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Degree of Iron Deficiency Anaemia in Anaemic Hospitalised Patients in Osogbo, South – West, Nigeria

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Abstract Iron deficiency anaemia in moderate to severely anaemic hospitalised patients was carried out in Osogbo metropolis, with the aim of determining the degree of iron deficiency anaemia in the study population. One hundred confirmed anaemic and recently un-transfused patients with haemoglobin concentration level less than 8 g/dL were selected from two major hospitals in Osogbo. Participants were within aged 6 months – 65 years of both sexes. The parameters estimated were haematological indices using automation (Humancount machine). Serum iron and ferritin were also estimated using Atomic Absorption Spectrophotometry, blood film was made for every patient and stained using Leishman technique. Out of 100 anaemic patients who participated in this study; 30 were children while 70 were adults, age group 0-15 and 16-30 had prevalence of 30 and 38 respectively. Based on the parameter analyzed, 73 were diagnosed to be iron deficient with anaemia, remaining 27 were due to other causes of anaemia like sickle cell anaemia as observed. Among the 73 iron deficient patients, 24(32.9%) were males and 49 (67.1%) were females, there were two peaks 26 (35.6%) and 28 (38.4%) in a group 0-15 and 16-30 years respectively, in 73 diagnosed to be iron deficient anaemia, 26 (35.6%) were children and 47 (64.4%) were adults, degrees of iron deficiency anaemia in the study population were 49 (67.1%) moderate and 24 (32.9%) severe. Iron deficiency anaemia is the commonest type of anaemia in the study area; it has prevalence in adult females.

Keywords: *iron deficiency, hospitalized patients, degree of anaemia*

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1. Introduction

Iron deficiency anaemia is the commonest type of anaemia throughout the world, it has been reported to affect about 50-60% of young children and pregnant women also 20-30% of non-pregnant women in the developing countries [1]. Although iron deficiency anaemia is often thought to be due to a diet low in iron, this is rarely the case without significant blood loss or intestinal parasite for example; hookworm [2]. Anaemia remains a wide spread public health problem with major consequences for human health as well as social and economic development. Anaemia is a clinical condition characterised by reduction in haemoglobin concentration of blood below the normal for the age, sex, physiological condition and altitude above sea level of that person [3]. World health organisation define anaemia in man as haemoglobin concentration level less than 130 g/L, women with haemoglobin concentration level less than 120 g/L, children aged 6 month to 6 years with haemoglobin concentration level less than 110 g/L and those aged 6-14 years with haemoglobin concentration level less than 120 g/L [4]. Iron deficiency is the most commonly described as occurring in three stages; the first stage of iron depletion refers to a decrease in iron stores without any effect on essential body iron, this may be characterised by low serum ferritin level. Low iron stores have not been found to cause any dysfunction but, may progress to stage two or iron deficient erythropoiesis. This occurs when inadequate iron is available to the erythroid marrow and to tissues for normal biochemistry and function. Abnormalities in physiological function can occur at this stage which may be detected by low serum iron, reduced transferrin saturation levels, increased serum transferrin and high levels of free erythrocyte protoporphyrin. Serum transferrin receptor has been found to increase during this stage. Haemoglobin level may be reduced, representing a mild anaemia, which is difficult to detect using an arbitrary cut-off value for haemoglobin. There is also an increase in microcytic cells. The last and severe stage is iron deficiency anaemia identified by a significant reduction in haemoglobin levels and a decrease in mean corpuscular volume. The second stage of iron deficient erythropoiesis has usually been taken to indicate iron deficiency, sometimes identified as function iron deficiency. In its early stages, iron deficiency erythropoiesis is difficult to detect as traditional laboratory parameters may not have changed significantly and there is a marked overlap in values between normal and iron

