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Some Haematological Parameters of the Elderly in Sokoto, Nigeria

Amilo GI[1]*, Ibeh NC[2] and Onuigwe FU[2]

[1]Department of Haematology, Nnamdi Azikiwe University, Nigeria
[2]Department of Medical Laboratory Science, Nnamdi Azikiwe University, Nigeria

***Corresponding author:** Amilo GI, Haematology Department, Faculty of Medicine, Nnamdi Azikiwe University, Awka, Nigeria, Tel: +2348037400757; Email: ifymilo@yahoo.com

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Abstract

The assessment of haematological parameters is very necessary because, they are important proxy indicators useful in the assessment of immune status, therapeutic purposes and monitoring of disease progression and treatment outcome for proper patient management. This study was aimed at determining some haematological parameters in apparently healthy elderly persons living in Sokoto, Nigeria. This was a cross-sectional study involving a total of 105 apparently healthy elderly persons living in Sokoto. Elderly persons aged 60years and above were recruited for the study. Full blood counts (FBC) were determined using five part haematological analyser by Mindray, Germany. Data were analysed using Statistical Package of Social Sciences (SPSS) version 25. Haematological parameters showed distinct differences with some local reference ranges. This study found out that the values of WBC, Lymphocyte, Neutrophil, Eosinophil, Monocyte, RDW-CV, Platelet Count, MPV, PDW and Plateletcrit were within the normal range in according to reference ranges used in Sokoto. While the values of RBC, HCT, MCHC, MCH and MCV were lower based on reference values used in Sokoto. However, RDW-CV was raised. There were statistical significant increases in mean values of Hb, HCT and MCV among male than females in Sokoto metropolis ($p<0.05$). There was statistical significant increases in mean values of PLT count among females than males in ($p<0.05$). There were statistical differences in mean values of Neutrophil, RBC, HCT, PLT and PCT among different age groups in Sokoto metropolis ($p<0.05$). There were statistical differences in mean values of WBC, Lymphocyte, Neutrophil, Eosinophil, RDW-CV, PLT, PDW and PCT among different groups of BMI in Sokoto metropolis ($p<0.05$). It was observed that monocyte increased significantly with BMI from normal weight to obesity ($p<0.05$). In conclusion, this study established a baseline data for FBC in elderly in Sokoto. Some of the parameters under study vary with local reference range. Elderly have lower haemoglobin and HCT. There is age, gender and BMI variation in the parameters studied. There is need to establish a different reference ranges for elderly in a given location for proper understanding and management of elderly population in our society.

Keywords: Haematological; Parameters; Elderly; Sokoto; Nigeria

Abbreviations: FBC: Full blood counts; SPSS: Statistical Package of Social Sciences; WBC: White Blood Cell; RBC: Red blood Cell; Hb: Haemoglobin; HCT: Haemotocrit; MCHC: Mean Corpuscular Haemoglobin Concentration; MCH: Mean Corpuscular Haemoglobin; MCV: Mean Corpuscular Volume; RDW-CV: Red Cell Distribution Width-coefficient of variation; RDW-SD: Red Cell Distribution Width-Standard Deviation; PLT: Platelet Count; MPV: Mean Platelet Volume; PDW: Platelet Distribution Width; PCT: Plateletcrit.

Introduction

Haematological parameters are quantifiable constituents of blood like erythrocytes and its indices, leukocytes and platelets. These blood components originate from the haemopoeitic stem cell, they occupy the entire capacity of the bones at birth but it is been replaced with fatty marrow with increase in age, thereby affecting these blood parameters [1]. Based on the occupation of the bone marrow by fatty marrow as a result of ageing, different reference ranges could be seen for different age groups [2]. The assessment of haematological parameters is very necessary because, they are important proxy indicators useful in the assessment of immune status, therapeutic purposes and monitoring of disease progression and treatment outcome for proper patient management. The developmental stages of life vary directly with basic biological variables of age and sex independently. In pursuant of effective health care through accurate diagnosis, haematological parameters are routinely assessed [1].

