

PREVALENCE OF ANAEMIA AMONG CHILDREN ATTENDING PAEDIATRICS

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ABSTRACT^[PP1]

Introduction: Anaemia is defined by the World Health Organization^[PP2] as Hb <12g/dl in adult non-pregnant females, Hb < 11g/dl in pregnant females, Hb <13g/dl in adult men, Hb <12g/dl and Hb <11g/dl in male & female children respectively. The aetiological factors of anaemia include; iron deficiency, other micronutrient deficiencies, excessive blood loss, inheritance disorders of haemoglobin, malaria and other parasitic infections, HIV—infection and drug treatment-related complications.^[PP3] This study was designed to investigate the prevalence and types of anaemia among the children attending the Paediatrics Department of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto North Western Nigeria.

Method: Four hundred children between the ages of aged 0 newborn^[PP4] to -15 years were recruited for this study. Haematological parameters tested include red cell indices, white cell total and differential, platelet counts, and morphologies were studied with a MythicTM^[PP5] 5-part auto-analyzer and manual techniques. Malaria testing was done using a Parasite-F strip and manual thin film stained with giemsa stain. Other investigations included serum iron, ferritin, TIBC and Hb electrophoresis using an alkaline pH of 8.4

Result: Out of the four hundred children tested, 139 (34.8%) were anaemic, revealing while 261 (65.2%) were non-anaemic. The results revealed five aetiological types of anaemia among the children; iron deficiency 62(44.6%), sickle cell 43(31.0%), normocytic normochromic 19(13.7%), anaemia of chronic diseases 10(7.1%), and megaloblastic/macrocytic 5(3.6%) based on aetiological classification and three while morphologic classifications (i.e., included; Normocytic anaemia 48(34.5%), macrocytic anaemia 18(13.0%), and microcytic anaemia 73(52.5%)).

Conclusion: This cross-sectional non-intervention study found approximately one-third of a child cohort observed the prevalence of 34.8% of anaemia among our cohort of children aged 0-15 years, attending the Paediatrics Departments of Usmanu Danfodiyo University Teaching Hospital, Sokoto, North Western Nigeria in a north-western Nigeria. This findings leads to the potential There is need for the for targeted provision of iron and other micro nutrient supplementation for anaemic children, particularly those with anaemia in the area.

Key Words: Anaemia, Prevalence, children, Paediatrics Department, UDUTH, Sokoto.

INTRODUCTION

Anaemia is a global public health problem affecting more than 56 million people, with two-thirds of them being from developing countries [PP6][PP7]. It is associated with a decrease in the haemoglobin concentration with a consequent decrease in the haematocrit (PCV) level. Anaemia is defined by the World Health Organization (WHO) as Haemoglobin (Hb) <12g/dL [PP8] in adult non-pregnant female, Hb < 11g/dl in pregnant females, Hb <13g/dl in adult men, Hb <12g/dl in male children, Hb <11g/dl in female children and Hb < 13g/dl in newborn [1][PP9]. ~~Anaemia affects more than 56 million people globally, two-thirds of them being from developing countries~~ [2]. ;

The aetiological factors of anaemia are multi-factorial and include; iron deficiency, other micronutrient deficiencies, excessive blood loss, inheritance of the disorders of haemoglobin synthesis, malaria and other parasitic infections (i.e., hookworm and schistosomiasis infestations), HIV-infection, and drug treatment-related complications [3]. Among the numerous factors, both nutritional and non-nutritional that contributed to the onset of anaemia, iron deficiency and malaria play the most critical roles ~~an important role~~ [4].

Anaemia is a common clinical problem encountered among the under-fives in everyday paediatric practice [PP10].

