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Original Article

Paediatrics Section

Maternal Anaemia is a Risk Factor for Anaemia in Infants at 14-16 Weeks-Need for Early Initiation of Iron Supplementation

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ABSTRACT

Introduction: Exclusive Breast Feeding (EBF) is recommended uniformly for all infants till six months. It is believed that since bioavailability of iron in breastmilk is high this along with the fetal iron stores will be adequate till six months. Current recommendation for iron supplementation in term infants is only from six months. However, maternal iron deficiency may reduce fetal iron stores and the infant may develop deficiency earlier.

Aim: To study the prevalence of anaemia in term appropriate for gestation age exclusively breastfed infants at 14-16 weeks of age and its relationship to mothers' haemoglobin at delivery.

Materials and Methods: This observational study was done from March 2017 to July 2018. We recruited 350 Term Appropriate for Gestational Age (TAGA) infants on EBF aged 14-16 weeks. Chi-square test was used to test the association between the categorical variables. A binary logistic regression was used to calculate the odds ratio and 95% confidence interval.

Results: Among the 350 infants studied 129 (36.8%) had anaemia. In the anaemia group, 34 (26.4%) out of 129 infants were significantly underweight compared to 36 (16.3%) out of 221 non-anaemic infants. There were significantly more anaemic children among the lower Socio-economic class with 10/17 (58.8%). Among the 350 mothers, 137 (39%) had anaemia at the time of delivery. The prevalence of anaemia in the infants born to anaemic mothers was 64% and among non-anaemic mothers it was 19%. There was a moderate positive correlation (0.52) between maternal Haemoglobin (Hb) at delivery and anaemia in infants at 14-16 weeks.

Conclusion: The prevalence of anaemia in the infants born to anaemic mothers was significantly higher than non-anaemic mothers. Maternal anaemia should be taken as a risk factor for anaemia in EBF infants and these children should be routinely started on iron supplements in early infancy.

Keywords: Breast feeding, Haemoglobin, Iron deficiency, Pregnant women

INTRODUCTION

Iron-Deficiency Anaemia (IDA) is the most common nutritional disorder in the world [1]. Its prevention is of special importance in infancy since it places the infant at risk of infectious diseases, impaired growth, and poor psychomotor development which is often irreversible even after the correction of anaemia [2]. All world organisations recommend EBF for six months. Although breast milk has a relatively small amount of iron, its absorption is high, especially when babies are breastfed exclusively in the first six months after birth. This along with the fetal iron stores is believed to be sufficient. Hence, iron supplementation is currently recommended only from six months by National Iron plus Initiative in India [3]. However, maternal iron deficiency during pregnancy may hamper the development of fetal iron stores prior to birth, increasing the risk of anaemia during infancy [4]. Hence, AAP in 2010 has recommended universal supplementation of iron to infants starting at four months of age [5]. Before changing current guidelines in India, it is important to know the prevalence of anaemia at 3-4 months of age. There are very few studies on the prevalence of anaemia in infants in this age group especially in those on EBF [6]. Also, maternal anaemia as a risk factor for anaemia in infants has not been widely researched and there are no guidelines for iron supplements in this group. This study was carried out to assess the prevalence of anaemia in EBF infants at 14-16 weeks of age and to correlate its relationship with mothers' haemoglobin at delivery. Our hypothesis is that infants born to mothers with anaemia and receiving EBF are at risk of anaemia before six months.

MATERIALS AND METHODS

This observational study was done in Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai, Tamil Nadu, a tertiary care teaching hospital in Southern India from March 2017 to July 2018. TAGA infants, 14-16 weeks of age, on EBF coming to the well-baby clinic were enrolled. Those with major congenital anomaly, infants on iron supplementation already or infants whose parents were not willing to participate were excluded (Vitamin D intake was not an exclusion criterion). Considering prevalence of IDA as 14% [7], and absolute precision of 4%, 95% confidence interval with power of 77%, the sample size calculated was 289. We recruited 350 infants for our study. The study was initiated after approval from the Institutional Ethics Committee (Ref: CSP–MED/16/AUG/20/90) and with the written consent of parents. Parents' demographic data and mother's Haemoglobin (Hb) at the time of delivery was noted. Anthropometry was recorded as per standard techniques [8,9]. Blood was drawn by venipuncture for Complete Blood Count by Beckman Coulter Technique (an automated 5-part machine). Children with anaemia were presumed to have IDA and accordingly given iron supplements and followed up in the pediatric outpatient department.

Study Definitions

- Term neonate: Baby born between 37-42 weeks of gestation.
- Appropriate for Gestational Age (AGA): Babies whose weight for gestation age is between 10th and 90th centile
- Exclusive breast feeding: Defined as no other food or drink, not even water, except breast milk (including milk expressed or from a wet nurse), but allows the infant to receive ORS, drops and syrups (vitamins, minerals and medicines).
- Anaemia: Hb concentration that is 2 standard deviation or more below the mean for healthy population of same age. In this study, for infants below six months Hb <10.3 gm/dL and for antenatal mothers Hb<11 g/dL [2,10] was considered anaemia.

