African Journal of Laboratory Haematology and Transfusion Science

Vol 2, issue 1, page 35-44 | March 2023 | Article ID : 2023-AJLHTS-0004

www.hbtssn.org/ajlhts | ISSN (Print): 2814-0591; (Online): 2814-0605

ORIGINAL ARTICLE

Full blood count and some iron parameters of Street Children in Calabar, Nigeria

Akpan, P. A.*, Etura, J. E., Asuquo, B. L.

Department of Haematology and Blood Transfusion Science, Faculty of Medical Laboratory Science, University of Calabar, Nigeria

Email: apu0520@unical.edu.ng; +2348027321305

Submitted: 08-02-2023
Accepted: 24-02-2023
Published: 31-03-2023

Abstract

Introduction: Street children refer to persons below 18 years who depend on the streets for their survival. These Street Children constitute a vulnerable group with regards to proper nutrition and healthcare hence this study was carried out to assess their full blood counts and some iron parameters.

Methods: One hundred and eighty (180) children living on the street and homes in Calabar Metropolis were recruited into this study. Ethical approval was sought and obtained from the Cross River State Ministry of Health, Calabar. Consent was obtained from 90 apparently healthy children on the street while parents/guardians gave consent for 90 apparently healthy children living in homes (control). Demographic information was obtained by interview and weight and height measurements were taken using standard instruments; the body mass index was calculated and used to categorize the nutritional status of subjects. Haematological and iron parameters were determined by standard techniques. Data were analysed using a student t-test on SPSS version 21 with significance level set at $P \leq 0.05$.

Results: Street Children comprised more males (53.3%) than females with 82.2% being out of school. Strategies employed for survival include receiving benefits from support groups (62.2%), engaging in odd jobs (60%) and begging for alms (100%). The body mass index of Street Children showed that 75.55% of them were healthy in terms of their nutritional status (BMI 16.2-25.5) while those that were underweight (<16.2) and obese (>27.9) made up 20% and 4.45% respectively as compared to 82.23% healthy weight, 2.22% underweight, 11.10% overweight (>25.5-27.9) and 4.45% obese observed for their counterparts who live in homes. The red cell distribution width (RDWCV) was 13.61±3.25 and this was significantly lower (P=0.001) than 16.53±3.28 versus the control, while the total white blood cell count (7.87±4.18 x 10^9/L) was significantly higher (P=0.05) for street children in comparison with 5.90±1.94 X 10^9/L obtained for children in homes. Other haematological, as well as iron parameters, were comparable (P>0.05).

Conclusions: The haematological parameters of Street children differed from children in homes in terms of a lower red cell distribution width and higher total white cell count. Twenty percent of street children were underweight as indicated by a lower BMI for their age. It is recommended that individuals, corporate bodies and the Government should unite to end street living for children.

Keywords: Street Children, blood counts, iron, Haematological, Nigeria

Introduction

The term 'street children' describes persons under the age of 18 years who live and work on the streets, that is, they depend on the streets for their survival. They are clustered around public spaces like markets, parks, and bus stations. Children live on the streets for many complex reasons. Each child on the street is there for varying reasons which include poverty, parental death or neglect, broken homes, displacement by natural disasters, sexual abuse at home, rejection on moral grounds, and issues of mental health to mention a few; the list is not exhaustive as each child on the street has a unique story (1). The population of children on the streets is on the rise and it is difficult to know the exact number since they have no permanent shelter where they can be counted. It is estimated that there are 100-150 million children living on the streets globally with Nigeria ranking third with an estimate of over 7 million (2,3,4,5).