According to Padalia, et al. [3], haemoglobin concentration, red blood cell count and haematocrit value began to decrease in men in their sixth decade and in women in their seventh decade and the change were more prominent with advancing age, especially in men. Nonetheless, review of available literatures revealed that there is an inverse relationship between most haematological parameters and age, for instance, increase in age causes a decline in Hb, PCV, WBC and PLT; this could be an indication of a diminished reserved capacity of the bone marrow [1]. The parameters in a full blood count also known as haematological parameters are affected by many different factors such as age, gender, race, altitude, exercise, pregnancy and others. The normal haematological reference values therefore differ among people of different races, ages and gender [4].

Elderly are those in old age, that's later part of life; the period of life after youth and middle age (WHO, 2002) [5]. According to United Nations age classification, they are within the age of 60years and above (WHO, 2019) [6]. They have two common medical findings; anaemia and frailty. Anaemia in older persons is associated with increased physical impairment, frailty, cognitive decline, depression and mortality [7]. The elderly is expected to have a higher prevalence of anaemia compared to the general population, as longevity is associated with a variety of physiological dysfunctions, chronic and inflammatory diseases, and occasionally inadequate diet that lowers reserves and the availability of iron [8]. It may be tempting to assume that haematological parameters may be low in the elderly because of the established fatty changes in the marrow with age. Clinicians are still confronted with the problem of ''normal'' or ''physiological'' values in aged subject, despite considerable amount of data published concerning the haematological status of the aged. It is a well-established practice to determine the normal value of various haematological parameters in different parts of the world because of geographical, ethnic and other variations [9].

Improper reference values may have contributed to the misdiagnoses of anaemia in the country [10]. Haemoglobin values reduced in elderly when compared with young adult. Several factors including modifiable life lifestyle (dietary patterns, attitude) and non-modifiable (such as age, sex) also affect haematological parameters [1]. However, in sokoto metropolis they don't have different reference value for the elderly. They used the same value for all adults. This has lead to misdoiagnosis, knowing fully well that the elderly have a great difference from the the young adults both physiologically and otherwise. Therefore, this study sets out to evaluate the haemtological parameters in apparently healthy elderly persons living in Sokoto Nigeria. And this work therefore sets out to fill these gaps in the body of knowledge by investigating of changes in haematological parameters in the elderly in Sokoto. The outcome will help us to determine a baseline data in the town. This study would possibily show the difference in the local reference values, highlight need to have separate values for the elderly and show effect of age, gender and BMI on the studied parameters.

Materials and Methods

Study Design

This was cross-sectional study that involved apparently healthy elderly persons aged 60 years and above living in Sokoto. The study enrolled 105 elderly from Sokoto metropolis. Apparently healthy in this context as defined by Azuonwu, et al. [1] are those in good health condition with no observable signs and symptoms of ill health and free from HIV. The data were collected through interviewers administered questionnaire. Factors that may alter haematological values were sought as basis for exclusion from the study. According to Tsang, et al. [11], current smokers shall be defined as those currently smoking manufactured cigarettes, hand-rolled cigarettes, cigars, or pipe tobacco. Ex-smokers are those who had ever regularly smoked cigarettes, cigars, or a pipe. Blood samples were collected from those that met the inclusion criteria for assay of parameters under study. Anthropometric parameters were also taken. Height was measured to the nearest 0.1 centimetre with a portable stadiometer [12]. Weight of respondent was measured with a portable electronic weight scale in kilograms with light clothing (without shoes) to the nearest 0.1kg [13]. Body Mass Index (BMI) was calculated from the weight and height values for each individual using the formular = weight (kg)/ Height (m) 2 [14].

Study Area

The study was conducted in Sokoto. Sokoto is in Sokoto State which lies between longitude 050 to 130 03' East and latitude 130 06 North and covers an area of 66.33km^2 [15]. It has a land area of about 28,232.37sq kilometers and stands at altitudes of 272m above the sea level. The major indigenous tribes in the state are the Hausa and Fulani and other groups such as Gobirawa, Zabarmawa, Kabawa, Adarawa, Arawa, Nupes, Yorubas, Igbos and so on are also resident there, the town being cosmopolitan. The occupation of city inhabitants include; trading, farming, with a reasonable proportion of the population working in private and public domains. Based on 2006 population census, Sokoto state had a population of 3.5million with Sokoto metropolis having a population of 427,760 [16].

