Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Medical Laboratory Science

Haematological Indices and Serum Ferritin as Diagnostic Tools for Anaemia among Village Primary Pupils in Kaduna state, Nigeria

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DOI: 10.36347/sjams.2022.v10i10.037 | **Received:** 11.09.2022 | **Accepted:** 19.10.2022 | **Published:** 29.10.2022

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Abstract **Original Research Article**

Background: Anaemia is one of the major public health issues worldwide. Children in the developing world are vulnerable to iron deficiency anaemia (IDA) and iron deficiency (ID) because they are rising at a fast pace and consume diets low in iron. This study aims at assessing the level of anaemia in children aged 6-12years in rural Nigeria, using hematological indices and serum ferritin as diagnostic tools. ***Methods:*** This is a cross-sectional study carried out in two primary schools in Kumin Masara Kataf village in Kaduna state on schoolchildren aged 6-12years. Data collected include personal information and laboratory data such as haemoglobin content, and serum ferritin to determine iron status. Data analysis was done using IBM-SPSS Inc., Chicago, IL, USA version-25.0. ***Results:*** The overall mean haemoglobin was 10.11±1.02g/dl with 10.37±0.97g/dl and 10.02±1.02g/dl for children aged 10-12 and 6-9 years respectively (p=0.033). The overall serum ferritin was 15.37±4.87mg/L with 17.20±5.23mg/L among subjects aged 10- 12 and 14.72±4.58mg/L for 6-9 years (p=0.002). The prevalence of anaemia was 13.6%, IDA (50.3%), ID (30.9%), and iron depletion (5.8%). There was a significant difference between the prevalence of iron status according to age group (6- 9vs.10-12), P<0.05. Males had a higher prevalence of anaemia (69.2%) than females but females recorded a higher prevalence of IDA (51.6%) and ID (61.0%). ***Conclusion:*** This study found a high prevalence of IDA and ID among the rural schoolchildren in Nigeria. We recommend that healthcare providers should focus more on prevention of IDA at childhood rather than during pregnancy.

Keywords: Iron deficiency, Anaemia, Pregnancy, Mean Haemoglobin.

INTRODUCTION

Anaemia is one of the major public health issues across the world. According to the World Health Organization (WHO, 2011) [1], children and non-pregnant women have the highest prevalence of anaemia worldwide and accounted for 42.6% and 29.0% respectively. Anaemia is defined as a condition in which the number of red blood cells (RBC) or the haemoglobin (Hb) concentration are lower than normal and inadequate to meet the physiological needs of an individual. Haemoglobin is required to transport oxygen in the body system but if the RBC is abnormal or too few, or haemoglobin is not sufficient, it will be difficult for blood to transport oxygen to the body tissues [2]. This usually leads to symptoms such as fatigue, weakness, dizziness, shortness of breath etc. [2].

The most common micronutrient deficiency and the most common cause of anaemia worldwide is iron deficiency [3]. Children in the developing world are highly vulnerable to ID because they are rising at a fast pace and they consume a diet low in iron. (WHO, 2011) [1]. Africa and Asia have extreme public health significance of anaemia with an estimated 67.6% of children below five years suffering from anaemia in Africa and 65.5% in Southeast Asia 18i. The results of studies on the prevalence of anaemia among Nigeria children vary. A recent data from Nigeria Demographic and Health Surveys showed that 67.01% of children aged 6-59 months were anemic whereas a study conducted in rural Nigeria among school children aged 6-15 years found a higher prevalence of 85.5% [4]. Another study conducted in South-East Nigeria found a

prevalence of 49.2% among children below five years old. Among 87 pre- school children in Lagos, South-West Nigeria, the prevalence of iron deficiency anaemia was reported as 10.11% [5].

Iron depletion in the body occurs in three major stages. The first stage is iron depletion which is also referred to as "decrease of iron stores" and can be by insufficient serum ferritin concentration [6]. The second stage is referred to as iron deficiency when the absorption of iron to the body is insufficient due to depletion in iron storage; this also implies that the haemoglobin concentration reduces due to impaired synthesis. This can be determined from a decrease in serum ferritin, mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) [5, 7]. The third stage and the most severe of all the three stages is iron deficiency anaemia, which is a reduction of iron in the red blood cells. This stage can also be measured by a reduction in serum ferritin, MCV, MCH and Hb levels [8].

Studies revealed that even if it is present early in childhood, iron deficiency can affect motor and cognitive skills and can lead irreversible behavior disorder in children [9]. Iron deficiency anaemia (IDA) in children often has detrimental effects on physical, social, and cognitive capacities and performance [10]. Screening and detection of ID and IDA in childhood are very important, particularly the areas where there is a high rate of malnutrition. However, studies on the prevalence of IDA in school children are still limited in the northern villages [11]. This study aims to haematological indices and serum ferritin as a diagnostic tool for anaemia among village primary school pupils in Kummin Masara Kataf village in Kaduna state, Nigeria.