STATISTICAL ANALYSIS

We performed the statistical analysis using the SPSS package version 16. Presence or absence of anaemia was considered as primary outcome. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables.

The association between anaemia and quantitative variables was assessed by comparing the mean values. The mean differences along with their 95% CI were presented. Independent sample t-test was used to assess statistical significance. Association between quantitative explanatory and outcome variables was assessed by calculating Pearson correlation coefficient. The association between anaemia and categorical variables was assessed by cross tabulation and comparison of percentages. Chi-square test was employed to test the association between the categorical variables. The p-value <0.05 was considered significant. A binary logistic regression was used to calculate odds ratio and 95% confidence interval.

RESULTS

A total of 350 healthy term EBF infants aged 14-16 weeks attending the well-baby clinic were enrolled in this study. Of these 129 (36.8%) were anaemic. [Table/Fig-1] describes the demographic and clinical profile of subjects [8,9].

	Anaemia n=129 (%) n (%)	No anaemia n=221 (%) n (%)	Total n=350 n (%)	p-value	Odds ratio
Age at enrollment					
14 weeks	80 (39.6)	122 (60.4)	202 (58)	0.15	1.495 (0.864-2.597)
15 weeks	24 (36.4)	42 (63.6)	66 (18.9)	0.45	1.303 (0.655-2.591)
16 weeks (REF)†	25 (30.5)	57 (69.6)	82 (23.1)		
Gender					
Boys	74 (38.5)	118 (61.5)	192 (54.9)	0.47	1.174 (0.758-1.819)
Girls (REF)	55 (34.8)	103 (65.2)	158 (45.1)		
Birth order					
1st	73 (42.2)	100 (57.8)	173 (49.4)	0.04*	1.577 (1.018-2.443)
2nd (REF)	56 (31.6)	121 (68.4)	177 (50.6)		
Weight at enrollment§					
Underweight	34 (48.5)	36 (51.5)	70 (20)	0.02*	1.879 (1.104-3.196)
Normal (REF)	92 (33.5)	183 (66.5)	275 (78.6)		
Overweight	3 (60)	2 (40)	5 (1.4)	0.23	2.984 (0.49-18.171)
Length at enrollment§					
Stunted	51 (44.3)	64 (55.7)	115 (32.9)	0.04*	1.604 (1.015-2.5338)
Normal (REF)	78 (33.2)	157 (66.8)	235 (67.1)		
Nutritional status§					
MAM and SAM	31 (45.6)	37 (54.4)	68 (19.4)	0.09	1.573 (0.919-2.690)
Normal (REF)	98 (34.8)	184 (65.2)	282 (80.6)		
Socio-economic class‡					
Upper Middle	6 (42.9)	8 (57.1)	14 (4)	0.43	1.56 (0.513-4.756)
Lower Middle (REF)	48 (32.4)	100 (67.6)	148 (42.3)		
Upper Lower	65 (38)	106 (62)	171 (48.9)	0.29	1.278 (0.805-2.02)
Lower	10 (58.8)	7 (41.2)	17 (4.8)	0.03*	2.976 (1.067-8.298)

[Table/Fig-1]: Demographic and clinical profile of subjects.
Binary logistic regression was used †REF: Reference; ‡ As per Modified Kuppuswamy Socio-Economic Status Scale, 2016 [8] § Anthropometry as per WHO growth chart [9] Underweight-<-2 Z score, Normal -2 to +2 Z score, Over weight >+2 Z score Stunted <-2 Z score Moderate Acute Malnutrition (MAM) -2 to -3 Z score, Severe Acute Malnutrition (SAM) < -3 Z score

There was no significant relationship between age at enrollment, sex and prevalence of anaemia. There were significantly more anaemic children in the lower Socio-Economic class (58.8%) than in the other groups. Birth order was significant with prevalence in infants born to primi mothers being higher (42.2 vs 31.6), (odds ratio 1.577, 95% confidence interval 1.01 to 2.44). The infants with anaemia were significantly more likely to be underweight {26.4% (34/129-underweight infants/Total anaemia) vs. 16.3% (36/221-underweight/no anaemia)}, stunted {39.5% (59/129-stunted/total anaemia) vs. 29% (64/221 stunted/no anaemia)} and have acute malnutrition {24% (31/129 MAM/total anaemia) vs 16.7% (37/221 MAM/no anaemia)}. Underweight infants had a significant relationship with anaemia (odds ratio 1.879, 95% confidence interval 1.10 to 3.19). The prevalence of anaemia was significantly more among stunted infants (odds ratio 1.604, 95% confidence interval 1.01 to 2.53). The mean Hb concentration in the anaemic children was 9.6 g/dL.