Anaemia is typically diagnosed on a complete blood count. Apart from reporting the number of red blood cells and the haemoglobin level, the automatic counters also measure the size of the red blood cells by flow cytometry, which is an important tool in distinguishing between the causes of anaemia. Examination of a stained blood smear using a microscope can also be helpful, and it is sometimes a necessity in regions of the world where automated analysis is less accessible. In modern coulter counters, four parameters (RBC count, Hb concentration, PCV, and RDW) are measured, allowing others (MCV, MCH and MCHC) [PP11] to be calculated, and compared to values adjusted for age and gender. Other diagnosis required for proper differential diagnosis of anaemia include; malaria testing, haemoglobinopathies (using electrophoresis at alkaline pH), serum transferrin, serum iron and total iron binding capacity [5].

Anaemia is a common blood disorder in children and imposes an economic burden on the parents/caregivers and the country as a whole. Majority of anaemic children (76.2%) are under

the age of 5 years, the most frequently affected age is 2 years (23.8%) with a male to female ratio was 1:2 [7][PP12]. Severe anaemia[PP13], which is a life threatening condition, is a common occurrence in pediatric emergency units in most hospitals in developing countries. In various African settings, about 12 to 29% of hospitalized children have severe anaemia with hospital case fatality rate ranging between 8 and 17% [8]. Severe anaemia is a major paediatric problem in Nigeria [6][PP14]. It is associated with many unwanted untoward effects on the patient, such as, congestive cardiac failure, chest pain, jaundice, splenomegaly, joints pain, fever, and swelling of the limbs etc. Severe anaemia[PP15] which is a life threatening condition is a common occurrence in children emergency units in most hospitals in developing countries and most anaemia related deaths encountered are usually due to severe anaemia. It is a common blood disorder in children and imposes an economic burden on the parents/caregivers and the country as a whole. Majority of anaemic children (76.2%) are under the age of 5 years, the most frequently affected age is 2 years (23.8%) with a male to female ratio was 1:2 [7]. In various African settings, about 12 to 29% of hospitalized children have severe anaemia with hospital case fatality rate ranging between 8 and 17% [8]. Serum ferritin has been the most commonly used single laboratory parameter to discriminate between ACD and IDA [PP16][9]. Nemeth and Ganz, 2006, developed and validated the first very sensitive and easily done serum enzyme linked immunoabsorbent assay for serum ferritin, which can be used reliably to diagnose anaemia. [PP17]

MATERIAL AND METHODS

STUDY AREA

This study was carried out in Paediatrics Department of Usmanu Danfodiyo University Teaching (UDUTH) Sokoto, North-western Nigeria. Sokoto State is located in the extreme North-west of Nigeria, near to the confluence of the Sokoto River and the Rima River. The State is located between longitude 11°30', 13°50' East and latitude 4° to 6°0' North. It is bordered to the north by Niger Republic, Zamfara State to the east while Kebbi State borders most of the southern and western parts [10]. The State falls within the Savannah vegetation zone. Rainfall starts late and ends early with mean annual rainfall ranging from 500 to 1,300 mm, and annual average temperature of 28.3°C (82.9°F[PP18]). It has a land area of about 28,232.37 sq kilometres and stands at altitudes of 900 m above the sea level[PP19]. The State has three peculiar seasons; the cold dry (December-February), hot dry (October-April) and wet[PP20]. The wet

season begins in most part of the State in May and lasts up to September. The major indigenous tribes in the state are the Hausa and Fulani and other groups such as Gobirawa, Zabarmawa, Kabawa, Adarawa, Arawa, Nupes, Yorubas, Ibos and others^[PP21]. Occupation of city inhabitants include trading, commerce, with a reasonable proportion of the population working in private and public sectors. The majority of the Hausas' are farmers, while Fulanis are nomadic and are engaged in animal rearing [11]. The population has experienced significant growth going from 3,696,999 in 2006 [12] to Based on 2006 population census, Sokoto State had a population of 3,696,999 [12], with an average estimate of 4,806,098 in 2015 based on the population annual growth rate of 3% [13].

STUDY POPULATION

A total of 400^[PP22] children aged newborn to 15 years with mean age 5.27 ± 4.63 years^[PP23] whose parents completed a written informed consent for their wards to participate in the study were recruited for this prospective cross-sectional study. The subjects were recruited from Paediatrics Department of UDUTH Usmanu Danfodiyo University Teaching Hospital, Sokoto, North- Western Nigeria. The age of 15 years is considered as the limit for Paediatrics patients in UDUTH, Sokoto [14].

