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Prevalence of Iron Deficiency in 3-5 month old Healthy Breastfed infants

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ABSTRACT: Objective : To assess the prevalence of iron deficiency (ID) and iron deficiency anemia (IDA) in exclusively breastfed healthy infants, aged between 3 to 5 months, with a birth weight of >2.5kg.
Methods: The cross-sectional study was conducted in the Well Baby Clinic of a tertiary care center in Eastern India from January 2018 to December 2019
Inclusion Criteria: Age-3 to 5 months, healthy, exclusively breastfed, term gestation with a birth weight of >2.5 kg
Exclusion criteria: Systemic illness, leucocytosis, leucopenia, thrombocytopenia or iron supplementation
After informed consent from the guardian, blood sample was collected from the baby for complete blood count and serum ferritin assay. Iron deficiency (ID) was defined as serum ferritin <12µg/L and Iron Deficiency Anemia (IDA) was defined as ID plus Hb<10.5g/dl
Results: One hundred and fifty six infants were eligible for the study out of which 21 were lost to follow up and 30 refused. Blood was drawn from 105 patients out of which 5 were hemolysed, 8 were insufficient and 16 had abnormal CBC. So final number of sample analysed were seventy six. The prevalence of iron deficiency in infants between 3 to 5 months was 22.3% and iron deficiency anemia was 21.05%.
Conclusions: The study shows that as high as 22.3% of term babies who are exclusively breast fed have iron deficiency between the ages of 3 and 5 months of age. It may be justified to recommend iron supplementation to this group of babies instead of 6 months as this will go a long way in preventing long term adverse health outcome.
Keywords: Anemia. Breastfeeding. Infants. Iron deficiency. Supplementation

I. INTRODUCTION

The World Health Organization recommends exclusive breast feeling to all babies for the first 6 months of their life and complementary feeds to be added thereafter (1). Breast feeding provides adequate nutrition for optimum growth during the first six months of life but WHO in the 54th World Health Assembly expressed concern that some of them may become iron deficient (2). Iron deficiency (ID) is associated with adverse psychomotor and cognitive development. Low intelligent quotient scores have been observed in iron deficient children even before the development of anemia (3, 4).

The infant's reserves of iron at birth play a major role in determining the risk for anemia during infancy because the iron concentration of human milk is low. (5)

The American Academy of Pediatrics (AAP) in 2010 recommended universal iron supplementation for term breastfed infants from 4 months of age (6). However the recommendations received criticism of being premature and based on limited evidence (7). Iron supplementation is recommended for low birth weight babies with a birth weight of less than 2.5 kg from 1 month of age as they have low iron stores but there is no universal recommendation for full term babies yet. The concern remains whether we are missing out these babies and are thereby contributing to a generation of children with low IQ and chronic anemia.
Hence this study is being carried out to evaluate prevalence of iron deficiency and iron deficiency anemia in exclusively breastfed infants who are healthy and weigh more than 2.5 kg.

II. MATERIALS AND METHODS

The study was cross-sectional and was conducted in the Well Baby Clinic of Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences, Kolkata from January 2018 to December 2019. The children were enrolled during their vaccination visits after taking informed

consent from their parents/guardians. The study was approved by the Institute's Ethics Committee.

The inclusion criteria were (a) Birth weight of >2.5 kg, (b) Term baby, (c)Appropriate for gestation, (d) Age from 3 months to 5 months (e) Exclusively breastfed, (f) Apparently healthy and afebrile

The Exclusion criteria were (a) Premature , small or large for gestational age (b)any apparent systemic illness (c)prior hospitalization for any illness (d) History of blood transfusion (e) intake of iron supplementation (f) any abnormality in blood counts like leucocytosis, leucopenia or thrombocytopenia. The inclusion and exclusion criteria were ascertained by history, examination and medical records.

Detail history was taken regarding the antenatal period, mother's socioeconomic status , intake of iron and folic acid tablets, her diet and her haemoglobin levels. Mode of delivery, any illness in the baby, birth weight and present weight were recorded. The baby was examined for any pallor, hepatosplenomegaly or any other systemic illness.