METHODOLOGY

The study was carried out among primary school children in Masara Kataf village in Kaduna state, Nigeria. This is a cross-sectional study carried out from February to August 2020. The study population comprised primary school pupils from two schools situated rural areas of Masara Kataf village in Kaduna state, Nigeria. The school-age children involved males and female pupils aged 6 - 15 years. A total of 191 school-ages were recruited as the study participants. Children with haematological problems (infection, inflammation, malignancy) or chronic diseases that could have significant effects on the analyzed parameters were excluded from the study. Also children with a history of blood transfusion within three months before the study, those who received iron therapy or had high-sensitivity C-reactive protein were excluded. In data collection, five millilitres of venous blood samples were collected from each child after taking their history. Iron deficiency anaemia (IDA) was by the WHO standards of a low haemoglobin concentration based on age: Hb < 11.5 for 6-9 and 12.0 g/dL for 10-12 years [10], 221 with ferritin <15 mg/L. Iron deficiency (ID) without anaemia is described as normal Hb according to age ferritin <15 mg/L110.231 while Iron depletion - serum ferritin (SF) 15 - <20mg/L. Anaemia was classified into Haemoglobin (g/dl) Normal (>11.5/12.0), Mild anaemia (10.0- 11.4/11.9), Moderate anaemia (7.0-9.9), and Severe anaemia (<7. 0).In statistical analysis ,data were analysed using IBM- Statistical Package for the Social Sciences (SPSS) version 25.0 for Windows. The Chi-square test was used to establish the association between categorical variables. Independent T-Test was carried out to for mean values comparison of two groups, and the ANOVA test was done to compare mean values of three or more groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study comprised 191 schoolchildren from two primary schools with age range 6 - 12 years. The mean age of the study subjects was 9.4± 2.8 years. The study subjects comprised 95 (49.7%) males and 96 (50.3%) females with 141 (73.8%) within the age group 6 — 9 years, 50 (26.2%) were between 10 — 12 years. The mean haemoglobin among the study subjects was 10.11±1.02 g/dl among children aged 6-12 years with 10.37±0.97 g/dl and 10.01+1.02 g/dl for children aged 10 — 12 years and 6 — 9 years respectively (P = 0.033). The overall serum ferritin was 15.37+4.87 mg/L and subjects aged 10 — 12 years had significantly higher serum ferritin of 17.20±5.23 mg/L as compared to 14.72±4.58 mg/L for subjects aged 6 — 9 years (p = 0 0.002). A total of six (3.4%) of the children had normal iron status, 95 (50.3%) had IDA, 59 (30.9%) had ID, and 11 (5.8%) subjects had iron depletion. We found significance between the prevalence of iron status according to age group (6 — 9 and 10 - 12) except for iron deficiency as shown in Table 1.

Table 1: Iron status in primary school pupils according to age group

Stage	6-9 years (n=141)	10-12 years (n=50)	Total (n=191)	P-value
Haemoglobin	10.02±1.02	10.37±0.97	10.11±1.02	0.033*
Serum ferritin	14.72±4.58	17.20±5.23	15.37±4.87	0.002*
Normal	1(16.7)	5(83.3)	6(3.4)	0.001*
Anaemia	15(57.7)	11(42.3)	26(13.6)	0.044*
IDA	78(82.1)	17(19.9)	95(50.3)	0.010*
Iron deficiency	44(74.6)	15(25.4)	59(30.9)	0.874
Iron depleted	4(36.4)	7(63.6)	11(5.8)	0.004*

We did not find any significant haemoglobin and serum ferritin difference between males and females (P>0.05). However, males have a higher prevalence of anaemia (69.2%) than females (30.8%). The prevalence of IDA (51.6%) and ID (61.0%) was higher in the female population but the prevalence of iron depletion was higher among males (72.7%).

Table 2: Iron status in primary school pupils according to gender

Stage	Males(n=95)	Females(n=96)	Total (n=191)	P-value
Haemoglobin	10.05±1.02	10.17±1.02	10.11±1.02	0.436
Serum ferritin	15.89±5.31	14.84±4.36	15.37±4.87	0.136
Normal	3(50.0)	3(50.0)	6(3.4)	0.990
Anaemia	18(69.2)	8(30.8)	26(13.6)	0.032*
IDA	46(48.4)	49(51.6)	95(50.3)	0.717
Iron deficiency	23(39.0)	36(61.0)	59(30.9)	0.047
Iron depleted	8(72.7)	3(27.3)	11(5.8)	0.116

DISCUSSION

The overall prevalence of anaemia in this study was 13.6%. This value is lower than Nigeria Demographic and Health Surveys report that 67.01% [1, 9] and some previous studies conducted in Nigeria among school children aged 6- 15 years (85.5%) [1, 10], 49.2% among children below five year's old but but higher. The prevalence of 10.11% seen in Lagos State [1, 11]. Anaemia remains a common health challenge in developing countries like Nigeria and affected about 27.0% of the world population in 2013, 42.6% children and 29.0% non-pregnant women in 2015. Comparing the prevalence of anaemia in this study with other developing countries, the prevalence found in this study is similar to 13.0% that was obtained in a similar study in Indonesia, 11.8% among 6 months old in Beijing China but lower than 30.61% found in Chittagong, Bangladesh 1253, 66.6% among children 6-23 Months old in Northeast Ethiopia, and 18.7% in Pakistan.