STUDY DESIGN

This is a prospective cross-sectional study designed to investigate the prevalence and the types of anaemia among 400 children attending the Paediatrics wards of UDUTH Usmanu Danfodiyo University Teaching Hospital, Sokoto, North- Western Nigeria. Whole blood samples from the subjects were tested for full blood count, malaria parasites, blood film reports, Hb electrophoresis. Serum samples were tested for serum iron, total iron binding capacity, serum transferrin, and serum ferritin.

This study was approved by Ethical Committee of Usmanu Danfodiyo University Teaching Hospital UDUTH, Sokoto (Approval attached under appendices) and written informed consent was obtained from the parents of all participants in this study.

METHODS

÷About three to five mL of blood were collected from the subjects (about 2.5mL in K₃EDTA containers while the remainder was decanted into plain containers). The anti-coagulated samples were used for full blood counts using automated haematological analyser; blood films were stained with Leishman's stain for blood morphology, and giemsa stain for malaria parasites. Haemoglobin electrophoresis was carried out at pH 8.4 using the procedure described by Monica Cheesbrough (2008). Samples in coagulated containers were allowed to clot and serum was separated for the investigations of serum iron, serum ferritin, serum transferrin and Total iron binding capacity using ELISA techniques.

STATISTICAL ANALYSIS

The data collected were entered into the data editor of statistical package for social sciences (SPSSTM-Version 20) software. Analysis was based on simple percentages, proportions, and values were expressed as Mean $\pm$ SD. A Chi-square test at a 95% confidence level was also used to test for association between aged groups, anaemia and gender. A p-value of < 0.05 was considered as significant in all statistical analysis.

RESULTS

~~Table 1: Mean Values and Standard Deviation of the Haematological Variables.~~

Four hundred subjects including 224(56.0%) male and 176(44.0%) female aged newborn to 15 years participated in this study. The children include pre-primary school (0- 5.0 years), primary school (5.1- 10.0 years) and post primary school (10.1- 15.0 years). The mean values and standard deviations of the haematological and biochemical parameters are shown below.

Table 1: Mean Values and Standard Deviation of the Haematological Variables.

Variable	Mean $\pm$ Std
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Age	5.27 ± 4.63
Haemoglobin (Hb) (g/dL)	11.12 ± 2.51
Packed Cells Volume (PCV) (%)	33.30 ± 7.99
Red Blood Cells (RBC)(x 10 ¹² /l)	3.81 ± 0.82
Total Leucocytes Count (TLC) (x 10 ⁹ /l)	9.20 ± 6.89
Platelets count (PLT)(x 10 ⁹ /l)	310.60 ± 136.70
Serum Iron (S I)(ug/dL)	82.59 ± 31.55
Serum Ferritin (S F) (ng/mL)	56.66 ± 27.92
Serum Transferrin (ST) (mg/dL)	253.72 ± 82.81
Total Iron Binding Capacity (TIBC) (mg/dL)	304.30 ± 99.60
Mean Cells Volume (MCV) (fl)	88.28 ± 12.41
Mean Cells Haemoglobin (MCH) (pg)	28.72 ± 4.38
Mean Cells Haemoglobin Concentration (MCHC) (g/dL)	32.39 ± 15.39
Red Cells Distribution Width (RDW) (%)	16.62 ± 7.35

This table shows the Mean Values and Standard Deviation of the haematological variable, iron and iron related/biochemical parameters. From the general view, they appear relevant and appropriate to the requirement of our manipulation. sd = Standard Deviation, g/dL = gram/decilitre, % = percent, $\times$ = multiply, μ g = microgram, ml = millilitres, mg = milligrams, fl = femtolitres, pg = picogram, l = litre.

Table 2: Age and Gender Distribution of the Study Population.