Children who lack parental care and live on the streets, constitute a marginalized group and are one of the most vulnerable groups of poor people living in towns and cities across the world. Whereas children are supposed to be loved and protected by adults, children living on the streets are rather exposed to all sorts of dangers from children like them, law enforcement, Government officials and even family members. Street children are denied access to education and healthcare which should be their right; they suffer violence, and sexual abuse, forced recruitment into substance abuse and criminal activities (6,1,2). Street children are a vulnerable and neglected group with regards to proper nutrition, hygiene and healthcare. In a bid to assess their state of health, this study is aimed at providing information on full blood count and iron parameters of street children in Calabar. The findings of this study may be useful as a basis for advocacy with the Government and other relevant stakeholders.

Materials and Methods

Study area: The study area was Calabar, located in Cross River State in the South-South Geopolitical Zone of Nigeria. Sampling was done at Mary Slessor Road, Bogobiri street, Etim Edem motor park, Cultural Centre, and Lemna street; these are public spaces close to markets and bus stations in Calabar Metropolis.

Study population: A total of 180 apparently healthy children between the ages of 6 to 16 years were enrolled for the study. This comprises 90 children living on the street and 90 children living in homes to serve as a control. The control group was recruited from Lourdes Academy High School Ekorinim, Calabar. Both males and females were included in the study.

Ethical approval and informed consent: Ethical approval was sought and obtained from the Cross River State Ministry of Health, Calabar. Consent was obtained from children on the street after providing them with food items such as biscuits, sweets and soft drinks while parents/guardians gave consent for children living in homes. Street children who did not consent and children whose parents did not consent as well as children who were ill were excluded from the study.

Experimental design: The study was cross-sectional in design. Demographic information was obtained and documented from the study subjects by interview. Their body weight and heights were measured using a standard weighing scale and metre rule and the body mass index was calculated. The BMI was then used to classify the study subjects into different nutritional statuses. The classification of children into 'underweight' (BMI <16.2Kg/m^2), 'healthy weight' (BMI 16.2-25.5 Kg/m^2), 'over weight' (BMI >25.5-27.9 Kg/m^2) and 'obese' (BMI >27.9Kg/m^2) is based on the Centre for Disease Control and Prevention Growth Chart where the range of values that fall below the 5th percentile for a particular age group are classified as underweight, 5th to 85th percentile as healthy weight, >85th to <95th percentile as overweight and >95th percentile as obese (7).

Sample collection: Five millilitres (5ml) of venous blood was collected from the antecubital vein of the subjects after proper disinfecting of the puncture site with 70% alcohol; 3ml of blood was dispensed into an EDTA (Ethylene diamine tetra-acetic acid) bottle to a final concentration of 2mg/ml while 2ml was put in a plain sample container, allowed to clot and centrifuged to obtain serum for iron tests.

Determination of Haematological parameters using an automatic haemoanalyzer (ERMA INC model PCE-210N).

Principle: "Direct current is established between two electrodes, one in the sample beaker and the other in the aperture tube. Passage of a blood cell through the aperture displaces conducting fluid with increase in resistance. An equivalent change in potential is created between both electrodes. The volume of cells passing through determines the height of the pulses produced and the pulses are directed to a threshold circuit with an amplitude discriminator which selects the pulse height for counting" (8).

Procedure: Anticoagulated blood sample was mixed properly by gentle inversion and 100µl was automatically drawn into the machine through a probe. The blood was diluted and the results were displayed on the computerized screen in standard units.

Determination of serum iron (SI)

Serum iron was determined using kit produced by TECO DIAGNOSTICS USA. The principle is that the iron in serum dissociates from its iron (111)-transferrin complex by the addition of an acidic buffer containing hydroxylamine. This addition reduces iron (111) to iron (11). The chromogenic agent, ferene-S forms a highly coloured iron (11)-complex that is measured photometrically at 560nm. The test measures transport iron bound to the protein transferrin and was determined according to the manufacturer's instruction.