deficient subjects. Serum transferrin receptor may provide a more sensitive index to detect the early stages of functional iron deficiency, after several weeks, the latter stage of iron deficient erythropoiesis can be identified by low levels of serum ferritin, transferrin saturation and increase levels of erythrocyte protoporphyrin [5,6,7]. Iron status can be measured using haematological and biochemical indices, each parameters of iron status reflects changes in different body iron compartments and are affected at different levels of iron depletion. Specific iron measurements includes haemoglobin concentration, mean cell volume, haematocrit, serum iron, serum ferritin, erythrocyte protoporphyrin, transferrin, transferrin saturation levels and more recently transferrin receptors and red cell distribution width. Haemoglobin has been used longer than any other iron status parameter. It provides a quantitative measure of the severity of iron deficiency once anaemia has developed. Haemoglobin determination is a convenient and simple screening method and is especially useful when the prevalence of iron deficiency is high, as in pregnancy or infancy [8]. The limitations of using haemoglobin as a measure of iron status are its lack of specificity (as factors such as vitamin B_{12} or folate deficiency, genetic disorders and chronic infections can limit erythropoiesis) and its relative insensitivity due to the marked overlap in values between normal and iron deficient populations. To identify iron deficiency anaemia, haemoglobin must be measure together with more selective measurements of iron status. A reduction in mean cell volume (MCV) occurs when iron deficiency becomes severe, at about the same time as anaemia starts to develop. It is a fairly specific indicator of iron deficiency once thalassemia and the anaemia of chronic disease have been excluded. A cut-off value of 80fL is accepted as the lower limit of normal in adult. Red cell distribution width (RDW) is a relative new red cell blood parameter which can be used in combination with other parameters for the classification of anaemias. It is an index of the variation in the size of the red blood cells and can be used to detect subtle degrees of anisocytosis. An elevated red cell distribution width appears to be the earliest haematological manifestation of iron deficiency. It is more sensitive than serum iron, transferrin saturation or serum ferritin levels. A low mean cell volume together with an increased red cell distribution width is strongly suggestive of iron deficiency and when accompanied by an increase erythrocyte protoporphyrin can be considered diagnostic, it was then concluded that the use of red cell distribution width would be worthwhile in association with the usual iron status parameters in epidemiological studies. Serum iron is sensitive to the stage of mild iron deficiency, as the levels decrease after body stores are fully depleted but before haemoglobin levels drop. The limitation of using serum iron include it is wide diurnal variations and its lack of specificity as low levels may be found after blood loss or donation, in pregnancy, with chronic infections, shock, pyrexia, rheumatoid arthritis and malignancy. The diurnal variation has been found to vary by as much as 100% during a 24 hour interval in healthy subjects. Serum iron is used in combination with other parameters as it is not specific enough as a sole measure of iron status. Serum ferritin is a reliable and sensitive parameter for the assessment of iron stores in healthy subjects. Quantitative phlebotomy has shown a close relationship between serum ferritin concentration and mobilization iron stores and demonstrated that 1 µg/L of serum ferritin corresponds to 8-10 mg of storage iron. Serum ferritin is widely used in clinical practice and population screening. Serum ferritin levels below 12 µg/L are highly specific diagnostic for iron deficiency and denote complete exhaustion of iron stores in adults, while in children, serum ferritin levels below 10 µg/L has been suggested for iron deficiency. Although a low serum ferritin level defines the onset of iron deficiency, it does not indicate the severity of the iron deficiency due to higher assay variability. Ferritin is an acute phase reactant; its serum levels may be elevated in the presence of chronic inflammation, infection, malignancy and liver disease. Alcohol consumption has also been suggested to independently raise serum ferritin. Correct interpretation of serum ferritin relies on using the appropriate reference range specific for age and sex. Serum ferritin concentration tend to be lower in females than male, reflecting the lower iron stores of females, both sexes however seem to have a skewed distribution with a long tail stretching into the higher ranges. Ferritin levels in men increase in the latter part of the second decade and then either remain stable or rise only slowly until the age of 65 years. In woman, levels remain low until after the age of 45 years when they begin to rise and reach the same level as those of males by the age of 60-70 years. This trend probably reflects the cessation of menstruation and childbearing; in pregnant women, serum ferritin level fall dramatically to below 20 µg/L during the second and third trimester, even in women taking supplements [8-14]. Most of the earlier research on anaemia in different parts of the world was mainly focused upon females, very few studies were conducted on anaemia in general population in the pasts; this present study will therefore address this problem. The aim of this study was to determine the proportion of iron deficiency anaemia in moderate to severely anaemic patients, also to have an ideal of the pattern of anaemia in this particular group of anaemic patients in the study area.

