Niger J Paed 2014; 41 (2):129 –132

ORIGINAL

Ekwochi U
Osuorah DIC
Odetunde OI
Egbonu I
Ezechukwu CC

Prevalence of iron deficiency anaemia in anaemic under-5 children in Enugu South East Nigeria

DOI:http://dx.doi.org/10.4314/njp.v41i2,10
Accepted: 12th October 2013

Ekwochi U (✉)
Department of Paediatrics,
Enugu State University Teaching Hospital,
Enugu, Nigeria.
Email: uekwochi@yahoo.co.uk
Tel: +2348034317785

Osuorah DIC
Child Survival Unit
Medical Research Council UK, The Gambia Unit

Odetunde OI
Department of Pediatrics,
University of Nigeria Enugu Campus Nigeria.

Egbonu I, Ezechukwu CC
Department of Pediatrics,
Nnamdi Azikiwe University Teaching Hospital,
Nnewi, Anambra State

Abstract: *Background:* Iron deficiency anaemia has been described as the commonest type of nutritional anaemia in infancy and childhood. The associated adverse health sequelae include permanent behavioural and cognitive impairments. Early detection and prompt treatment are necessary to prevent these complications.
Aim: To determine the prevalence and socio-demographic distribution of iron deficiency anaemia among anaemic under five children in Enugu.
Subjects and methods: Under-five children presenting at a tertiary hospital were consecutively enrolled and screened for iron deficiency anaemia using haematocrit and serum ferritin levels. Iron deficiency anaemia was defined as haematocrit level <30% and ferritin level <12ng/ml.
Results: Three hundred and twelve children (187 males, 125 females) aged below 60 months had a PCV check out of which 178 (57.1%) were anaemic (PCV< 30%). Of the anaemic group, 61(34.3%) had iron deficiency anaemia. Prevalence of iron deficiency anaemia was higher among the males (38.0%) [*p*=0.235], age group 13-23months (40.0%)[*p*=0.575] and children from lower socioeconomic class (43.5%)[*p*=0.158]. There is a positive but weak correlation between serum ferritin and haematocrit levels [r= 0.11 *p*=0.130].
Conclusion: The prevalence of iron deficiency anaemia in the study population was high and varies with the child's age group, gender and parental socioeconomic class.

Keywords: iron deficiency anaemia, serum ferritin, haemtocrit, Enugu.

Introduction

Anaemia is a common clinical problem encountered among the under-fives in everyday paediatric practice. Iron deficiency has been documented as the commonest cause of nutritional anaemia worldwide [1-4]. Prevalence of iron deficiency anaemia varies between countries, affecting 5.4% children in Spain, 30.8% and 22.3% under-five children in Brazil and Nigeria respectively [5,6,7]. Among the several parameters of iron homeostasis, serum ferritin, being a major form in which iron is stored in the body, and which easily shows changes in body iron storage, has been favoured by many authors as the single best blood test for diagnosis of iron deficiency [8-11.]. A study has documented that serum ferritin of less than 60 ng /ml had a positive likelihood ratio of 24.35, sensitivity of 69.5%, specificity of 97.1% and a positive predictive value of 94.1% while an iron saturation of less than 7% had a positive likelihood ratio of 21.62, sensitivity of 44.1%, specificity of 98.0% and positive predictive value of 93.8%. It was concluded that serum ferritin is the best marker for predicting iron deficiency, followed by percentage saturation [8]. According to WHO, serum ferritin level below 12ng/ml is the generally accepted cut- off level at which iron stores are considered depleted [12]

Iron deficiency anaemia is associated with adverse health sequelae including permanent behavioural and cognitive impairments [13, 14]. Therefore, early detection and prompt treatment are necessary to prevent these complications. However, not all childhood anaemia is due to iron deficiency, and empirical iron therapy in all anaemic patients in whom iron deficiency has not been documented could lead to iron toxicity, it therefore becomes imperative to document the prevalence of iron deficiency among the anaemic population, hence, justifying the aim of the current study.

Subjects and methods

This was a prospective and analytical study which was carried out at the Enugu State University Teaching

Hospital, (ESUTH) from December 2009 to June 2010. ESUTH is a tertiary health facility situated in the Enugu Metropolis. ESUTH serves as a referral centre for the primary and secondary health facilities in Enugu state and environs. Enugu State is in the South-East geopolitical zone of Nigeria and has a population of 3.5 million people, according to the National Population Census of 2006 [15]. The study population was children aged 2-59months presenting in Children's Emergency Room (CHER) and Children Outpatient (CHOP) unit of the Department of Paediatrics. Patients aged 3-59months were consecutively selected. The haematocrit of identified subjects was done and those with values below 30% were recruited into the study while those not anaemic (haematocrit 30% and above) were dropped. Information on personal data (age, sex, residential address and phone number of parents) was obtained from caregivers. The socioeconomic class of the parents was determined in accordance with the method described by Olusanya, Okpere and Ezimokhai [16]. Serum from 2ml of venous blood was stored at -20^{o}c -0^{o}c in a freezer in the Chemical Pathology laboratory until analysis for ferritin. Serum ferritin analysis was carried out in batches every three. The haematocrit was done using capillary blood from a finger prick.