Procedure: Test tubes were labelled accordingly; blank, standard, control and sample. 2.5ml iron buffer reagent was added to all tubes then 0.05ml (50l) sample was added to each tube and mixed. The spectrophotometer was set to zero using blank at 560nm. Absorbance of all tubes was read and recorded (A_1 reading) then 0.05ml (50l) of iron colour reagent was added to all tubes and mixed. All tubes were placed in a heating bath at 37°C for 10 minutes. The spectrophotometer was set to zero using blank at 560nm and absorbance of all tubes were read and recorded (A_2 reading).

$$\text{Serum iron} = \frac{\text{A2 test} - \text{A1 test}}{\text{A2 std} - \text{A1 std}} \times \text{concentration of standard}$$

Reference range: 10-30μmol/L

Determination of total iron binding capacity (TIBC)

The TIBC was determined using kit produced by TECO DIAGNOSTICS USA. This is a measure of the total amount of iron that can be carried in serum by transferrin and was determined by calculating the unsaturated iron binding capacity (UIBC) first and summing with the value of serum iron.

Principle: The unsaturated iron binding capacity (UIBC) is determined by adding Fe (II) iron to serum to enable binding to the unsaturated iron binding size on transferrin. The excess Fe (II) irons react with ferozine to form a colour complex which is measured using a colorimeter. The difference between the amount of Fe (II) added and the amount of Fe (II) measured represent the unsaturated iron binding capacity.

Procedure: Test tubes were labelled blank, standard, control and test and 2.0ml UIBC buffer reagent was added to all the tubes. 1.0ml iron-free water was added to "blank" and mixed; 0.5ml (500l) was added to "Test" and 0.5ml (500l) added to iron standard respectively and mixed. The spectrophotometer was set to 0 at 560nm with reagent blank. The absorbance of all tubes was read and recorded (A_1 reading). 0.05ml (50l) of iron color reagent was added to all tubes and mixed. The tubes were placed in a heating bath at 37°C for ten (10) minutes. The spectrophotometer was reset at 560nm with reagent blank, and the absorbance was read and recorded (A_2 reading).

$$\text{UIBC} = \frac{\text{Absorbance 2 test} - \text{Absorbance 1 test}}{\text{Absorbance 2 std} - \text{Absorbance 1std}} \times \text{Concentration of standard}$$

TIBC (mg/dl) = Serum iron + UIBC

Reference range: 43-80 μmol/L

Calculation of transferrin saturation with iron (TS):

Transferrin saturation with iron is the percentage of the transferrin that is being used to transport iron in the body. Transferrin saturation with iron was calculated using the formular

$$\text{TS} = \frac{\text{serum Iron concentration} \times 10}{\text{TIBC}}$$

Reference range: 15-50%

Determination of serum ferritin (SF)

Ferritin was determined using human ferritin enzyme immunoassay test kit by Diagnostic Automation, Inc. Calabasas USA. This assays the level of stored iron in the body. The ferritin quantitative test is based on a solid phase enzyme linked immunosorbent assay (ELISA). The assay system utilizes one anti-ferritin antibody for solid phase (microtiter wells) immobilization and another mouse monoclonal anti-ferritin antibody in the antibody-enzyme (horseradish peroxidase) conjugate solution.

Procedure: The test sample is allowed to react simultaneously with the antibodies, resulting in the ferritin molecules being sandwiched between the solid phase and enzyme-linked antibodies. After a 60-minute incubation at room temperature, the wells are washed with water to remove unbound labelled antibodies. A substrate solution is added and incubated for 20 minutes. The colour development is then stopped with addition of 2N HCl, and the colour is measured spectrophotometrically at 450nm. The concentration of ferritin is directly proportional to the colour intensity of the test sample. Serum ferritin was determined according to the manufacturer's instruction.
Reference range: 7-140ng/ml

Statistical analysis: Data were analysed using a student t-test on SPSS version 21 with significance level set at $P \leq 0.05$.