2. Materials and Methods

One hundred clinically anaemic patients with haemoglobin concentration level less than 8 g/dL recently un-transfused of either sex between age 6 months and 65 years were selected from LadokeAkintola University Teaching Hospital, Osogbo and Asubiaro State Hospital, Osogbo. 5 ml of venous blood samples were collected from each participants, 2 ml was dispensed into dry di-potassium ethylene diaminetetera acetic acid (K_2EDTA) bottles for the analysis of red blood cell indices, red cell distribution width, haemoglobin concentration, packed cell volume using automated machine (Humancount); 3 ml of blood sample was dispensed into plain bottles for serum iron and serum ferritin analysis using advanced instrumentation in water analysis (atomic absorption spectrophotometry). Blood film was made from dry di-potassium ethylene diaminetetera acetic acid (K_2EDTA) bottles for every patient and stained using Leishman technique. Data obtained were analyzed using computer database software from the statistical package for social sciences version 16.0 (SPSS version 16).

3. Results

Out of 100 anaemic patients who participated in this study; 30 were children (20 males and 10 females), while 70 were adults (50 females and 20 males). Age and sex distribution of the participants are shown in Table 1. Based on the parameter analyzed, 73 were diagnosed to be iron deficient with anaemia, blood film morphology shows microcytic, hypochromic, anisocytosis and poikilocytosis in iron deficiency anaemia; remaining 27 were due to other causes of anaemia like sickle cell anaemia as observed in the peripheral blood film, among the 73 iron deficient patients, 24 (32.9%) were males with prevalence in children and 49 (67.1%) were females with prevalence in adult, The result of this study show high prevalence of iron deficiency anaemia within the age group 16-30 years. There were two peaks 26 (35.6%) and 28 (38.4%) in a group 0-15 and 16-30 years respectively as shown in Table 2. However, in 73 patients diagnosed to be iron deficient anaemia, 26 (35.6%) were children and 47 (64.4%) were adults, degrees of iron deficiency anaemia in the study population were 49 (67.1%) moderate and 24 (32.9%) sever as show in Table 3 – Table 5.

Table 1. Age and sex distribution in anaemic patients

AGE GROUP	SEX	
	MALE	FEMALE
0-15 N=30	20	10
16-30 N=38	8	30
31-45 N=17	2	15
46-60 N=11	8	3
61-75 N=4	2	2
TOTAL	40	60

Table 2. Age and sex distribution in iron deficiency anaemia

AGE GROUP	SEX	
	MALE	FEMALE
0-15 N=26	17	9
16-30 N=28	3	25
31-45 N=13	2	11
46-60 N=11	1	3
61-75 N=4	1	1
TOTAL	24	49

Table 3. Age and red cell indices in degree of iron deficiency anaemia

AGE	MCV	MCV	MCHC	MCHC	MCH	MCH
	Moderate	Sever	Moderate	Sever	Moderate	Sever
Children	60-75fL	<60fL	300-320g/L	<300g/L	20-30pg	<20pg
0-5	12	6	11	7	12	6
6-12	6	2	6	2	6	2
Adults	71-80fL	<70fL	300-320g/L	<300g/L	23-33pg	< 23pg
	31	16	32	15	31	16
Total	49	24	49	24	49	24

Table 4. Age and haematological parameters in degree of iron deficiency anaemia

AGE	RBC	RBC	HB	HB	PCV	PCV
	Moderate	Sever	Moderate	Sever	Moderate	Sever
Children	3.0-4.0 $x10^{12}$	<3.0 $x10^{12}$	6-9g/L	<5g/dL	18-27%	<15%
0-5	13	6	12	6	12	6
6-12	5	2	6	2	6	2
Adults	3.0-4.5 $x10^{12}$	<3.0 $x10^{12}$	7-10g/dL	<6g/gL	21-30%	<18%
	31	16	31	16	31	16
Total	49	24	49	24	49	24

Table 5. Age and iron status, red cell distribution width in degree of iron deficiency anaemia

AGE	IRON	IRON	FERRITIN	FERRITIN	RDW	RDW
	Moderate	Sever	Moderate	Sever	Moderate	Sever
Children	<300 µg/L	<100 µg/L	6-10 µg/L	<6 µg/L	>14.5%	>14.0%
0-5	13	5	12	6	13	4
6-12	6	2	6	2	6	3
Adults	<600 µg/L	<150 µg/L	6-12 µg/L	<6 µg/L	>15%	>16%
	30	17	31	16	30	17
Total	49	24	49	24	49	24