Laboratory methods for serum ferritin estimation

The assay system (Human Ferritin Enzyme Immunoassay Test Kit) manufactured by Diagnostic Automation/ Cortez Diagnostics, Inc. California, USA, utilizes one anti-ferritin antibody for solid phase (microtitre wells) immobilization and another mouse monoclonal anti – ferritin antibody in the antibody–enzyme (horseradish peroxidase) conjugate solution. The test sample was allowed to react simultaneously with the antibodies, resulting in the ferritin molecule being sandwiched between the solid phase and enzyme linked antibodies. After 60mins incubation at room temperature, the wells were washed with water to remove unbound labeled antibodies. A solution of TMB was added and incubated for 20mins resulting in the development of blue colour. The colour development was stopped with the addition of 2N HCL and the colour was changed to yellow and measured spectrophotometrically at 450nm. The concentration of ferritin is directly proportional to the colour intensity of the test sample.

Ethical clearance

Ethical clearance was obtained from the Ethics Committee of the hospital. Informed consent was obtained from parents or caregivers of the patients.

Data management and analysis

Data were collected from the proforma and stored in a Microsoft Excel file and later transferred to Statistical Package for Social Sciences (SPSS, version 15, Chicago IL, USA) for analysis. The study population was categorized into three age groups; 3months -12months, 13months -23months and 24months - 59months.

Iron deficiency anaemia was defined as serum ferritin level of <12ng/ml plus haematocrit level of <30% [1917]. The results were analyzed by simple frequency count, percentage and proportion and out-laid in tables and scatter plots as deemed necessary. Chi-square tests were employed for test of significance in each of the characteristics of the population at $p \leq 0.05$.

Results

Three hundred and twelve children (187 males, 125 females) aged below 60 months had a PCV check out of which 178 (57.1%) were anaemic (PCV< 30%).
Of the anaemic group, 100 (56.2%) were males and 78 (43.8%) were females. Sixty-five (36.0%) were aged 3-12months, 45 (25.3%) between 13 and 23 months and 68(38.8%) aged 24 months or more. Children from lower, middle and upper socio-economic class accounted for 62(34.8%), 56(31.5%) and 60(34.8%) respectively (table 1).

Table 1: Socio-demographic distribution of children with anaemia

Variable	Proportion N=178	PCV% Mean ± SD (Range)	Serum ferritin ng/dl Mean ± SD (Range)
Sex			
Male	100 (56.2)	23.44± 5.69 (8, 29)	76.80 ± 120.63 (0.50, 531.3)
Female	78 (43.5)	23.13 ± 5.11 (10, 29)	77.97 ± 107.76 (0.80, 473.0)
Age category			
3- 12 months	65 (36.0)	25.09 ± 4.60 (12, 29)	62.44 ± 84.39 (0.5, 467.0)
12- 23 months	45 (25.3)	22.64 ± 4.84 (12, 29)	75.86 ± 113.62 (1.2, 468.0)
24-59 months	68 (38.8)	22.08 ± 6.02 (8, 29)	92.17 ± 137.67 (0.8, 531.3)
Socioeconomic class			
Upper	56 (31.5)	23.90 ± 5.38 (8, 29)	62.62± 87.71 (0.8, 443.9)
Middle	60 (33.7)	23.70± 5.10 (10, 29)	83.23±126.48 (0.8, 531.3)
Lower	62 (34.8)	23.23± 5.59 (10, 29)	83.17±125.11 (0.5, 473.0)

PCV- Pack cell volume, SD- Standard deviation, Range (min, max value)

The mean serum ferritin and PCV level for the anaemic subjects stratified by their iron status is shown in table 2.

Table 2: Serum ferritin level and packed cell volume of the study population.

Variable	Mean ± SD	Max.	Min.	Range	t (p)
Serum ferritin ng/dl					45.2(0.001)
Iron deficient	5.7±3.8	11.8	0.8	11.3	
Non iron deficient	114.7±126.5	531.0	12.4	518.9	
Pack cell volume					4.3(0.04)
Iron deficient	22.2±5.7	29.0	10.0	19.0	
Non iron deficient	23.9±5.2	29.0	8.0	21.0	

SD- Standard deviation, t- independent sample t test

Sixty-one (34.3%) out of the 178 anaemic children surveyed were iron deficient. Table 3 shows the sociodemographic distribution of the children with iron deficiency anaemia.