A total of 137 (39.1%) mothers had anaemia at the time of delivery. The prevalence of anaemia in the infants born to these mothers was (64% vs. 19.2%), significantly more than that in infants born to non-anaemic mothers (odds ratio 7.53, 95% confidence interval 4.62 to 12.27). There was a moderate positive correlation of +0.52 between maternal anaemia and infants with anaemia at 14-16 weeks [Table/Fig-2].

Infants	Anaemia n (%)	No anaemia n (%)	Total 350 n (%)	Total p-value	95% CI	Coefficient of correlation
Maternal Anaemia	88 (64.2)	49 (35.8)	137 (39.1)	<0.001	7.53 (4.62-12.27)	+0.52 (moderate positive correlation)
No Maternal Anaemia (REF)	41 (19.2)	172 (80.8)	213 (60.9)			

[Table/Fig-2]: Relationship between maternal anaemia and infants' haemoglobin.

DISCUSSION

In this study we evaluated the prevalence of anaemia in term appropriate for gestation age EBF infants at 14-16 weeks of age and its relationship to mother's haemoglobin at delivery. Among the 350 infants studied, the prevalence of anaemia at 14 to 16 weeks was 36.8%. The prevalence of maternal anaemia at the time of delivery was 39.1%. 64.2% of the infants born to these mothers were anaemic as compared to 19.2% in the non-anaemic mothers.

The risk of an infant developing iron deficiency is further increased if the umbilical cord is prematurely clamped in an already anaemic mother. Studies have shown that delayed cord clamping has had a significant effect on the haemoglobin status of infants [11].

Rahimy M et al., from Benin, Africa studied 252 infants at four months and found the prevalence of anaemia to be 42% [12]. However, Marques R et al., from Brazil studied 102 infants at four months and observed that the prevalence of IDA was only 3.4% [13]. He concluded that breast fed infants is protected from Iron Deficiency (ID) till four months after which iron surveillance is recommended. In India, Krishnaswamy S et al., from Chandigarh observed that among 215 infants evaluated at four months, prevalence of ID was 21.4% and IDA was 16.7% [3].

EBF is believed to protect children from malnutrition. Severe acute malnutrition is a major public health issue, which affects 7.5% of under-five children in India as per National Family Health Survey (NHFS)-4 [14]. Other studies among EBF babies have shown the prevalence of underweight and acute malnutrition to be variable. Krishnaswamy S et al., in their study of 215 healthy term breast fed infants aged four months, noted wasting in 6 (2.9%) and stunting in 37 (17.2%) infants, respectively [3]. The significantly higher proportion of malnutrition among EBF infants reflects suboptimal breastfeeding practices. Aetiologies such as low birth weight, persistent diarrhea and recurring sepsis, chronic underlying diseases or disability should be considered [15]. The relationship between weight for age and anaemia is interesting. Marques R et al., observed that children growing rapidly are more susceptible to ID [13]. Arya A et al., observed that 95% of the children with SAM had anaemia [16].

World Health Organization estimates, that up to 56% of all women living in developing countries are anaemic [17]. In India, National Family Health Survey -4 has identified that 50.4% pregnant women from 15-49 years of age were anaemic. A 53.1% of all women aged 15-49 years were anaemic [14]. Kumar A et al., found lower iron levels in the breast milk of mothers with severe anaemia, when compared to non-anaemic mothers' milk [18]. Marques R et al., in a study on maternal haemoglobin in mothers with infant aged 4-5 months observed that for an increase of 1 g/dL in maternal Hb, there was an estimated increase of approximately 1.1-0.8 g/dL Hb in infants [19]. Hemachitra J et al., observed that anaemia in babies at 3-6 months of age was significantly associated with maternal anaemia [4]. Viteri FE et al., in the USA, showed serum iron levels were reduced in infants born to anaemic mothers [20]. De Pee S et al., showed maternal anaemia is a risk factor for infant anaemia [21]. On the contrary Marques R et al., found no association study between the body iron status of mothers and those of their children at six months of age [13].

Various randomised controlled studies have shown that iron supplementation from 1-6 months of age [7,22] resulted in higher haemoglobin, mean corpuscular volume at six months and higher visual acuity and Psychomotor Developmental Index at 13 months of age. Iron supplementation is recommended at four months of age in the USA for EBF infants.

LIMITATION

One limitation of this study is that this is a descriptive study of the nutritional status in anaemic and non-anaemic children, hence it is expected that in some aspects they will not match. ID is presumed to be the commonest cause of anaemia in our country. But recent studies have highlighted the importance of other nutrients like vitamin B12 which may also be deficient in mothers and hence in their breast milk, particularly among vegetarians. As ours is a large country with diverse ethnicities and dietary habits, more and more studies from different parts of the country could help frame recommendations.

CONCLUSION

The prevalence of anaemia at 14-16 weeks in EBF TAGA infants born to mothers with anaemia at delivery was higher (64%) than that in infants born to non-anaemic mothers (19%). Since iron deficiency is the commonest cause of anaemia, this group may be considered for early routine iron supplements.

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