66) g/dl as compared to females mean of 10.0 (1.94) g/dl. Mean MCV was also less in males 64.32 (8.6) fl as compared to 68.82 (7.45) fl in females. Mean serum ferritin value was 23.81 (8.62) ng/ml for males and 28.74 (9.3) ng/ml in females. Females were positively associated with Hb (r=0.25, p=0.002), MCV (r=0.26, p=0.001) and ferritin levels (r=0.26, p=0.001)(table-II).

DISCUSSION

Iron deficiency is one of the most common problems in the developing world[4]. Due to increased iron requirement in infancy, poor bio availability of iron in milk, inadequate weaning practices and ineffective iron fortification programs in the developing world; iron deficiency anemia in infancy is still rampant[3,15]. Iron is an important constituent which is required for regulating cellular functions and development of brain, muscles and red blood cells. Various neurocognitive and behavioral impairments have been associated with iron deficiency in children with some authors reporting low intelligent quotient scores even before the development of anemia[4,5,20].

In this study we analyzed the effects of different feeding regimes on iron status and the frequency of anemia in infants between 6 to 9 months of age. This study revealed significant results in all three groups. The type of milk consumed was statistically linked to all three investigated parameters (p<0.001) showing a strong association between type of milk consumed and serum ferritin, Hb and MCV levels. Interestingly, analysis between groups revealed that Mean hemoglobin, serum ferritin and MCV levels were significantly increased in fortified milk fed infants as compared to breast and cow milk fed (p<0.001). Lowest levels were observed in case of cow milk fed children. Our findings are supported by Elalfy *et al*[1]. Dube *et al*[13] and Thorisdottir *et al*[7] who found highest prevalence of iron deficiency anemia in cow milk group and lowest in fortified milk group. Thorisdottir *et al*[7] however did not find any association between Hb and MCV levels and type of milk consumed[7].

There have been contradicting results regarding association between length of exclusive breastfeeding and anemia. Clark *et al*[8], Joo *et al*[15],

Vendt *et al*[10] and Meinzen-Derr *et al*[11] found increased odds of iron deficiency anemia in infants who were exclusively breast fed for 6 months as compared to formula fed. Contrary to this findings Shakur *et al*[16] did not find an association between exclusive breast feeding and anemia however the study included very few infants who were breast fed till 6 months. Burke *et al*[2] did not report significant association between length of exclusive breast feeding and iron deficiency anemia although a positive relationship with iron deficiency was seen. Recently Cai *et al*[21] proposed absence of membrane iron transporter in human lactating epithelial cells leading to low iron content of breast milk.

The association of cow milk consumption and prevalence of iron deficiency anemia in infants is well documented in literature[6,7,22,9]. In addition to low iron content and poor bio-availability of cow milk it is also associated with occult intestinal blood loss and inhibition of dietary iron absorption by calcium and casein[6]. Some authors have also revealed association between introducing cow milk in infancy and delay in developmental milestones[23]. Hence cow milk consumption in infancy is strongly discouraged due to its detrimental health effects and if required it must be accompanied with iron supplementation[6].

This results for infants on fortified milk were in congruence with previous studies on effect of fortified milk on iron status[24]. Almost half a century back The American Academy of Pediatrics' Committee on Nutrition emphasized on the early use of fortified formula to supplement iron stores which was later found to drastically reduce the prevalence of iron deficiency anemia in infancy[25]. In 2010 the AAP recommended iron supplementation at 1mg per kg per day for all term breast fed infants starting from 4 months and 2mg per kg per day from second month in preterm breast fed babies[20].

We also observed significant difference among males and females in Hb, and iron status markers (p<0.005) with females positively associated with Hb, MCV and ferritin levels as observed previously by some authors[1,3,11,24]. The reason behind this could be higher pre and postnatal growth, robust fetal erythropoiesis, low iron absorption and increased loss of intestinal blood in male infants as suggested by two independent studies.

This study had certain limitations as it targets only a specific population which does not represent the whole community. The majority of infants belonged to urban families who have higher literacy rates and per capital income than the country average. C-reactive protein (CRP) was not concurrently calculated with serum ferritin to exclude falsely elevated ferritin level, which might lead to under-estimation of the prevalence of Iron Deficiency. Age of weaning and nutritional value of diet provided to infants was not taken into consideration which could lead to bias.

CONCLUSION

Considering the long term detrimental effects of iron deficiency on growth and brain development; the alarming prevalence of this menace is an eye opener. Wide spread parental education programs are required to curb the practice of providing cow milk in Infancy and emphasize on need for iron supplementation. Administration of iron supplements to infants and mothers has already shown promising results in Pakistan[3]. Additionally universal screening should be carried out at 12 months as per AAP recommendations[20]. Although we observed fortified milk to have best results in terms of iron status we still recommend breast feeding as the optimum choice due to its role in growth and development along with iron fortification beyond 4 months.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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