Study Site

The study was carried out in Sokoto metropolis. Laboratory analysis of haematological parameters from Sokoto metropolis were assayed at Haematology Departments of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto respectively.

Recruitment of Participants

The study subjects were consecutively recruited until a required sample size was achieved.

Ethical Consideration

Ethical approvals were obtained from Sokoto State Ministry of Health with reference numbers: SKHREC/079(2019).

Inclusion Criteria

Apparently healthy elderly persons (≥ 60 years) living in Sokoto, those within the age limit who were willing to give informed consent. Those not on iron medications or supplements like erythropoiesis-stimulating agents and colony-stimulating factors (erythropoiesis enhancer) and HIV negative in addition to having no history of blood transfusion in the last six months- were included in the study.

Exclusion Criteria

Non- healthy elderly persons < 60 years of age were excluded. Those on iron medications or supplements like erythropoiesis-stimulating agents and colony-stimulating factors (erythropoiesis enhancer) were also excluded. Equally, HIV positive persons and those with history of blood transfusion within the last six months were excluded.

Sampling Method

Sampling method adopted was convenience sampling method as the study design entails going from house to house and organising medical outreaches seeking for those who met the defined criteria.

Informed Consent

Written informed consent was obtained before recruitment into the study

Questionnaires

A standard semi-structured questionnaire was administered to the eligible subjects to collect anthropometric parameters (height, weight for calculation of Body mass Index (BMI) and socio-demographic details (gender, age) and other co-founding factors.

Sample Collection

A blood sample (2ml) was withdrawn from each participant with minimal stasis from the antecubital vein using dry, sterile disposable 2ml syringe and dispensed in the tube containing the anticoagulant, ethylene diamine tetra-acetic acid (EDTA) and was used for the determination of the FBC.

Laboratory Procedure

Determination of FBC (Mindray Auto Haematology Analyzer, HM-500X, 2016, Germany)

The EDTA blood was used to determine FBC using automated five parts haematology analyser

a) **Principle of the Test:** The Beckman coulter method of sizing and counting particles uses measurable changes in electrical resistance produced by non-conductive particles suspended in an electrolyte. A suspension of blood cell passes through a small orifice simultaneously with an electric current. The individual blood cells passing through the orifice introduce an impedance change in the orifice determined by the size of the cell. The system counts the individual cells and provides cell size distribution. The number of cells counted per sample is approximately 100 times greater than the usual microscope count to reduce the statistical error by a factor of approximately 10 times.

b) **Procedure:** The autoanalyser was switched on. And sample ID was entered and checked on the touch screen display. The sample was mixed gently by inverting it at least three times. Then, the tube was held up for probe of the sample. The sample was moved close to the probe to aspirate the sample. Then, the machine analysed and displayed the results on the screen which was printed out.

Data Analysis

Data were collected into excel spread sheet and transferred into the data editor of Statistical Package for Social Sciences (SPSS, Version 23, Inc., Chicago USA) software and was used to analyse data generated. Mean and standard deviation of haematological parameters were determined. The effect of Gender with changes haematological parameters were determined using students t-test while that of Age and BMI were determined using one way ANOVA. Error probability (p-value < 0.05) was considered significant.

Results

Mean ± SD of FBC of the study subjects and Sokoto Reference Range

The WBC (7.02 ± 1.88 109/L) value was normal based on local reference values used in Sokoto. However, Lymphocyte count (3.13 ± 1.00 109/L) showed normal values. Neutrophil value (3.22 ± 0.94 109/L) was normal. The mean eosinophil count (0.23 ± 0.15 109/L) was normal. Also, monocyte value (0.44 ± 0.22 109/L) was normal. The RBC (4.48 ± 0.84 1012/L) showed normal values. It was observed that Hb value (13.18 ± 1.16 g/dl) was normal. HCT value (39.28 ± 5.57 %) was low. The MCHC value (34.46 ± 8.15 g/dl) was low. It was observed that MCH value (32.36 ± 17.04 pg) was low. Also, MCV value (90.60 ± 13.36 fL) was low and the upper limit high. RDW-CV value (12.92 ± 0.99 %) was normal. This study showed that RDW-SD value (50.95 ± 8.62 fL) was raised. The PLT value (254.69 ± 77.05 109/L) was normal. In addition, MPV value (8.91 ±0.68 fL) was normal. This study showed that the PDW value (14.66 ±1.17) was normal based on established reference ranges. The PCT value (0.226 ± 0.058 %) was normal (Table 1).