4. Discussion

Out of the 100 anaemic patients that participated in this present study, 73 prevalence rate of iron deficiency anaemia was recorded; blood film morphology shows microcytic, hypochromic, anisocytosis and poikilocytosis in iron deficiency anaemic condition as supported by Thomas *et al.*, 2006 [15]. These red cell morphology is due to depleted iron stored [7]. Similar to this study, Muhammad *et al.*, 2005 reported that out of the 100 consecutive anaemic patients selected from Ayub Teaching Hospital, 68 patients were found to be iron deficiency in moderate to severely anaemia [3]. Contrary to this present study, Patel *et al.*, 2005 reported that, 40 patients out of 100 anaemic patients were found to have iron deficiency anaemia [16]. Sex distribution of iron deficiency anaemia in this study reveals prevalence rate of 24 (32.9%) and 49 (67.15%) for males and females respectively. This is similar to the result obtained by Muhammad *et al.*, 2005 reported that 27 (39.71%) and 41 (60.29%) prevalence rates for males and females respectively [3], Patel *et al.*, 2005 also stated that females were affected more than the males [16]. However, in this present study, prevalence of iron deficiency anaemia in adult was high in female than male this is due to

menstruation especially in heavy menstrual blood loss greater or equal to 80 ml per month [17]; also prevalence of iron deficiency anaemia in children was high in male compared to female this is due to high immunity in female child. The prevalence iron deficiency anaemia declined sharply in males after 16 years of age coinciding with the end of a growth spurt while the prevalence among females stated to raise after the age 18 years as they proceed to marriage and childbearing [18]. Other reasons for increased prevalence of iron deficiency anaemia in female include; pregnancy and lactation [6] and tissue growth during pregnancy [13]. The result of this study show high prevalence iron deficiency anaemia within the age group 16-30 years. There were two peaks 26 (35.6%) and 28 (38.4%) in a group 0-15 and 16-30 years respectively. This result is however in contrast to the result obtained by Muhammad *et al.,* 2005 where majority of the patients with iron deficiency were aged between 20-60 years (82.2%) [3]. Patel *et al.,* 2005 reported that most patients affected with iron deficiency were age group 21-30 years with two peaks 46% and 36% in age group 21-30 and 31-50 respectively [16]. The high prevalence of iron deficiency anaemia with the age groups in this present study has been attributed to increased need for iron due to rapid growth, low intake of iron rich food in children (0-15 years). Anaemia is common in all age groups especially in age group 0-15 years and 16-30 years with 30 and 38 respectively, iron deficiency anaemia in this age group were 26 (35.6%) and 28 (38.4) respectively, this is similar to the finding in children in aged 2-5 and in adult age 19-40 years with 34.5% and 40% respectively, iron deficiency anaemia in this age group was 15.5% and 23,8% respectively according to Metinkilin *et al.,* 2002 [19] which is contrast to the result obtained in this study. However, degrees of iron deficiency anaemia in this study were 49 (67.1%) moderate and 24 (32.9%) sever, most of the patients in this present study were found to suffer from moderate iron deficiency anaemia. Similar to this present study, 36 (53%) were found to suffer from moderate iron deficiency anaemia and 32 (47%) of the patients were severely suffer to iron deficiency anaemia [3]. Patel *et al.,* 2005 also reported that most of the patients were found to suffer from moderate iron deficiency anaemia (53%) [16].

5. Conclusion

Iron deficiency anaemia is the commonest type of anaemia in the study area which could be improved by iron supplementation in the diet; it has high prevalence in adult female. Iron deficiency anaemia in the subjects tested may be due to poor socio economic condition, dietary or intestinal parasitic infestation. The high rate of iron deficiency anaemia has raised serious concern about nutritional disease risks in our society, this study will educate the public on importance of iron for their health and to provide optimal health information for the population concerned especially pregnant women and children. It would also guide primary health care providers in preventing and controlling iron deficiency anaemia through appropriate dietary intake and diagnosis management of iron deficiency anaemia.

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