This research work examined the haematological, iron, and iron-related parameters of four hundred children attending Paediatrics Department of UDUTH, Sokoto, North western Nigeria contributing children. Of the four hundred children tested, 224(56%) were male while 176(44%) were female. The children included; pre primary school (0-5.0 years), schooled (5.1-10.0 years) and post primary school (10.01-15.0 years) as shown below. [PP32]

Table 2: Age and Gender Distribution of the Study Population.

Gender			
Age (years)	Male	Female	Total
0.0 – 5.0	126(31.5%)	102(25.5%)	228(57.0%)
5.1 – 10.0	62(15.5 %)	35(8.8%)	97(24.3%)
10.1 - 15.0	36(9.0%)	39(9.7%)	75(18.7%)
Total	224(56.0%)	176(44.0%)	400(100.0%)

158 | ~~This table indicates the characteristics age and gender distribution of the total study population.~~ These are the total
 159 | study used in this study. $X^2 = 4.47$; $df = 2$, $p\text{-value} = 0.107$ $df = \text{degree of freedom}$.

160 | **Table 3: Prevalence of Anaemia among the Study Population.**

161 | Of the four hundred children tested, 139 (34.8%) children were anaemic while 261 (65.2%) were
 162 | not anaemic (normal) as shown in Table 3 below. Children aged 0-5.0 years are more affected
 163 | with anaemia compared to those above 5.0 years

Age (years)	Not anaemic	Anaemic	Total
0.0 – 5.0	154(38.5%)	74(18.5)	228(57.0%)
5.1 – 10.0	59(14.8%)	38(9.5%)	97(24.2%)
10.1 – 15.0	48(12.0%)	27(6.8%)	75(18.8%)
Total	261(65.2%)	139(34.8%)	400(100%)

164 | **Table 3: Prevalence of Anaemia among the Study Population.**

165 | ~~The [PP34] overall prevalence of 139 (34.8%) of anaemia was observed among the children attending UDUTH,~~
 166 | ~~Sokoto, North Western Nigeria~~ ($X^2 = 1.42$; $df = 2$ $p\text{-value} = 0.500$). Linear by linear association ($X^2 = 0.684$; $df =$
 167 | 1 , $p\text{-value} = 0.038$, $df = \text{degree of freedom}$).

168 | **Table 4: Severity of Anaemia among the Study Population.**

Children whose Hb $\geq$ 13g/dl were considered not anaemic, mild anaemic children had Hb of 12-12.9g/dl, moderate children had Hb of 9-11.9g/dl while severe anaemic children [presented with](#) ~~had~~ Hb of < 8g/dl as indicated below.

Table 4: Severity of Anaemia among the Study Population.

Degree of Anaemia					
Age (years)	Not Anaemic	Mild A.	Moderate A	Severe A.	Total
0.0 – 5.0	154(38.5%)	32(8.0%)	34(8.5%)	8(2.0%)	228(57.0%)
5.1 – 10.0	59(14.8%)	8(2.0%)	22(5.5%)	8(2.0%)	97(24.3%)
10.1 – 15.0	48(12.0%)	6(1.5%)	17(4.2%)	4(1.0%)	75(18.7%)
Total	261(65.3%)	46(11.5%)	73(18.2%)	20(5.0%)	400(100%)

This table has assessed the severity of anaemia in the total population and indicates that children aged 0.0-5.0 years are more severe than those above 5.0 years. $X^2 = 9.7$; $df = 6$, $p\text{-value} = 0.133$, $df = \text{degree of freedom}$. A = Anaemia.

Table 5: Age and Gender Specific Distribution of the Anaemic Children.

This table shows the age and gender specific distribution of the anaemic children. Male children were more vulnerable to anaemia than their female counterpart.

Table 5: Age and Gender Specific Distribution of the Anaemic Children.

Gender			
Age (Years)	Male	Female	Total

0.0 – 5.0	46(33.1%)	28(20.1%)	74(53.2%)
5.1 – 10.0	27(19.4%)	11(7.9%)	38(27.3%)
10.1 – 15.0	14(10.1%)	13(9.4%)	27(19.5%)
Total	87(62.6%)	52(37.4%)	139(100%)

Children age 0.0-5.0 years were considered as pre-primary school, 5.1-10.0 years were schooled, while 10.1-15.0 years were considered as post primary school children. $X^2 = 2.49$; $df = 2$, $p\text{-value} = 0.287$.