Parameters	Subjects	Sokoto Local Values
	Lower limit – Upper limit	Lower limit – Upper limit
WBC (109/L)	5.14 – 8.90	4.00 – 11.00
Lymph (109/L)	2.13 – 4.13	0.60 – 4.10
Neut (109/L)	2.28 – 4.16	1.50 – 7.50
Eosino(109/L)	0.08 – 0.38	0.02 – 0.60
Mono (109/L)	0.22 – 0.66	0.20 – 1.00
RBC (1012/L)	3.64 – 5.32	3.80 – 5.80
Hb (g/dl)	12.02 – 14.34	12.00 – 16.50
HCT (%)	33.71 – 44.85	36.00 – 56.00
MCHC (g/dl)	26.31 – 42.61	32.00 – 36.00
MCH (pg)	15.32 – 49.40	26.50 – 33.50
MCV (fL)	77.24 – 103.96	80.00 – 99.00
RDW-CV (%)	11.93 – 13.91	10.00 – 15.00
RDW-SD (fL)	42.33 – 59.57	35.00 – 56.00
PLT (109/L)	177.64 – 331.74	93.00 – 450.00
MPV (fL)	8.23 – 9.59	7.00 – 11.00
PDW	13.49 – 15.83	10.00 – 18.00
PCT (%)	0.168 – 0.284	0.100 – 0.500

Table 1: Mean ± SD of FBC of the study subjects and Sokoto Reference Range.
Key: WBC= White Blood Cell, Lymph= Lymphocyte, Neut = Neutrophil, Eosino = Eosinophil, Mono= Monocyte Baso= Basophil, RBC= Red blood Cell, Hb= Haemoglobin, HCT= Haemotocrit, MCHC= Mean Corpuscular Haemoglobin Concentration, MCH= Mean Corpuscular Haemoglobin, MCV= Mean Corpuscular Volume, RDW-CV= Red Cell Distribution Width- coefficient of variation, RDW-SD= Red Cell Distribution Width-Standard Deviation, PLT= Platelet Count, MPV= Mean Platelet Volume, PDW= Platelet Distribution Width, PCT= Plateletcrit.

Mean ± SD of FBC of the study subjects in Sokoto Based on Gender compared using t test

Mean Hb (g/dl) of the subjects was significantly higher in males than females in Sokoto (p=0.000).

Also, HCT (%) of the subjects was significantly higher in males than females in Sokoto (p=0.031).

Mean ± SD of Red Cell Indices, Platelet (PLT) and Platelet indices of the study subjects in Sokoto Based on Gender compared using t test

Mean MCV (fL) in male in Sokoto was significantly higher than female (p=0.006). PLT (109/L) of the subjects in different gender in Sokoto was significantly higher in females than males (p= 0.014).

Mean ± SD of FBC of the study subjects in Sokoto Based on Age compared using ANOVA

Comparison of the Neutrophil (109/L) in different age groups showed statistical difference (p=0.006). RBC (1012/L) of the subjects in different age groups in Sokoto showed statistical difference (p= 0.018). And comparison of HCT (%) of the subjects in different age groups in Sokoto showed statistical difference (p= 0.011).

Mean ± SD of Red Cell Indices, Platelet (PLT) and Platelet indices of the study subjects in Sokoto Based on Age compared using ANOVA

Comparison of the Platelet count (PLT) (109/L) in different age groups showed statistical difference (p=0.004). Comparison of Plateletcrit (PCT) (%) of the subjects in different age groups in Sokoto showed statistical difference (p= 0.000) (Tables 2-5).