The overall prevalence of IDA in this study was 50.3%, ID was 30.9%, and iron depletion was 5.8% as factors associated with anaemia though the study only assessed iron deficiency as a cause of anaemia while other factors such as malaria, thalassemia trait, gastritis and duodenitis were not considered. Although iron deficiency has been proven to be the most common cause of anaemia, other studies have associated these other factors as significantly associated with anaemia.

This study was conducted in the village among schoolchildren with low-socioeconomic status. Studies have established that low socio-economic is a risk factor of ID and IDA.

Before the development of anaemia, the three stages of iron deficiency include iron depletion, iron deficiency without anaemia (ID), and iron deficiency with anaemia. Early detection of ID to prevent unwanted complications is very vital since all these stages can lead to permanent problems, particularly to growth and development. ID and IDA were higher among females than males and children between 6-9 years old. Studies have shown that girls, particularly the adolescent girls were more prone to iron deficiency anaemia because, unlike male children, they experience menstruation which causes loss of iron. The higher IDA and ID found among children aged 6 -9 years in this study may be due to there were more subjects in this age group than in age group 10 — 12years (141 vs. 50). Intake of iron supplements in pregnancy can no longer prevent IDA because of insufficient iron storage in the body during pregnancy.

CONCLUSION

This study found a high prevalence of IDA and ID among primary school children in rural Masara Kataf village of Kaduna State, Nigeria. It is therefore advised that health care providers, particularly at primary health care centres should focus more on prevention of IDA at childhood and adolescence rather than during pregnancy. We also recommend giving daily iron supplementation as directed by the World Health Organization to children aged 5 — 12 years in areas with a prevalence of anaemia or two times a week for three months consecutively to children aged 6 — 12 years in Nigeria as it is in some other countries such as Indonesia.

The limitation of this study is that other causes of anaemia apart from the iron deficiency and haemoglobin levels were not assessed. Besides, the study was conducted in a rural area among children of low socioeconomic status only. There may be a need for further studies to compare children of high socioeconomic status with low status or to compare children aged 6-12 years and the adolescents up to 18 years.

REFERENCES

1. WHO. *The global prevalence of anaemia in 2011* [Internet]. Geneva: 2015. Available from: https://www.who.int/health-topics/anaemiditab—tab_1
2. Chaparro, C. M., & Suchdev, P. S. (2019). Anaemia epidemiology, pathophysiology, and

aetiology in low- and middle-income countries. *Ann N Y Acad Sci*, 1450(1), 15-31.

3. Andriastuti, M., Adiwidjaja, M., & Satari, H. I. (2019). Diagnosis of iron deficiency and iron-deficiency anaemia with reticulocyte haemoglobin content among children aged 6-18 years. *Iran J Blood Cancer*, 11(4), 127-32.
4. Lopez, A., Cacoub, P., Macdougall, I. C., & Peyrin-Biroulet, L. (2016). Iron deficiency anaemia. *Lancet*, 387(10021), 907-16.
5. Domellöf, M., Braegger, C., Campoy, C., Colomb, V., Decsi, T., Fewtrell, M., ... & van Goudoever, J. (2014). Iron requirements of infants and toddlers. *Journal of pediatric gastroenterology and nutrition*, *58*(1), 119-129.
6. Baker, R. D., Greer, F. R., Bhatia, J. J., Abrams, S. A., Daniels, S. R., Schneider, M. B., ... & Burrowes, D. L. (2010). Clinical Report-Diagnosis and prevention of iron deficiency and iron-deficiency anemia in infants and young children (0-3 years of age). *Pediatrics*, *126*(5), 1040-1050.
7. Rothman, M., Faber, M., Covic, N., Matsungo, T. M., Cockeran, M., Kvalsvig, J. D., & Smuts, C. M. (2018). Infant development at the age of 6 months in relation to feeding practices, Iron status, and growth in a peri-urban community of South Africa. *Nutrients*, *10*(1), 73.
8. Ayogu, R. N., Okafor, A. M., & Ene-Obong, H. N. (2015). Iron status of schoolchildren (6–15 years) and associated factors in rural Nigeria. *Food & nutrition research*, *59*(1), 26223.
9. Akodu, O. S., Disu, E. A., Njokanma, O. F., & Kehinde, O. A. (2016). Iron deficiency anaemia among apparently healthy pre-school children in Lagos, Nigeria. *African health sciences*, *16*(1), 61-68.
10. Ahmad, M. S., Farooq, H., Maham, S. N., Qayyum, Z., Waheed, A., & Nasir, W. (2018). Frequency of anemia and iron deficiency among children starting first year of school life and their association with weight and height. *Anemia*, *2018*(2).
11. Kazmi, A., Mansoor, R., Almani, M. I. K., & Zafar, H. (2017). Estimation of serum ferritin level to detect iron deficiency anemia in children less than 5 years of age. *Journal of Islamabad Medical & Dental College*, *6*(4), 259-262.