Table 6: Age Specific Grading of Anaemia among the Anaemic Children.

The results of this table indicated that children under five (05) years of age are more affected with anaemia than those above five years.:-

Table 6: Age Specific Grading of Anaemia among the Anaemic Children.

Degree of Anaemia				
Age(years)	Mild A.	Moderate A.	Severe A.	Total
0.0 – 5.0	37(26.6%)	29(20.9%)	8(5.7%)	74(53.2%)
5.1 – 10.0	11(8.0%)	19(13.6%)	8(5.7%)	38(27.3%)
10.1 – 15.0	7(5.0%)	16(11.5%)	4(3.0%)	27(19.5%)
Total	55(39.6%)	64(46.0%)	20(14.4%)	139(100%)

Children age 0.0-5.0 years were considered as pre-primary school, 5.1-10.0 years were schooled, while 10.1-15.0 years were considered as post primary school children. $X^2 = 8.132$; $df = 4$ $p\text{-value} = 0.087$

Table 7: Gender Specific Grading of Anaemia among the Anaemic Children.

Of the 139 anaemic children recorded, 87(62.6%) were male while 52(37.4%) were female indicating that male suffer more with anaemia than female.

Table 7: Gender Specific Grading of Anaemia among the Anaemic Children.

Degree of Anaemia				
Gender	Mild A.	Moderate A.	Severe A.	Total
Male	36(25.9%)	36(25.9%)	15(10.8%)	87(62.6%)
Female	19(13.7%)	28(20.1%)	5(3.6%)	52(37.4%)
Total	55(39.6%)	64(46.0%)	20(14.4%)	139(100%)

Proportion M/F = 2:1; M = male, F = female, Mild A = Mild Anaemia, Moderate A = Moderate Anaemia while Severe A = Severe Anaemia. $X^2 = 2.07$; df = 2, p-value = 0.27.

Table 8: Aetiological Classification of Anaemia among the Anaemic Children based on age groups. These results revealed that iron deficiency anaemia is the most common type of anaemia among the anaemic children.

Table 8: Aetiological Classification of Anaemia among the Anaemic Children based on age groups.

Aetiological Classification of Anaemia						
Age(years)	IDA	SCA	NNA	ACD	MBA	TOTAL
0 – 5.0	40(28.8%)	19(13.7%)	8(5.7%)	6(4.3%)	1(0.7%)	74(53.2%)

5.1 – 10.0	11(7.9%)	13(9.4%)	7(5.0%)	3(2.1%)	4(2.9%)	38(27.3%)
10.1 – 15.0	11(7.9%)	11(7.9%)	4(3.0%)	1(0.7%)	0	27(19.5%)
Total	62(44.6%)	43(31.0%)	19(13.7%)	10(7.1%)	5(3.6%)	139(100%)

$X^2 = 14.04$; $df = 8$, $p\text{-value} = 0.076$. IDA = Iron Deficiency Anaemia, SCA = Sick Cells Anaemia NNA = Normocytic Normochromic Anaemia, ACD = Anaemia of Chronic Diseases, MBA = Macrocytic/Megaloblastic Anaemia.

~~Table 9: Morphologic Classification of Anaemia among the Anaemic Children based on~~

~~Age Groups.~~ This table shows that microcytic anaemia is the most common type of anaemia among the anaemic children.

Table 9: Morphologic Classification of Anaemia among the Anaemic Children based on

Age Groups.

Morphologic Classification of Anaemia				
Age(years)	NA	MACA	MICA	TOTAL
0 – 5.0	27(19.4%)	6(4.3%)	42(30.2%)	75(54.0%)
5.1 – 10.0	11(7.9%)	11(7.9%)	16(11.5%)	38(27.3%)
10.1 – 15.0	10(7.2%)	1(0.7%)	15(10.8%)	26(18.7%)
Total	48(34.5%)	18(13.0%)	73(52.5%)	139(100%)

NA = Normocytic Anaemia, MACA = Macrocytic anaemia, MICA = Microcytic Anaemia. $X^2 = 2.7$; $df = 2$, $p\text{-value} = 0.291$.