2 ml blood was obtained for complete blood count and serum ferritin. The sample was run on fully automated blood cell coulter(Beckmann Coulter, LH 750 Analyser)

Serum ferritin was estimated by immunometric enzyme assay by ELISA kit (Electrochemiluminosense Cobase601)

The normal values of haemoglobin, leucocyte and platelet count were referenced from Lanzkowsky's Manual of Pediatric Hematology and Oncology(8). The infants with leucopenia, leucocytosis, thrombocytopenia or with a peripheral smear suggesting an alternative diagnosis were excluded.

Iron deficiency (ID) was defined as per WHO guidelines as serum ferritin of <12µg/L and iron deficiency anemia (IDA) was defined as ID with a Hb of <10.5 g/dl (9).

III. STATISTICAL ANALYSIS

Statistical analysis was performed with help of R Studio R version 3.6.0 (2019-04-26) -- "Planting of a Tree", Copyright (C) 2019. The R Foundation for Statistical Computing Platform: x86_64-w64-mingw32/x64 (64-bit) Using this software , basic cross tabulation and frequency distributions were prepared . Chisquare test was used to test the significance of independence of attributes.$p \leq 0.05$ was considered statistically significant.

IV. RESULTS:

One hundred and fifty six infants were eligible for the study out of which 21 were lost to follow up and 30 refused. Blood was drawn from 105 patients out of which 5 were hemolysed, 8 were insufficient 16 had abnormal CBC. So final number of sample analysed were seventy six.

The clinical and laboratory data is presented in Table 1 and Table 2. The mean age of the babies was 4.1 month. There were 42 male and 32 female babies (male to female ratio was 1.3:1). The mean birth weight was 2.8 Kg. All the mothers were enrolled in the antenatal program and were receiving iron and folic acid tablets throughout their pregnancy regularly, except four mothers who were irregular. The mean maternal hemoglobin was 11.2gm/dl. According to modified Kuppuswamy scale 21 (27.6%) mothers belonged to the lower middle category while 55 (72.3%) were upper middle class.

None of the babies had any apparent congenital anomaly and their general and systemic examination was normal.

The mean haemoglobin was 10.7 g/dl (median: 11, SD 1.04). The mean ferritin level was 74.2µg/L (median: 80, SD 49.9) Table 3 shows that that iron deficiency was found in 17 out of 76 babies (22.3%) and iron deficiency anemia was found in 16 out of 76 (21.05%.)

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Table 1. Clinical and Laboratory data of the babies enrolled in the study

Different Variable Under Study	Mean	SD	Median	First Quartile	Third Quartile
Age_in_months	4.151316	0.5034530	4.00	4.000	4.500
Mother.s_HB_gms.dl	11.286842	1.0915850	11.05	10.675	12.000
Birth_Weight	2.862632	0.2519437	2.80	2.700	3.025
Present_Weight	5.780263	0.9238715	5.70	5.000	6.625
Baby.s_HB_gms.dl	10.763158	1.0458607	11.00	10.200	11.500
Baby.s_Ferritin_µL	74.223684	49.9200958	80.00	15.000	106.750
Baby.s_MCV_Iron_Defficiency_Meaure	77.955263	7.1226661	78.00	75.000	84.000

Table 2- Clinical and Laboratory parameters of the babies (n=76)

Different Categorical Variable Under Study	Values	p-values
Gender	Female : 32 ; Male : 44	----------
Mode_Of_Delivery	FTND : 35 LSCS : 41	----------
Mother.s_HB_gms.dl	Sufficient : 38 Defficient : 38	----------
Iron_Folic_Acid_Intake	Irregular : 4 Yes : 72	----------
Socio_Economic_Status	Lower Middler Class : 21 Upper Middle Class : 55	----------
Diet_Of_mother	Non Veg : 69 Veg : 7	----------
Baby.s_HB_gms.dl	Sufficient : 53 Defficient : 23	0.0005791
Baby.s_Ferritin_µL	Sufficient : 59 Defficient : 17	1.452e-06
Baby.s_MCV	Sufficient : 55 Defficient : 21	9.617e-05