Table 3: Socio-demographic distribution of children with iron deficiency anaemia

Variables	Iron deficiency anaemia		χ^2 (p)
	Yes	No	
Sex			
Male (n = 100)	38(38.0)	62(62.0)	1.41(0.235)
Female (n = 78)	23(29.5)	55(70.5)	
Age category			
3-12 months (n =65)	22(34.4)	42(65.6)	1.11(0.575)
13-23 months (n =45)	18(40.0)	27(60.0)	
24-59 months (n =68)	21(30.4)	48(69.6)	
Upper (n =56)	17(30.4)	39(69.6)	3.69(0.158)
Middle (n= 60)	17(28.3)	43(71.7)	
Lower (n= 62)	27(43.5)	35(56.5)	

Discussion

In this study the prevalence of iron deficiency among the anemic under-five children was 34.3%. The prevalence was higher in males, age group 13-23months and children of low socioeconomic parents though the variation in these demographic groups was not statistically significant. There was no available local study specifically documenting the prevalence of iron deficiency in anaemic under-five population with which to compare the prevalence value in this study. However, such a high prevalence rate was expected as iron deficiency has long been documented as the commonest cause of anaemia in childhood [18, 19]. A study in Imo state Nigeria, has document even a higher prevalence (48.1%) among under fives [20], this study like the current study employed ferritin as the only indices for iron status , however, their studied subjects were not limited to anaemic patients like in the current study.

The mean serum ferritin level of the iron deficient anaemic subjects (5.69 ± 3.8ng/dl) in this study was lower than 50.6 ± 52.6ng/dl documented by earlier authors in apparently healthy under-five children in Port Harcourt [11]. This was not surprising as the latter study was on apparently healthy children who supposedly will have adequate micronutrient level including iron and hence a higher ferritin level compared to anaemic population in this study. For similar reason, earlier researchers documented a lower prevalence of IDA among apparently healthy infants [21] compared to the prevalence documented on anaemic infants in the current study. Iron deficiency anaemia was observed to be more prevalent among the age group 13-23months compared to the other age groups. This is in consonance with the findings of previous researchers [22,23], who reported that severe iron deficiency anaemia usually affects children during their second year of life. Higher prevalence of iron deficiency anaemia in this age group could be attributed to increased iron requirements related to rapid growth in this age group. There was no significant gender difference in the prevalence of iron deficiency anaemia in the current study (p = 0.235). A similar finding has been documented by other authors [11]. Menstrual loss and pregnancy which are the major factors accountable for gender disparity in the prevalence of iron deficiency are not implicated in this study age groups.

Although the observed progressive increase in the prevalence of iron deficiency anaemia from upper to lower socioeconomic class in the current study was not significant, other studies have documented a higher prevalence of IDA among the children of lower socioeconomic group [24,25]. Some earlier researchers in particular, have reported that iron deficiency anaemia is three times more prevalent in the low income-families than those living above the poverty level [26,27]. The reason for such trend is obvious as the lower socioeconomic groups due to financial constraints and ignorance may not be able to provide the recommended daily allowance for iron in their children's diets resulting in deficiency.

Conclusion

There is a high prevalence of iron deficiency anaemia among anaemic under-five children in Enugu. This prevalence however, did not significantly vary with, sex, age-group or their parental socio-economic class.

Limitations

Due to limited access to facilities the authors could not carry-out concomitant blood cultures to rule out presence of in infection in the subject. Also for similar reason, we could not carry out other iron parameters in addition to ferritin level on the studied subjects. However, we recommend that future researches involving ferritin in infection prone environment should rule out presence of infection in the subjects.

Author's Contributions
EU : Designed the study, data collection
OOI : Introductory text.
ODIC: Statistical analysis, wrote results section and the abstract of the study.
EU, OOI and ODIC : Discussion
IE and CE Manuscript review.

Conflict of interest: None
Funding: None

Acknowledgement

The authors are thankful to the medical and nursing staff of the Paediatrics department of ESUTH, Park Lane, Enugu for their assistance during the sample collection in this study.