DISCUSSION

Anaemia in this study was defined based on the WHO criteria of haemoglobin values of less than 11g/dl; mild anaemia (9.0–10.9 g/dl), moderate anaemia (7.0–8.9 g/dl) and < 7.0 g/dl (severe anaemia). The global prevalence of anaemia in school-age and preschool-age children is 25.4% and 47.4% respectively. It affects 293 million children globally with the highest prevalence found in Africa (67.6%) [15].

Four hundred subjects comprising 224(56.0%) male and 176(44.0%) female were used in this study. Of the four hundred children tested, 139 (34.8%) children were anaemic as shown in table 3. A total of 16 (4%), 103 (25.8%) and 20 (5%) children had mild, moderate and severe anaemia respectively while 261 (65.2%) were not anaemic (normal) as indicated in table 4. The mean values and standard deviation of the haematological and biochemical parameters were also showed in table 1. The tests performed on iron and iron related biochemical parameters were haemoglobin (Hb) concentration, packed cell volume (PCV), serum iron (SI), total iron binding capacity (TIBC), serum ferritin (SF), serum transferrin (TS), mean cell volume, mean haemoglobin concentration mean cell haemoglobin concentration and red cell distribution width. As shown in table 4, the mean values obtained for haemoglobin concentration, packed cell volume, serum ferritin (SF), serum iron (SI), total iron binding capacity (TIBC), serum transferrin (TS), mean cell volume (MCV), mean haemoglobin concentration (MCH), mean cell haemoglobin concentration (MCHC) and red cell distribution width (RDW) of the anaemic children were; 11.12 ± 2.51 g/dl, $33.3 \pm 7.99\%$, 56.66 ± 27.92 ng/ml, 82.59 ± 31.55 ug/dl, 304.3 ± 99.60 ug/dl, 253.72 ± 82.81 g/dl, 88.22 ± 12.41 fl, 28.72 ± 4.38 pg, 32.39 ± 15.39 g/dl and $16.62 \pm 7.35\%$ respectively. Our observation is consistent with the average MCV in IDA of 66.81 fl, the mean value of MCH of 23.97 pg, mean value of MCHC of 34.81%, and mean haemoglobin of 10.41 gm/dl in IDA recorded by Abu-syed *et al.*, 2014 [16]. ~~These observations are also similar to the report by Bainton *et al.*, 1971 [17]; which showed a mean MCV, MCH, MCHC and haemoglobin of 74 fl, 20 pg, 28% and 7.6 gm/dL respectively in patients with IDA [18].~~

In this study, we recorded an overall prevalence of anaemia of 34.8% among our cohort of children in Sokoto, North Western Nigeria. This finding is consistent with the global prevalence of 33% [18]. Our observed prevalence is however lower compared to the local findings which recorded high

prevalence rate of anaemia of 49.6% in children in South Eastern Nigeria [19]. Similarly, our observed prevalence among children in Sokoto is also lower compared to the high prevalence of 82%, 62%, 66.7% and 57.1% reported in Abia State [20], Ibadan [21], Anambra State [22] and Enugu [23] respectively. The low prevalence observed in our study may be linked to the fact that this present study was carried out in Usmanu Danfodiyo University Teaching Hospital where a significant number of patients seen are in the higher economic class and have access to better nutrition. They are also more likely to be able to afford insecticide-treated mosquito bed nets and thus are less exposed to malaria and malaria-related anaemia. This may also be linked to the facts that the study was conducted between March to June, 2015(dry session) when there is climatic changes and the environment is not conducive for the breeding of female anopheles mosquitoes (causative agent of malaria). However, our observed prevalence is higher than a 29% prevalence of anaemia reported in Katsina [24]. Several factors may be responsible for the high prevalence of anaemia among children recorded in our study and in other studies from other parts of Nigeria. These include; malaria, poor nutrition, frequent bacterial infections, poor hygiene and high parasitic infections, etc [25]. This was because not all the children were might come from the high economic background.