Results

Table 1 presents the demographic data and survival strategies of children living on the street versus their counterparts who live in homes. The mean age of children on the street was 11.9±2.19 years while that of the children at home was 12.9±2.61 years. There were more males (53.3%) living on the street than females. A majority (82.2%) of the children on the street had no access to formal education whereas those at home were all enrolled in school. The strategies employed by Street Children revealed that they all (100%) depend fully on the street for their survival; 62.2% have received benefits from support groups ranging from individuals to organisations at some point while 37.8% have not received any support. More than half (60%) of street children engage in odd jobs to meet their needs and all of them (100%) beg for alms to survive. Figure 1 shows the body mass index and nutritional status of Street Children and their counterparts who live in homes. It was observed that 75.55% of the Street Children were healthy in terms of their nutritional status (BMI 16.2-25.5) while those that were underweight (<16.2) and obese (>27.9) made up 20% and 4.45% respectively as compared to 82.23% healthy weight, 2.22% underweight, 11.10% overweight (>25.5-27.9) and 4.45% obese observed for their counterparts who live in homes.

Table 2 compares the full blood count of street children versus the control. The red cell distribution width (RDWCV) was 13.61±3.25 and this was significantly lower (P=0.001) than 16.53±3.28 versus the control, while the total white blood cell count ($7.87 \pm 4.18 \times 10^9$/L) was significantly higher (P=0.05) for street children in comparison with $5.90 \pm 1.94 \times 10^9$/L obtained for children in homes. All other haematological parameters were comparable. The serum iron, total iron binding capacity, transferrin saturation and serum ferritin levels for Street Children were similar (P>0.05) to values obtained for children in homes as presented in figure 2.

Table 1
Demographic data and survival strategies of children living on the street and in homes

Parameter	Children living on the street n=90	Children living at home n=90
Mean age (years)	11.91±2.19	12.91±2.61
Gender		
Males n (%)	48 (53.3)	32 (35.6)
Females n (%)	42 (46.7)	58 (64.4)
Education		
None n (%)	74 (82.2)	0 (0.0)
Primary n (%)	10 (11.1)	60 (66.7)
Junior secondary n (%)	6 (6.7)	30 (33.3)
Survival strategy		
Lives fully on the street n (%)	90 (100)	0 (0.0)
Benefits from support group		
Yes n (%)	56 (62.2)	0 (0.0)
No n (%)	34 (37.8)	0 (0.0)
Engaged in odd jobs		
Yes n (%)	54 (60.0)	0 (0.0)
No n (%)	36 (40.0)	0 (0.0)
Engaged in begging for alms		
Yes n (%)	90 (100.0)	0 (0.0)
No n (%)	0 (0.0)	0 (0.0)

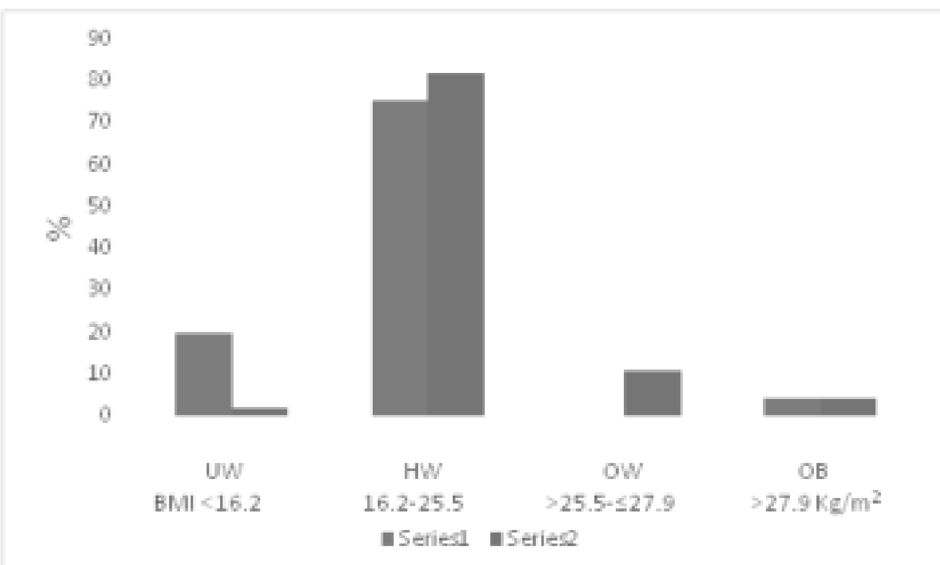

FIG. 1: Body mass index and nutritional status of Street Children and children in homes
Series 1: Street Children **Series 2:** Children in homes
UW: Underweight; HW: Healthy weight; OW: Overweight; OB: Obese