Parameter	Male	Female	t-value	p-value
	n=69	n=36		
WBC (10^9/L)	7.0 ± 2.0	7.1 ± 1.7	-0.685	0.495
Lymph (10^9/L)	3.1 ± 1.0	3.3 ± 1.1	-0.393	0.695
Neut (10^9/L)	3.2 ± 1.0	3.3 ± 0.7	-0.036	0.972
Eosino (10^9/L)	0.2 ± 0.3	0.2 ± 0.2	0.385	0.701
Mono (10^9/L)	0.5 ± 0.4	0. 4 ± 0.4	0.578	0.565
RBC (10^{12}/L)	4.5 ± 1.1	4.4 ± 0.5	0.935	0.352
Hb (g/dl)	13.6 ± 0.9	12.5 ± 1.1	5.646	0.000*
HCT (%)	40.1 ± 6.1	37.7 ± 3.9	2.193	0.031*

*p< 0.05 is significant

Key: WBC= White Blood Cell, Lymph= Lymphocyte, Neut= Neutrophil, Eosino= Eosinophil, Mono= Monocyte, RBC= Red blood Cell, Hb= Haemoglobin, HCT= Haemotocrit

Table 2: Mean ± SD of FBC of the study subjects in Sokoto Based on Gender compared using t test.

Parameter	Male	Female	t-value	p-value
	n=69	n=36		
MCHC (g/dl)	35.3 ± 9.8	32.8 ± 2.8	1.525	0.13
MCH (pg)	34.2 ± 20.6	28.6 ± 3.7	1.617	0.109
MCV (fL)	93.1 ± 15.7	85.7 ± 4.8	2.786	0.006*
RDW-CV (%)	12.8 ± 0.8	13.2 ± 1.2	-1.935	0.056
RDW-SD (fL)	52.1 ± 10.1	48.8 ± 3.9	1.923	0.057
PLT (10^9/L)	241.5± 69.7	280. 1± 84.8	-2.498	0.014*
MPV (fL)	9.0 ± 0.7	8.8 ± 0.6	1.299	0.197
PDW	14.6 ± 1.2	14.8 ± 1.1	-1.238	0.219

*p< 0.05 is significant

Key: MCHC= Mean Corpuscular Haemoglobin Concentration, MCH= Mean Corpuscular Haemoglobin, MCV= Mean Corpuscular Volume, RDW-CV= Red Cell Distribution Width- coefficient of variation, RDW-SD= Red Cell Distribution Width-Standard Deviation, PLT= Platelet Count, MPV= Mean Platelet Volume, PDW= Platelet Distribution Width, PCT= Plateletcrit.

Table 3: Mean ± SD of Red Cell Indices, Platelet (PLT) and Platelet indices of the study subjects in Sokoto.

Parameter	60-64	65-69	70-74	75-79	≥ 80	p-value
	n = 42	n = 37	n = 5	n = 4	n = 17	
WBC(10^9/L)	7.4 ± 2.3	6.8 ± 1.7	7.7 ± 1.6	5.6 ± 0.7	6.7 ± 1.0	0.287
Lymph (10^9/L)	3.3 ± 1.1	3.2 ± 1.0	2.4 ±0.8	2.3 ± 0.8	2.9 ± 0.6	0.057
Neut (10^9/L)	3.2 ± 1.1	3.1 ± 0.8	4.7 ± 0.4	2.9 ± 0.1	3.1 ± 0.5	0.006*
Eosino (10^9/L)	0.3 ± 0.2	0.2 ± 0.1	0.2 ± 0.2	0.2 ± 0.0	0.2 ± 0.1	0.461
Mono (10^9/L)	0.5 ± 0.2	0.4 ± 0.2	0.4 ± 0.0	0.3 ±0 .2	0.4 ± 0.1	0.141
RBC (10^{12}/L)	4.2 ± 1.1	4.8 ± 0.7	4.6 ± 0.4	4.1 ± 0.3	4.4 ± 0.3	0.018*
Hb (g/dl)	12.9 ± 1.2	13.5 ± 1.0	13.4 ± 1.0	13.0 ± 0.8	13.0 ± 1.3	0.224
HCT (%)	37.1 ± 7.5	41.4 ± 2.8	40.9 ± 2.5	38.3 ± 2.7	39.7 ± 3.5	0.011*

*p< 0.05 is significant

Key: WBC = White Blood Cell, Lymph= Lymphocyte, Neut= Neutrophil, Eosino= Eosinophil, Mono= Monocyte, RBC= Red blood Cell, Hb= Haemoglobin, HCT= Haemotocrit

Table 4: Mean ± SD of FBC of the study subjects in Sokoto Based on Age compared using ANOVA.