In this present study, we observed prevalence of severe anaemia, mild anaemia and moderate anaemia of 20(14.4%), 64(46.0%) and 55(39.6%) respectively among our cohort of children in Sokoto, Nigeria. Our observed prevalence varies slightly from prevalence of severe anaemia, mild anaemia and moderate anaemia of 16.7-22.2%, 13.9% and 8.3% respectively observed in a previous report in North Western Nigeria [26]. Our study is also consistent with the prevalence level for developing countries recorded to be 42% for pre-school children but inconsistent with 53% of anaemia recorded previously for school children in developing countries. This may be due to poor nutrition, mal-absorption, poor environment or poor socio-economic background.

The results of our findings revealed that out of 139 anaemic children; 74 (53.3%) were in the pre-school age (0-5.0 years), 38 (27.3%) were school age (5.1-10.0) and 27 (19.4%) were post- primary school children (10.1-15.0). These findings indicate that children under the age of five are more vulnerable to anaemia than those above five years. This finding is consistent with the global findings of 47.4% and 27.4% in pre-school and schooled children respectively [27]. Our study is also consistent with the prevalence level for developing countries recorded to be 42% for pre-school children but inconsistent with 53% of anaemia recorded previously for school children in developing countries [28]. This may be due to poor nutrition, mal-absorption, poor environment or poor socio-economic background.

This study also indicates that, of the 139 anaemic children tested, anaemia was higher among male children 87(62.6%) compared to female children 52(37.4%) representing a male to female ratio of 2:1 approximately. This finding is consistent with the findings of a previous report [29]. In this present study, we observed a low prevalence of severe anaemia of 5% among our cohort of children in Sokoto, Nigeria. Our finding is consistent with the findings of previous studies by other Nigerian workers which indicated prevalence rates ranging from 2.7% to 12.5% [30]. Our observed prevalence for severe anaemia is however lower than a prevalence rate of 9.7% reported in under-5 children in Abakaliki South Eastern Nigeria [31]. Similarly, previous report in various African settings indicated that about 12 to 29% of hospitalized children had severe anaemia [32].

In this study, we observed the prevalence of 44.6% of iron deficiency anaemia among the anaemic children in study population. According to WHO criteria, the accepted cut-off point

for iron deficiency anaemia screening in children is set at 11gm/dl, 70fl and 20pg for haemoglobin, MCV and MCH respectively. Following these criteria, the most common type of anaemia recorded among the children in this present study is iron deficiency anaemia, followed by sickle cell anaemia 31.0%, normocytic normochromic anaemia 13.7%, anaemia of chronic diseases 7.1% and macrocytic/megaloblastic anaemia 3.6%. ~~The findings from this study is higher compared to the finding in a study done in Ibadan, Nigeria, where iron deficiency anaemia recorded a prevalence rate of 31.5% in children aged between one to ten years, attending University College Hospital Ibadan [34].~~ Our finding is also higher compared to the prevalence rate of 34.3% reported in Enugu South East Nigeria by [33]. The higher prevalence recorded in our study, may be linked to the facts that some children in this area are malnourished. Other factors may include; inadequate intake of iron containing food, mal-absorption from the gastro-intestinal tract and excessive loss from the circulation. Also prevalence of iron deficiency anaemia in children was higher in male compared to female. The prevalence of iron deficiency anaemia declined sharply in males after 15 years of age coinciding with the end of a growth spurt while the prevalence among females stated to rise after the age 18 years as they proceed to marriage and childbearing [34]. The most common causes of anaemia; for instance, a microcytic anaemia is often the result of iron deficiency. Morphology will remain an important element of classification and diagnosis. Limitations of MCV (Mean Cell Volume) include cases where the underlying cause is due to a combination of factors - such as iron deficiency (a cause of microcytosis) and vitamin B12 deficiency (a cause of macrocytosis) where the net result can be normocytic cells [35].