Table 2: Full blood count of Street Children and children in homes

Parameters	Children on the street n=90	Children in homes n=90	p-value
RBC (X 10^9/L)	4.75±0.69	4.78±1.35	0.884
PCV (L/L)	0.37±0.08	0.39±0.06	0.590
HB (g/L)	120.10±20.5	124.70±18.8	0.270
MCV (fl)	80.20±8.06	78.69±10.29	0.440
MCH (pg)	25.14±2.67	23.81±4.98	0.120
MCHC (g/L)	31.21±0.85	30.75±1.86	1.360
RDWCV*	13.61±3.25	16.53±3.28	0.001
WBC (X 10^9/L)*	7.87±4.18	5.90±1.94	0.050
NEUT (X 10^9/L)	4.38±0.71	3.09±0.50	0.495
LYM (X 10^9/L)	3.02±0.64	2.41±0.48	0.574
MEB (X 10^9/L)	0.78±0.22	0.54±0.12	0.543
PLT (X 10^9/L)	280.69±198.31	216.31±120.79	0.066
MPV (fl)	10.25±1.41	9.91±1.25	0.225
PDW	38.25±2.02	37.67±2.62	0.236
PCT	0.23±0.14	0.29±0.19	0.125
PLCC	65.22±39.57	73.33±45.69	0.371
PLCR	32.78±8.85	29.95±8.83	0.134

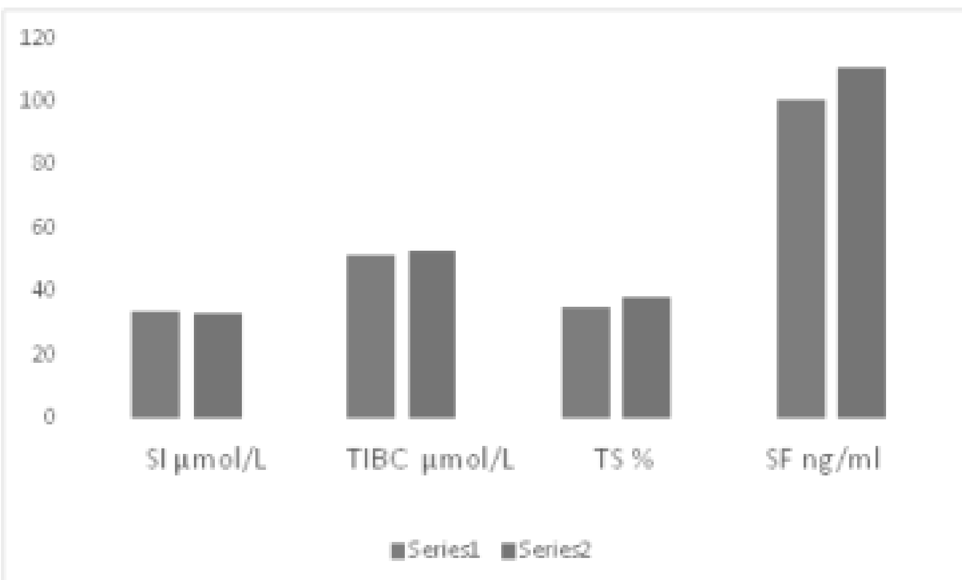

FIG. 2: Some iron parameters of street children versus their control
Series 1: Street Children
Series 2: Children in homes