Parameter	60-64	65-69	70-74	75-79	≥ 80	p-value
	n = 42	n = 37	n = 5	n = 4	n = 17	
MCHC (g/dl)	37.0 ± 12.5	32.6 ± 0.9	32.7 ± 0.5	34.0 ± 0.3	32.9 ± 0.7	0.135
MCH (pg)	36.8 ± 26.4	29.1 ± 1.8	29.3 ± 0.1	31.7 ± 0.2	29.6 ± 1.6	0.3
MCV (fL)	92.1 ± 20.7	88.9 ± 3.6	89.7 ± 1.8	93.2 ± 0.5	90.2 ± 3.2	0.866
RDW-CV (%)	13.2 ± 1.4	12.8 ± 0.4	12.3 ± 0.5	12.4 ± 0.5	12.8 ± 0.2	0.095
RDW-SD (fL)	52.9 ± 13.2	49.5 ± 2.4	47.7 ± 0.7	50.6 ± 2.1	50.2 ± 2.1	0.407
PLT (10^9/L)	242.0 ± 78.9	262.9 ± 64.7	375.0 ± 76.7	228.5 ±103.3	238.8 ± 64.6	0.004*
MPV (fL)	8.9 ± 0.7	8.9 ± 0.7	8.9 ± 0.2	9.1 ± 1.2	9.0 ± 0.6	0.989
PDW	14.7 ± 1.4	14.7 ± 1.0	13.6 ± 0.7	15.6 ± 1.5	14.6 ± 0.6	0.136
PCT (%)	0.218 ± 0.0	0.231 ± 0.1	0.331 ± 0.1	0.197 ± 0.1	0.211 ± 0.5	0.000*

*p< 0.05 is significant

Key: MCHC= Mean Corpuscular Haemoglobin Concentration, MCH= Mean Corpuscular Haemoglobin, MCV= Mean Corpuscular Volume, RDW-CV= Red Cell Distribution Width- coefficient of variation, RDW-SD= Red Cell Distribution Width-Standard Deviation, PLT= Platelet Count, MPV= Mean Platelet Volume, PDW= Platelet Distribution Width, PCT = Plateletcrit

Table 5: Mean ± SD of Red Cell Indices, Platelet (PLT) and Platelet indices of the study subjects in Sokoto Based on Age compared using ANOVA.

Mean ± SD of FBC of the study subjects in Sokoto Based on BMI compared using ANOVA

Comparison of the WBC (109/L) in different BMI in Sokoto show statistical difference (p=0.011). Also, comparison of Lymph (109/L) of the subjects in different BMI in Sokoto shows statistical difference (p=0.000). Comparison of Neut (109/L) of the subjects in different BMI in Sokoto shows statistical difference (p=0.019). Comparison of Eosino (109/L) of the subjects in different BMI in Sokoto shows statistical difference (p=0.000). There was statistical significant increase in Mono (109/L) of the subjects as the BMI increase from normal weight to obesity (p=0.012).

Mean ± SD of Red Cell Indices, Platelet (PLT) and Platelet indices of the study subjects in Sokoto Based on BMI compared using ANOVA

Comparison of the RDW-CV (%) in different BMI in Sokoto showed statistical difference (p=0.000). Also, comparison of PLT (109/L) of the subjects in different BMI in Sokoto showed statistical difference (p=0.017). Comparison

of PDW of the subjects in different BMI in Sokoto showed statistical difference (p=0.001). Comparison of PCT (%) of the subjects in different BMI in Sokoto Metropolis showed statistical difference (p=0.008) (Tables 6 & 7).