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Table 3 -Frequency of iron deficiency

Total No	No of babies with Iron deficiency (ID)	No of babies with iron deficiency anemia (IDA)
76	17 (22.3%)	16 (21.05%)

V. DISCUSSION

Anemia is a major public health problem that affects mainly children, predominantly in low-income countries and is most often due to iron deficiency. (10) Iron deficiency is one of the most common nutritional deficiencies in the world. (11) Iron is required for basic cellular function and plays a very important role in brain, muscles and red blood cells. Iron deficiency can cause neurodegerative changes even before it causes anemia and may have a long term implication in the developing brain.

In our study all the mothers were of middle socio economic background and were receiving regular antenatal check up with iron and folic acid tablets and a good diet. The babies were born at term with a weight of more than 2.5 kg and were growing well on exclusively breast milk. Infants with leucocytosis, leucopenia, thrombocytopenia and abnormal peripheral smear suggestive of an alternative diagnosis were excluded.

The WHO estimates that 27% of preschool children have iron deficiency anemia (12). The prevalence of iron deficiency in infants less than 6 months have not been adequately evaluated despite being quite common. Selected studies on iron deficiency and iron deficiency anemia in this age group have been summarised in Table 4. Several studies have suggested that iron deficiency is quite common in this group of babies. As per the National Iron Plus Initiative, iron supplementation is recommended from 6 months of age and we may be missing out these babies who may have long term health problems (13).

Full-term healthy babies receive enough iron from their mothers in the third trimester of pregnancy to last for the first four months of life. Hence American Academy of Pediatrics recommends iron supplementation to all healthy full term infants from 4 months of age instead of 6 months(14).

Table 4. Selected studies on iron deficiency and iron deficiency anemia in infants < 6 months

Sl no	Country, year of Publication, Reference	Age (months)	N	Prevalence of iron deficiency (%)	Prevalence of iron deficiency anemia (%)	Remarks	
1	Turkey (2000) (15)	4	116	19.8	9.5	Study recommends iron supplementation from 4 months of age	
2	Benin (Africa) (2007) (16)	4	252		42	Study recommends iron supplementation from 3 months of age	
3	Germany (2010) (17)	4	53	6	nil	Study recommends iron from 4 to 6 months of age	
4	Peru (2013) (18)	5-6	59	28.6	24.5	2-5 month old exclusively breastfed infants at risk for iron deficiency	
5	Delhi (India)	3	76	11.8		Another Indian	

	(2014) (19)					study demonstrating iron deficiency in < 6months	
6	Chandigarh(India) (2017) (20)	3-5	215	14.9	8.4	Largest study showing iron deficiency in less than 6 month old, term healthy babies	

It is surprising to note that iron supplementation is recommended at 4 months of age in USA, while the same is not followed in many other developing countries. Maybe the reason for this is that enough studies have not been undertaken regarding the prevalence of iron deficiency in babies less than 6 months. In the index study iron deficiency was found in 22.3% and iron deficiency anemia was found in 21.05%.

The limitation of the study was the sample size was small as many mothers were reluctant to undertake an invasive procedure. And also, as it was a hospital based study it did not represent the community at large. The haemoglobin electrophoresis was not done to exclude Beta Thalassemia trait and C reactive protein was not assessed to rule out falsely elevated serum Ferritin.

VI. CONCLUSION

Considering the detrimental effects of low iron on developing brain, a prevalence of 22.3% of iron deficiency in 3 to 5 month old healthy infants is concerning. It is crucial to run similar trials with a larger sample size and if similar results are achieved then it will be reasonable to recommend iron supplementation from 4 months of age instead of the current 6 months.

Contributions- SB, SK and NG enrolled the children, collected and analysed the data: SB drafted the manuscript and supervised the study. All authors approved the final manuscript. SB will act as the guarantor for the paper.

Compliance with Ethical Standards

Conflict of interest None

Source of Funding None

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