Discussions

The full blood count and some iron parameters of Street Children and children living in homes were compared in this study. The Street Children enrolled in this study were within the age range of 9-15 years. It has been documented that during this period of growth and formation, children should be surrounded by a loving family to provide structure and guidance, with access to proper nutrition (food and clean drinking water), healthcare, shelter and education at the very least (9,10). This is not the case with the children on the streets. They are left all alone to cater for themselves; to provide food and take shelter in the open wherever their roaming takes them. Of course, healthcare is lacking for this vulnerable group; they are exposed to unhygienic environment and are very likely to fall ill often. When this happens, they have no access to hospital consultation or treatment. Their health is left to chance or at best they are subjected to treatments by drug stores around them. Self-medication could lead to drug abuse and misuse. In this study, more males rather than females were observed to be living on the streets, this could be as a result of the fact that female children are more protected and nurtured by families stemming from their delicate nature as suggested previously (11). The number of out-of-school children in Nigeria is estimated to be 20 million, the second largest number in the world after India. Poverty, insecurity, tradition and lack of schools are among the factors responsible for many children being out of school (12). Most (82.2%) of the street children in this study had no formal education, leaving them idle and exposed to all sorts of vices and dangers. This is a cause for concern as the children are the future leaders of the nation; if they are not being educated today, they cannot lead and compete with their counterparts who are educated. The street children in this study depend totally on what the streets can provide for their upkeep hence they have developed coping mechanisms and formulas ranging from accepting charity when available and doing odd jobs. Children are not supposed to work or cater for themselves; indeed, it has been observed that child labour constitutes a societal menace occasioned by poverty and suffering (13), it deprives children of their childhood and potential and has been reported to be harmful to their physical and mental development (14,15) hence it should be discouraged rather than accepted. Street children automatically become beggars as 100% of those enrolled were observed to beg for alms. This comes with its psycho-social effects such as the development of an inferiority complex, poor social interaction and loss of self-respect and dignity; also, exposure to harsh weather, accident, harassment as well as verbal and sexual abuse. A previous study confirms these observations (16).

In this study, 20% of the Street Children were observed to be underweight based on their body mass index as compared to 2% of children living in homes. This means that 20% of the street children are malnourished according to the WHO anthropometric index (17) indicating that these children are deficient in their intake of nutrients with imbalance of the essential nutrients as well as impaired utilization of nutrients. The BMI is a useful indicator for the measurement of growth and health status. It is a fact that BMI is influenced by other factors apart from genetics, age and gender; these include diet, physical activity, sleeping habits, and environmental and social factors all of which are affected by street living (18). Malnutrition generally results in stunted growth and poor physical development which is ultimately expressed in poor health status. A malnourished child will have lower immunity against infections and diseases.

A comparison of haematological parameters of street children versus children living in homes revealed a significantly lower red cell distribution width (RDWCV) below the reference range (13.0±0.9). A low RDW in combination with a haemoglobin value (120.10±20.5g/L) within the reference range observed for Street Children in the present study disagrees with the report of anaemia among homeless children in Sudan (19). This difference is probably due to the kinds of food (leafy vegetables, sea food, plantain etc) that are consumed in the study area. An elevated RDWCV as seen in the control indicates variations in the size of the red cell (anisocytosis) as well as active erythropoiesis occasioned by rapid growth and development for their age group. Again, the total white cell count was significantly higher for street children than the control while differential white cell counts remained comparable; the values were however within the reference range. A previous report observed normal white cell numbers with lymphocytosis, eosinophilia and hyper-segmentaion of neutrophils for homeless children (19) which is at variance with the findings of the present study. One possible explanation for the increase in white cell numbers in the present study is that the street children find themselves in an environment that exposes them to infectious agents such as bacteria, parasites and viruses hence the increase in white cells depicts immunologic response.

The iron parameters of the two groups of children were not significantly different. A similar finding has been reported. This can be related to the fact that the body does not excrete iron (19,20). When red cells are broken down at the end of their lifespan, the iron is recycled and stored. There is release of iron into the body each time the red blood cell breaks because of the heme constituent in haemoglobin. There will be depletion or excess iron only when there is a defect in iron stores or overload of iron in the body.