Parameter	<18.5	18.5-24.9	25.0-29.9	≥ 30	p-value
	n= 19	n= 51	n= 28	n= 7	
WBC (10^9/L)	7.4 ± 2.7	6.6 ± 1.3	7.8 ± 2.0	5.9 ± 0.5	0.011*
Lymph (10^9/L)	3.9 ± 1.1	2.8 ± 0.9	3.8 ± 1.0	2.6 ± 0.4	0.000*
Neut (10^9/L)	3.6 ± 1.2	3.2 ± 0.8	3.2 ± 0.9	2.3 ± 0.3	0.019*
Eosino (10^9/L)	0.2 ± 0.2	0.2 ± 0.1	0.3 ± 0.2	0.3 ± 0.1	0.000*
Mono (10^9/L)	0.4 ± 0.2	0.4 ± 0.2	0.5 ± 0.3	0.6 ± 0.2	0.012*
RBC (10^{12}/L)	4.3 ± 1.1	4.4 ± 0.8	4.8 ± 0.8	4.7 ± 0.5	0.096
Hb (g/dl)	13.4 ± 1.4	13.1 ± 0.7	13.3 ± 1.6	12.5 ± 0.8	0.349
HCT (%)	37.5 ± 8.5	39.2 ± 5.2	40.6 ± 4.1	39.4 ± 1.1	0.315

*p< 0.05 is significant

Key: WBC= White Blood Cell, Lymph= Lymphocyte, Neut= Neutrophil, Eosino= Eosinophil, Mono= Monocyte, RBC= Red blood Cell, Hb= Haemoglobin, HCT= Haemotocrit

Table 6: Mean ± SD of FBC of the study subjects in Sokoto Based on BMI compared using ANOVA.

Parameter	<18.5	18.5-24.9	25.0-29.9	≥ 30	p-value
	n= 19	n= 51	n= 28	n= 7	
MCHC (g/dl)	37.6 ± 10.6	34.7 ± 9.5	32.7 ± 1.0	31.6 ± 1.7	0.171
MCH (pg)	34.2 ± 13.4	34.2 ± 22.8	29.1 ± 1.6	26.8 ± 3.9	0.469
MCV (fL)	89.3 ± 8.3	92.7 ± 18.0	89.1 ± 2.8	84.4 ± 8.1	0.347
RDW-CV (%)	13.9 ± 1.7	12.6 ± 0.6	12.8 ± 0.5	13.4 ± 0.7	0.000*
RDW-SD (fL)	53.1 ±6.8	51.3 ± 11.3	49.5 ± 2.6	48.6 ± 4.4	0.477
PLT (10^9/L)	262.1 ± 67.2	274.6 ± 80.5	222.3 ± 74.3	219.6 ± 24.6	0.017*
MPV (fL)	9.0 ± 0.5	8.7 ± 0.8	9.1 ± 0.6	9.3 ± 0.2	0.082
PDW	15.0 ± 0.7	14.2 ± 1.2	15.0 ± 1.1	15.6 ± 0.8	0.001*
PCT (%)	0.235 ± 0.1	0.241 ± 0.1	0.198 ± 0.1	0.204 ± 0.0	0.008*

*p< 0.05 is significant

Key: MCHC= Mean Corpuscular Haemoglobin Concentration, MCH= Mean Corpuscular Haemoglobin, MCV= Mean Corpuscular Volume, RDW-CV= Red Cell Distribution Width- coefficient of variation, RDW-SD= Red Cell Distribution Width-Standard Deviation, PLT= Platelet Count, MPV= Mean Platelet Volume, PDW= Platelet Distribution Width, PCT= Plateletcrit

Table 7: Mean ± SD of Red Cell Indices, Platelet (PLT) and Platelet indices of the study subjects in Sokoto Based on BMI compared using ANOVA.

Discussion

This study found out that the values of WBC, Lymphocyte, Neutrophil, Eosinophil, Monocyte, RDW-CV, Platelet Count, MPV, PDW and Plateletcrit were within the normal range according to reference ranges used in Sokoto. While the values of RBC, HCT, MCHC, MCH and MCV were lower based on reference values used in Sokoto. However, RDW-CV was raised according to Sokoto reference values. The low values are in support of previous work by Okpokam and Ndemateh [17], in Calabar who reported low Hb and HCT values in elderly. The low values here could not be as a result of pathological issues but inevitable consequences of ageing [1]. MPV was normal in Sokoto metropolis based on previous established reference ranges [18]. MPV is the most commonly used method to measure platelet size [19]. Platelet activation indicator is MPV which is central to processes involved in coronary heart diseases and endothelial dysfunction [20]. Studies have shown that elevated MPV can be attributed to age, obesity, smoking, hyperlipidemia, diabetes mellitus,