CONCLUSION

Generally, there is high prevalence of anaemia among the children in Sokoto (34.8%), and iron deficiency anaemia is the highest, followed by sickle cell, normocytic normochromic, anaemia of chronic diseases while megaloblastic anaemia is the least. Serum iron and ferritin levels, as measured by ELISA can be reliably used for the differential diagnosis of iron deficiency anaemia (from other anaemia) among children. There is need for the provision of iron and other micro nutrient supplementation for children particularly those with anaemia in the area.

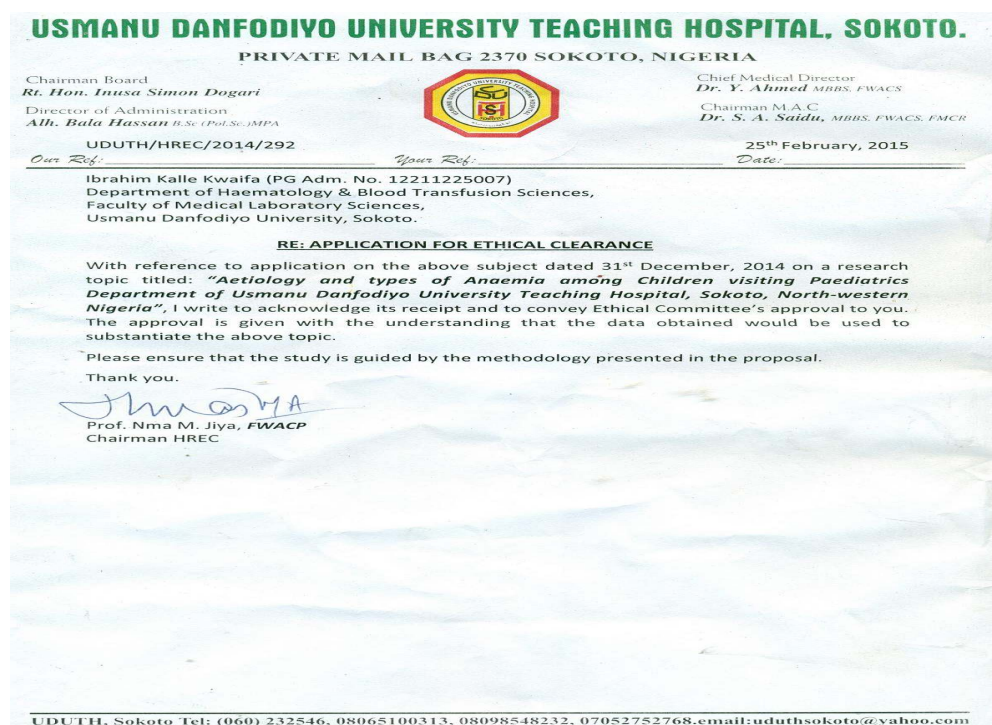
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APPENDIX I



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APPENDIX I

RESEARCH QUESTIONNAIRE

STUDY TITLE: Prevalence and Types of Anaemia among Children Attending Paediatric Departments (CLINIC 1, EPU, PSW, PMW, PNSW,SCBU, A&E) of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, North-Western, Nigeria.

I give consent for myself/child to be a participant in this study. I have been fully informed what participation will involve and had all my questions answered. I understand that I can withdraw from this study at any time without giving reason and without penalty.

• Age (Years).....

• Gender: Male [] Female []

- 226 • Occupation of the parent: Farming [] Business [] Civil Servant [] others []
 227 Specify.....
- 228 • Level of educational attainment of the parent: No formal [] Primary [] Secondary []
 229 Tertiary []
- 230 • Area of resident.....
- 231 • Number of children/sibling.....
- 232 • Number of wife(s).....
- 233 • Any medication: Haematinic [] others [] Specify.....
- 234 • Sign and symptoms of disease(s).....
- 235 • Hereditary disease(s) sickle cells anaemia [] others [] Specify.....