Conclusions

The haematological parameters of Street children differed from children in homes in terms of a lower red cell distribution width and higher total white cell count. Twenty percent of street children were underweight as indicated by a lower BMI for their age. It is recommended that individuals, corporate bodies and the Government should unite to end street living for children.

Acknowledgements

The authors acknowledge the Street Children who accepted to participate in this study. We also thank the Management of Lourdes' Academy, Calabar for their assistance in obtaining consent from the parents of the control subjects.

References

1. Consortium for Street Children. The facts about Street Children retrieved 24th January 2023 from **www.streetchildren.org** 2019.
2. United Nations International Children Education Fund. Situation analysis of children in Nigeria; Ensuring equitable and sustainable realization of child rights in Nigeria *www.unicef.org* 2022.
3. Adebola H. Strategies providing education for the Street Children in a Market Setting. In Adult Education in Nigeria *Journal of Nigerian National Council for Adult Education* 2006;12, 37 – 43.
4. De Benitez S T. State of the world's street Children: Violence. Retrieved November 2012 from Consortium for street children

www.streetchildren.org 2007.

5. Adewale A A, Afolabi B. Street Children Phenomenon in Nigeria: The Challenges and Way Forward *SSRN Electronic Journal* 2013.
6. Ergenia N, Fisher A J. Unsafe sexual behaviours in street children. *Social Science and Medicine* 2012; 56 (1), 149 –165.
7. Centers for Disease Control and Prevention, Children ages 2 years and older, CDC Growth Charts, Retrieved 14th February 2022 from *www.cdc.gov.*
8. Dayyai D G. Principles of working of automated hematology analyzer *Bioscience* 2017.
9. Ivy Prep Team. Understanding and meeting the basic needs of a child. Retrieved 25th January 2023 from www.ivyprep.org 2018.
10. Mcilroy T. 11 physical needs of a child during the early years www.empoweredparents.co 2022.
11. Frank A. Parenting boys vs. girls: how different is it? www.everydayhealth.com 2017.
12. UNESCO. Out-of-school numbers are growing in sub-saharan Africa. Global Education Monitoring Report www.unesco.org 2022.
13. Omokhodion F O, Omokhodion S I, Odusote T O. Perceptions of child labour among working children in Ibadan, Nigeria. *Child Care Health and Development* 2006; 32(3): 281-286.
14. International Labour Organization. What is child labour? Retrieved 20th January, 2023 from **www.ilo.org** 2020.
15. United Nations International Children Education Fund. Child labour Retrieved 20th January, 2023 from **www.unicef.org** 2021.
16. Mesele H A, Addis D. Socio-Economic Causes and Consequences of Begging in Dessie City, North East Ethiopa *SSRG International Journal of Humanities and Social Science* 2020; 7(4): 120-130.
17. World Health Organization, Malnutrition Retrieved 14th February, 2023 from *www.who.int.*
18. Nordin R, Said N, Nordin F F, Adnan N F. Factors influencing body mass index (BMI) among overweight and obese school children *Journal of Asian Behavioural Studies* 2018; 3(11).
19. Mustafa M H I, Eltayeb E A A, Elmahadi T E E, Nasir O. Determination of hematological parameters among homeless children exposed to chemical intoxication in Khartoum State, Sudan. *International Journal of Public Health and Epidemiology* 2013; 2(4): 072-077.
20. Hoffbrand A V, Moss P A H. *Essential Haematology*, Seventh Edition, Birmingham, UK. Pg 41 – 43 2016.

How to cite this paper:

Akpan, PA., Etura, JE, Asuquo, BL. Full blood count and some iron parameters of Street Children in Calabar, Nigeria. *Afr J Lab Haem Transf Sci 2023;* 2(1): 35 - 44