References

1. Kasili EG. Malnutrition and infections as causes of childhood anaemia in tropical Africa. *Am J Paediatr, Hematol Oncol. 1990; 12: 375 – 7.*
2. Bertil G. The Anaemias. In Berhrman RE, Klahman RM, Jeson HB, editors. Nelson textbook of Paediatrics. 17th ed. Philadelphia: Saudders; 2004:1614 – 1616.
3. Premji Z, Hamisi Y, Shiff C, Minjas, Lubeja P, Makwaya C. Anaemia and Plasmodium falciparum infection among young children in an holoendemic area, Bagamoyo, Tanzania. *Acta Trop 1995; 1:55 – 64.*
4. Fleming AF. Iron deficiency in the Tropics. *Clin Haematol 1982; 11: 365 – 88.*
5. Munoz PMA, Garcia VC, Galve RF, Fortea GE. Is general screening for anaemia and non deficiency justified in nursing infants? *Aten Primaria, 1995; 15: 446 – 8.*
6. Vieira AC, Diniz AS, Cabral PC, Oliveira RS, Lola MM, Sila SM, et al. Nutritional assessment of Iron status and anaemia in children under 5 years old at public day care centres. *J Pediatr 2008; 84 – 97.*
7. Maziya–Dixon B, Sanusi RA, Akinyele IO, Oguntona EB, Harris FW. 2004. Iron Status of children under 5 in Nigeria: Result of the Nigeria food consumption and nutrition survey. In: proceedings of Iron Deficiency in Early life and challenges and progress. 2004, Lima, Peru. 98
8. Choi CW, Cho WR, Park KH, Choi IK, Seo JH, Klim BS. The cut off value of serum ferritin for the diagnosis of iron deficiency in a community. *Ann Hematol 2005; 84:358 – 61. 78.*
9. Mansour MM, Francis WM, Farid Z. Prevalence of latent iron deficiency in patients with chronic S. Mansoni infection. *Trop Geogr Med 1985; 37:124 – 8.*
10. Ong KH, Tan HL, Lai HC, Kuperan P. Accuracy of various iron parameters in the prediction of iron deficiency in an acute care hospital. *Ann Akad Med Singapore 2005; 34:437 – 40.*
11. Jeremiah ZA, Buseri FI, Uko EK. Iron deficiency anaemia and evaluation of the utility of Iron deficiency indicators among healthy Nigerian children. *Hematology. 2007; 12: 249 – 53.*
12. WHO. Iron deficiency anaemia: assessment, prevention and control. A guide for programme manager. (UNICEF, UNU, WHO) 2001, pp 38
13. Granthan-McGregor S, Ani C. A review of studies on the effect of iron deficiency on cognitive development in children. *j Nutr 2001; 131:649-68*
14 Politt E. Iron deficiency and cognitive function. *Ann Rev Nutr 1993; 13:521-37*
15 National Population Commission:2006 provisional census figures. Census news 31:14
16. Olusanya O, Okpere E, Ezimokhai M. The importance of social class in voluntary fertility control in a developing country. *W Afr J. Med 1985; 4:205-12.*
17. Emodi I. The Anaemias.In: Azubuike JC, Nkangineme KEO,editors. Paediatrics and Child Health in a Tropical Region 2nd ed. Owerri, Nigeria: African Educational Services;2007:355-63.
18. Iron deficiency anaemia- children: Available from http:// www.nlm.nihi.gov/medlineplus/ ency/article/007134.html. [last accessed on 2013 october 24}
19. Anaemia in children. available from www.utoronto.ca/kids/ anaemia html. [last accessed 2013 october 24].
20. Onyemabi GA, Onimawo I A, Uwaegbute, CA. Prevalence of iron deficiency anaemia among underfive children in Imo state. *Aust. J. of Basic &Appl. Sci 2011;5:122-126.*
21. Akinkugbe FM, Ette ST, Duruwoju A. Iron deficiency anaemia in Nigeria infants. *Afr J Med, Sci. 1999; 28:25 – 9.*
22. Siellinga–Boelen AA, Storm H, Weigersma PA, Bijleved CM. Iron deficiency among children of asylum seekers in the Netherland. *J Pediatr Gastroentenol Nutr 2007; 45: 591 – 5.*
23. Sherriff A, Emond A, Hawkins N, Golding J. the ALSPAC Children in Focus Study Team. Haemoglobin and ferritin concentrations in children aged 12 and 18 months. *Arch. Dis. Child. 1999; 80:153.*
24. Male C, Persson LA, Freeman V, Guerra A, van't Hof MA, Haschke F. Prevalence of iron deficiency in 12-mo-old infants from 11 European areas and influence of dietary factors on iron status (Euro-Growth study). *Acta Paediatr. 2001;90:492-8.*
25. Gregory JR, Collins DL, Davies PSW, Hughes JM, Clarke PC. Nutritional diet and nutritional survey: Children aged 1½ to 4½ years. Vol I: Report of the Diet and Nutritional Survey. London: HMSO, 1995;
26. Kazal L.A Jr. Failure of hematocrit to detect iron deficiency in infants. *J Fam Pract 1996; 42:237 – 40. 51.*
27. Leblanc CP, Rioux FM. Iron deficiency anaemia following prenatal nutrition intervention. *Can J. Diet Pract Res. 2007; 68: 222 – 5.*