atherosclerosis and inflammation [19]. This is consistent with previous findings which stated that haematological parameters vary with location hence the need to establish reference ranges for each laboratory [21,22]. The findings are also, in agreement with previous studies that reported lower Hb and HCT for the elderly and variations within geographical locations and ethnic groups [23,24]. In addition to that is poor nutrition resulting in vitamin B12 and folic acid deficiency in old age might be another cause of low Hb and HCT among the elderly in the study locations. Furthermore, though the values of platelet counts were within the normal range but it was observed to be lower than the values of the Caucasians. This calls for attention during clinical trials and decision making to avert thrombocytopenia induced bleeding. Moreover, red cell indices are important in interpretation of full blood count results and can help the clinicians in proper diagnosis of anaemia [25]. The variation in the parameters assayed from the local reference range is an evident that elderly need separate reference range to suit their perculiarity.

There were statistical significant increases in mean values of Hb, HCT and MCV among male than females in Sokoto metropolis ($p<0.05$). The difference in Hb and HCT of the elderly in male and female is in tandem with previous studies that indicated that Hb and PCV levels are higher in males than in females [1,18,23,26,27]. Such gender differences could be attributed to andogenic hormonal influences on erythropoiesis in males among others [28]. This is because, Murphy [29] reported that Oestrogens dilates and androgens constricts the renal microvasculature: dilation and vasoconstriction in vessels below 300 μm in diameter respectively increase and decrease the haematocrit in blood in arterioles, capillaries and venules, altering the oxygen delivery per unit red cell mass, and providing a mechanism for varying the red cell mass without compensatory changes in erythropoiesis. There was statistical significant increases in mean values of PLT count among females than males in ($p<0.05$). This is in agreement with previous studies by Ranucci, et al. [30] who reported high platelet count for females than males which is associated with higher platelet reactivity in females. Platelets have estrogen receptors that inhibit platelet activation in pre-menopausal women. This effect is lost in post-menopausal women who were our participants.

There were statistical differences in mean values of Neutrophil, RBC, HCT, PLT and PCT among different age groups in Sokoto metropolis ($p<0.05$). The difference in some haematological parameters based on different age groups support previous studies that reported that haematological parameters vary with age [1,24]. According to Azuonwu, et al. [1], the haemopoietic process of the geriatrics involves inactive yellow marrow, replacing the red marrow (active form). Therefore, this could be as a result of age related changes in elderly.

There were statistical differences in mean values of WBC, Lymphocyte, Neutrophil, Eosinophil, RDW-CV, PLT, PDW and PCT among different groups of BMI in Sokoto metropolis ($p<0.05$). This is in agreement with previous study by Mwafya, et al. [31] who reported that obesity has effect on some haematological parameters. Though, the reason for this cannot be elucidated. Moreover, Obesity is the fifth leading cause of death globally and it's of public health concern [31]. Based on this regular BMI check is advocated. It was observed that the increase in monocyte increases significantly with increase in BMI from normal weight to obesity ($p<0.05$). This agrees with Ajayi, et al. [32] who reported that monocyte has positive correlation with BMI. Though the reason for this cannot be elucidated.

Conclusion

The study established baseline data for FBC in elderly living in Sokoto metropolis. Some haematological parameters vary with local used reference values. This emphasises on the need for each local diagnostic laboratory to establish its workable reference ranges for elderly. There were clear indications that gender and BMI have effect on some haematological parameters. This study showed that HCT, Hb and MCV were higher in males than females. And females have high platelet count than males. It was established that elderly have lower haemoglobin and HCT [33].

- **Recommendations:** Diagnostic laboratories should establish reference ranges for elderly to enhance better interpretation of results.
- Elderly should be given adequate attention in both research and medical care.
- **Suggestion for Further Studies:** The study should be carried out with larger sample size
- **Limitations of the Research:** The study has several limitations. One of them is apparently healthy elderly persons who might be having some unidentified diseases and refused to divulge them which can affect the parameters under study. Again it was difficult bridging the cultural and religious barriers to collect female samples from Sokoto metropolis.

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